

# Achieving sustainable landscapes and livelihoods in the Philippine uplands: the role of farmer and stakeholder aspirations and actions

by

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# Candidate's Declaration

This thesis contains no material which has been accepted for the award of any other degree or diploma in any university. To the best of the author's knowledge, it contains no material previously published or written by another person, except where due reference is made in the text.

Caroline Duque-Piñon

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# Abstract

Across many upland watersheds in developing countries, declining land health is constraining both the land use options that are available to farmers and the profitability of their farming livelihood, especially in marginal landscapes. In response, national and local governments tend to implement land use and management strategies aimed at promoting cropping systems and farmer practices that improve land health and income. In the Philippines, strategies have varied in objectives, scale and duration, and the extent to which they consider biophysical, environmental, and socio-economic dimensions. Demonstrated impacts have been patchy at best, especially where there are multiple stakeholders, each with their priorities around land use and often-competing livelihood goals.

This thesis is an empirical study that uses an integrated assessment (IA) framework to understand and reconcile local farmers' and external stakeholders' perceptions about the complexity and dynamics of land use and livelihoods in the Cabulig watershed in a mountainous area of the southern Philippines. It draws from multi-disciplinary theories of rural development, land use transition, sustainable livelihoods, and sustainable land and watershed management to (1) analyze the current land use and livelihoods conditions and trends, (2) investigate the drivers of land use and livelihood change, (3) explore the future that farmers and external stakeholders aspire to, and (4) examine the willingness and capacity of farmers to adopt and invest in better land use. The first three objectives are accomplished using a mixed-methods approach comprised of qualitative and quantitative data collection (including household surveys, key informant interviews, and farmer group discussions) and analytical methods (cognitive mapping, generalized linear modelling [GLM]). A numerical modelling approach using Bayesian networks (BN), a tool increasingly used for IA studies, is used to address the fourth objective. Nesting this mixed method approach within the IA framework is effective and valuable in exploring the biophysical, environmental and socio-economic dimensions of land use and livelihoods in the Cabulig watershed.

The research reveals the transition in the Cabulig catchment from swidden cultivation in forests to smallholder farming, and then into extensive and intensive commercial and plantation agriculture. There is heterogeneity in farmers' land use systems and crops across the landscape. However, current land uses are usually not suitable for the landscape positions where they are located; this is true under existing management systems and, for most crops, even with the best management practices. Livelihoods have diversified from subsistence or solely on-farm to a mix of on-farm, off-farm and non-farm activities. Farming alone is no longer feasible, which has led farmers to work as farm labourers, venture into small-scale business, or attempt to find employment in government and private companies in nearby towns and cities, or abroad. This

diversity in land use and livelihoods should be incorporated in planning to provide tailored and suitable interventions towards sustainable land use and watershed management.

The Sustainable Livelihood Approach (SLA) was used to structure the analysis into the importance of access (and claims) to resources in determining farmers' land use and livelihood strategies. While farmers' decisions and strategies are determined by their farms' biophysical conditions, available land, financial capital and labour, and experience and knowledge, external factors also played a major role. Factors at the watershed level include demographic changes, governance relating to policies and institutions, and the recent shift to the plantation economy. The latter has primarily influenced those farmers who have large uncultivated lands who either rented out their lands or themselves converted their farms into plantations. Those farmers with smaller land areas or limited livelihood capitals are mostly influenced by local drivers. These factors internal and external to smallholder farmers that influence their land use and livelihoods require consideration towards pro-poor development programs and projects.

There are two broad types of farmers that emerged based on analysis of their aspirations: 'prosperous' and 'survivalist'. Most farmers fall into the survivalist category and expressed a preference for agricultural crops, which reflects their reliance upon household consumption and short-term income. There is a disconnect between farmers and external stakeholders on their land use and crop preferences. Decision-makers and researcher key informants are supportive of the farmers' crop preferences but not their preferred agriculture-based land use; external stakeholders would prefer farmers adopt agroforestry/tree-based systems. Farmer preference in part reflects the current extension activities in the watershed, which are focused on changing crops and not the systems. Extension for agroforestry/tree-based farming systems is limited and if the government wants to shift farmers to agroforestry/tree-based systems, this is a clear gap to address. Geographic location (downstream) as an indicator of their vulnerability to extreme events also influences preferences around tree crops. Reconciling this land use and crop preferences between farmers and external stakeholders is crucial to achieve integrated rural development, as well as understanding and responding to the differing aspirations and well-being of the survivalist and prosperous farmers.

*Farming aspirations, slope, and perceived risks of typhoons* were the most statistically significant factors influencing farmers' willingness to adopt land uses that are more productive, profitable and sustainable. Their capacity to do so is affected by their *available financial capital, education, land use values*, and *reasons* for wanting to make a change. The results from the GLM were used with the cognitive maps, to develop BN models of farmers' willingness to change (WTC) and capacity to change (CTC) land use. The BN model on farmers' WTC land use revealed *current land use* as the most influential variable followed by the *access to extension* and *skills*, while the CTC BN model emphasized the availability of *financial capital, reasons* (for wanting to make a

change) and *education*. Using a scenario of improved access to extension, the WTC model suggests that in villages currently with poor access to extension, the probability that farmers would be willing to change their current land use into agriculture increases (at the expense of agroforestry/tree-based farms). The CTC model highlights that farmers who self-reported that they have the CTC land use have diverse livelihood activities relative to other farmers, and as such have lower risks of doing so. The CTC model with a scenario of improved financial availability suggests an increased probability of farmers' CTC land use. The primary motivation to change is driven by profitability and reflects the current livelihood status of most farmers in Cabulig as 'survivalists'. Ensuring that these key factors are provided to the farmers is important to enhance their willingness and capacity to change into sustainable land use systems.

This thesis makes an important contribution to the knowledge of rural development and the role it plays in transforming land use and diversifying livelihoods and improving the sustainable land use and management of upland watersheds. The development of interventions in the Cabulig watershed needs to shift from the current focus on the technical aspects of land use. There is a need to find alternate ways to improve farmers' livelihood capitals, especially financial capital, so as to encourage a transition to more environmentally sustainable and economically desirable crops or agroforestry-based systems. This needs to be matched with improved reach and effectiveness of extension services for farmers. In short, appropriate land use and watershed management interventions through effective extension service delivery is a policy imperative. However, this thesis argues that there is a need to implement appropriate extension programs, one being agroforestry/tree-based extension for restoring upland watersheds. These extension programs need to be more balanced and holistic considering both farmers' livelihood needs, aspirations and capabilities as well as environmental sustainability.

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## ***List of Acronyms and Abbreviations***

|          |                                                                 |
|----------|-----------------------------------------------------------------|
| ACIAR    | Australian Centre for International Agricultural Research       |
| A&D      | Alienable and Disposable                                        |
| ARC      | Agrarian Reform Communities                                     |
| AT       | Agricultural Technician                                         |
| B        | billion                                                         |
| BN       | Bayesian Network                                                |
| CBFMP    | Community-Based Forest Management Program                       |
| CDOC     | Cagayan de Oro City                                             |
| CENRO    | Community Environment and Natural Resources                     |
| CSIRO    | Commonwealth Scientific and Industrial Research Organisation    |
| CTC      | Capacity to change                                              |
| DA       | Department of Agriculture                                       |
| DAR      | Department of Agrarian Reform                                   |
| DENR     | Department of Environment and Natural Resources                 |
| DMPI     | Del Monte Philippines, Inc.                                     |
| ES       | Ecosystem Services                                              |
| FAO      | Food and Agriculture Organization                               |
| FO       | Farmer organization                                             |
| FSA      | Farming Systems Approach                                        |
| GATT-WTO | General Agreement on Tariffs and Trade-World Trade Organization |
| GIS      | Geographic Information System                                   |
| GPS      | Global Positioning System                                       |
| ha       | hectares                                                        |
| HEPP     | Hydroelectric power plant                                       |
| HH       | household                                                       |
| IA       | Integrated Assessment                                           |
| ISFP     | Integrated Social Forestry Program                              |
| ICRAF    | World Agroforestry                                              |
| KI       | Key informants                                                  |
| KII      | Key informant interviews                                        |

|         |                                                    |
|---------|----------------------------------------------------|
| LGU     | Local Government Unit                              |
| m       | metre                                              |
| M       | million                                            |
| MA      | Millennium Ecosystem Assessment                    |
| MAO     | Municipal Agriculture's Office                     |
| MBNRP   | Mt. Balatukan Natural Range Park                   |
| MENRO   | Municipal Environment and Natural Resources Office |
| MINERGY | Mindanao Energy Systems, Inc.                      |
| MNC     | Multinational companies                            |
| NCIP    | National Commission on Indigenous People's         |
| NGA     | National government agency                         |
| NGO     | Non-government organization                        |
| NIPAS   | National Integrated Protected Areas System         |
| NRM     | Natural resources management                       |
| PES     | Payments for ecosystem services                    |
| PD      | Presidential Decree                                |
| PhP     | Philippine Peso                                    |
| PMTFC   | Phillip Morris Fortune Tobacco Corporation         |
| PRA     | Participatory Rural Appraisal                      |
| RA      | Republic Act                                       |
| RDE     | Research, Development and Extension                |
| SEA     | Southeast Asia                                     |
| SLA     | Sustainable Livelihood Approach                    |
| SSS     | Social Security System                             |
| SWC     | Soil and water conservation                        |
| WW II   | World War II                                       |
| WTC     | Willingness to change                              |



## **Glossary and Terms**

|                        |                                                                                                                                                                                                                                                                                                                        |
|------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Acid upland soils      | Upland soils are pervasive in the humid tropics where soils are very acidic and the topsoil contains small amounts of nutrients and organic matter. Once disturbed and eroded, good management (e.g. conservation practices) and inputs (e.g. fertilizer or lime) are needed to make them arable for cropping again.   |
| Aspiration             | The farming livelihood or well-being that a farmer desires to achieve in the future, for which a farmer is motivated or driven by influencing decisions and actions.                                                                                                                                                   |
| Barangay               | The smallest administrative division in the Philippines, which refers to a village or suburban neighborhood.                                                                                                                                                                                                           |
| Capacity to change     | This is the ability or competency of a farmer to change land use, which may be influenced by livelihood capitals such as financial and human resources.                                                                                                                                                                |
| Climate change         | It is the long-term alteration of temperature and weather in a particular place, region, or around the earth.                                                                                                                                                                                                          |
| Conservation practices | These are land management technologies that are aimed to conserve, protect, or improve soil, water, vegetation, and other natural resources. For example, the adoption of contour farming in sloping land control or minimize soil erosion.                                                                            |
| Developing country     | These are countries that are less industrialized with lower per capita income level and human development index as compared to other developed countries.                                                                                                                                                              |
| Extension service      | External stakeholder-led interventions to deliver knowledge about agricultural or environmental management practices, build skills to improve farm productivity, food security, and livelihoods, and develop land use or livelihood options for farmers (ideally tailored to their needs, capacities, and aspirations) |
| Farming system         | The pattern of farm activities that contributes to a household's livelihood, such as agricultural and/or tree crops, livestock, processing, and off-farm activities. It includes the management strategy or technology used that determines the intensity or complexity of the production system.                      |
| Land use               | In rural areas such as the case study area, land use often includes agriculture (cropping), agroforestry, and forestry.                                                                                                                                                                                                |

|                        |                                                                                                                                                                                                                                                                                                                                                                                                          |
|------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Livelihood             | A set of activities to provide for the basic needs of life, such as food, shelter, clothing, education, and medicine. In upland watersheds, farming livelihood is the most common activity that provides the economic means of securing these necessities.                                                                                                                                               |
| Local government units | These are institutional units, which fiscal, legislative, and executive authority extend over from the provincial to city or municipal, and down to barangay levels distinguished for administrative and political purposes. The local chief executives (e.g. Governor, Mayor, Barangay Captain), along with their Councillors, are elected every three years and may serve for three consecutive terms. |
| Rural development      | It is a development strategy aimed to improve the socio-economic living conditions of farming households in rural areas. Apart from creating economic incentives from agriculture and forestry, the strategy also includes establishing enabling mechanisms such as policy support, education, resource-based enterprise, physical and social infrastructure, among others.                              |
| Smallholder farmer     | A household with a farm size smaller than or equal to three hectares.                                                                                                                                                                                                                                                                                                                                    |
| Sloping land           | This is the gradient or incline of the land, and for which steepness affects the way it should be used or managed.                                                                                                                                                                                                                                                                                       |
| Soil fertility         | The soil can support and sustain the growth of a plant, be it an agricultural crop or forest tree, and result in sustained and consistently high productivity.                                                                                                                                                                                                                                           |
| Stakeholder            | It is an individual or an institution that has an interest or stake in a watershed, whose decision and/or action can either affect its condition or be affected by others' decisions and/or action.                                                                                                                                                                                                      |
| Sustainable land use   | The use and management of land that meet changing human needs (agriculture, forestry, conservation) while ensuring long-term socio-economic and ecological functions of the resource.                                                                                                                                                                                                                    |
| Upland watershed       | A portion of a watershed that may also be referred to as upstream area or upland watershed, which indicate that it is part of one whole watershed that drains to the sea.                                                                                                                                                                                                                                |
| Willingness to change  | This is the inclination or keenness of a farmer to change land use, which could be dynamic as it may be influenced by needs, capacities, aspirations, or opportunities over time.                                                                                                                                                                                                                        |

# Chapter 1: Introduction

## **1.1 Background and research problem**

Watershed degradation and upland poverty are major problems in many developing countries today, especially in Southeast Asia (SEA). During the 1980s, Uexkull and Bosshart (1989) noted that most acid uplands were susceptible to erosion, and hence more suitable as a source of timber and sink for carbon dioxide than they were for food production. However, with a global population of about 7.8 billion, upland forestlands across the world are increasingly being converted for agriculture, commercial plantations, settlements, and infrastructure for this growing population, resulting in adverse environmental, economic and social impacts (FAO et al., 2019). The sustainability of land and other natural resources, and the livelihoods of upland farmers, who depend on these resources, are increasingly compromised (van Noordwijk et al., 2013). Smallholder farmers are particularly vulnerable to change (Brown et al., 2018; Salamanca & Rigg, 2017) as they are often unable to respond effectively to the expected impacts of rural development and climate change.

### **1.1.1 Land use and livelihood impacts on watershed degradation**

The rate and sources of deforestation in developing countries in tropical regions have been widely studied (Barbier & Burgess, 2001; Hosonuma et al., 2012; Leblois & Damette, 2016; Tole, 1998). This knowledge is critical because the soil under tropical forests is inherently infertile and fragile once cleared (Cramb, 2005; Uexkull & Bosshart, 1989). Their acid upland soils rapidly lose organic matter and nutrients and are vulnerable to compaction and erosion. Due to this fragility, the environmental impacts in these areas (e.g. changes in biodiversity, carbon storage, and hydrological processes) differ in scale compared with non-tropical regions. Over-clearing of upland areas alters hydrological processes and can induce flash-flooding (Wohl et al., 2012), especially as the frequency and severity of extreme events increase with climate change (Yumul et al., 2013). This increases the risk of disastrous flooding in downstream communities, as happened during Typhoon Sendong in 2011 in southern Philippines (Lo et al., 2017). Moreover, the inappropriate use of steeply sloping land causes erosion, which diminishes both water quality in streams and farmers' resource base. Clearing also increases the risk of landslides (Aurelio, 2016; Chakma & Chakma, 2017). Farming in marginal acid uplands without appropriate inputs of lime and fertilizer causes soil nutrient decline and reduces farm productivity (Atienza, 1989), especially with a shorter fallow period. Once degraded, these lands are very difficult to restore and over time this negatively affects farming livelihoods.

The scientific literature has demonstrated the impact of land use and livelihood change on landscape patterns, provision of ecosystem services, and climate dynamics in upland watersheds

(Hall et al., 2015; Villamor et al., 2014). However, the relative importance of various biophysical, environmental and socio-economic factors is not fully understood, with some studies noting the need to consider the specific context of each situation (Elmhirst, 2012; Fries & Rosenzweig, 2010). While the impact of land use and farming livelihood varies based on soil characteristics, topography, type of vegetation, the size of the watershed, climate, and other biophysical and environmental conditions, it does not follow ‘a simple linear causal relationship’ (van Noordwijk et al., 2004).

### **1.1.2 Actors and institutions that influence land use and livelihood**

There are three major sets of actors that shape land use in upland watersheds: farmers, general public including policymakers and private sector, and experts (Neef, 2012). Farmers make decisions on how to use and manage their land based on their perceptions and priorities. External stakeholders (policymakers, private sector and experts), who affect and are affected by farmers’ decisions and actions, design and implement interventions (e.g. infrastructure such as dams or roads, agricultural extension) to address a specific issue that may have a range of intended and unintended consequences (e.g. demographic, environmental change).

The priorities of farmers and external stakeholders should be in harmony for effective land use planning and management but in reality they often are not aligned (Halbrendt et al., 2014). Farmers’ decisions and plans are often based on short-term priorities such as survival (Rigg et al., 2016). Policymakers and government actors usually neglect to consider farmers’ short-term needs as well as their aspirations in their decision making and longer-term planning and enforcement of these plans while giving preferential considerations to private actors, such as multi-national corporations. Their plans are also often undermined by weak governance when implemented (Ratner, 2000). Experts, including researchers and natural resource scientists, are often influenced by their funding donors who frame their research in ways that can limit the involvement of community and policymakers in identifying problems and potential solutions. Experts are also challenged and politicized in communicating their science to the public (Hin & Subramanian, 2014). Studies show that some policies developed by government agencies or science-based land use and management activities recommended by researchers are incompatible with the on-ground realities of farmers in many upland watersheds in SEA because of the latter’s different priorities and aspirations (Broegaard et al., 2017).

Several studies have looked at the variations of these actors’ perceptions of conservation agriculture and deforestation (Halbrendt et al., 2014; Scales, 2012), but few have attempted to compare the crops and land use related preferences and farming aspirations of the three key actors or investigate the level of their cooperation (Hibbard et al., 2010). This thesis argues that there is a lack of integrated approaches to understand the interlinked social and natural systems, and to

facilitate improved communication and relationships between farmers and external stakeholders. Without changes the gap between farmers and science and policy widens and this risks increasingly poor acceptance and adoption of policy or science-based recommendations (Broegaard et al., 2017).

Although rural development has contributed to the improvement of infrastructure in the uplands, there has been a disparity in the distribution of benefits (Barbier, 2010). At one extreme, wealthy investors and multinational companies gain a disproportionate share of the financial benefits because they have the technical and financial resources, and the networks required to quickly respond to external developments. They are also able to mitigate the negative impacts of a changing climate. At the other extreme, smallholder farmers' limited livelihood assets (e.g. education, access to support, farm income) hinder their capacity to effectively cope with the risks associated with climate variability or other disruptions (Merritt et al., 2016; Saldajeno et al., 2012). Forced to fully utilize their land and unable to afford ameliorating treatments, farmers decisions can increase 'on-farm' risks of land degradation, lost livelihoods, and wasted investments from government or donor interventions, as well as off-farm risks to downstream communities of flash floods and landslides.

People and institutions have modified and shaped the landscapes of upland watersheds for their own economic and development pursuits. There are several components to this modification of the landscape. The dynamics of the human population – including its transition and growth in the past century, upstream-downstream population changes, and migration in and out of the watershed – tend to surpass the carrying capacity of watersheds (Douglas, 2006; Poffenberger & McGean, 1993). Similarly, people's livelihoods are dynamic, open to innovation, and adaptive to environmental and socio-economic changes (Erni, 2015; Lasco et al., 2011). Livelihoods should be considered as part of broader socio-economic and political systems with wider aspirations, interactions, and implications at different levels. Then there are external interests – operating at local/watershed through to global scales – that are at times incompatible with farming households' priorities and aspirations (Clement, 2008; Thongmanivong et al., 2009). Likewise, the way land and the natural resources within watersheds are used and developed depend on a variety of traditional and statutory laws resulting in, for example, overlapping and conflicting rules in pluralistic resource use regimes (Galudra et al., 2010; Piñon et al., 2012). Together, these interlinked components have important consequences for current and future land use and livelihoods in upland watersheds.

## **1.2 Research aim and objectives**

From the literature, it is clear that a multitude of complex, interacting, and dynamic factors are responsible for land use and livelihood change. The dynamics and complexity of upland

watersheds make it a ‘wicked problem’ to resolve (Rittel & Webber, 1973)<sup>1</sup>. Poor understanding of the landscape makes it challenging to develop and implement effective integrated interventions. Therefore, it is important to explore these challenges and find practical and effective ways to enable farmers and external stakeholders to sustain livelihoods and ecosystem services in upland watersheds. It is also critical to use an approach that can examine holistically rapidly changing upland watersheds that has the ability to (1) incorporate biophysical, environmental and socio-economic aspects, (2) systematically evaluate the problems, and (3) derive more inclusive solutions that are more likely to be adopted by farmers and external stakeholders.

### **1.2.1 Aim and case study**

This thesis aims to explore farmers’ and external stakeholders’ understanding of the factors influencing land use and livelihoods in rapidly changing upland watersheds and to investigate options for improving the willingness and capacity of farmers to adopt sustainable land use and management practices to achieve environmentally and socio-economically desirable outcomes. The selected study area is the Cabulig River watershed, an upland area in the province of Misamis Oriental, southern Philippines. This area represents the general conditions of many upland watersheds in SEA. It has degraded lands due to unsustainable farming practices and high rates of soil erosion, a growing population dependent on agriculture, a poor rural economy isolated from government extension and economic activities, an increasing presence of multinational companies that compete for land and affect smallholders’ livelihoods in multiple ways, and is a landscape that is vulnerable to the impacts of the changing climate.

### **1.2.2 Research questions**

This research considers the concepts of land use transition, sustainable livelihoods, and aspirations using integrated assessment as the overarching framework to understand the factors influencing farmers’ and external stakeholders’ land use decisions and livelihood strategies in Cabulig watershed. Specifically, it addresses the following questions in Figure 1.1:

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<sup>1</sup> Rittel and Webber (1973) contrasted wicked problems to “tame” problems, and alluded that the former is ill-defined, ambiguous and associated with moral, political and professional issues, difficult to resolve as they are strongly stakeholder dependent, not static as they composed of complex interacting issues that together evolved in a dynamic context.

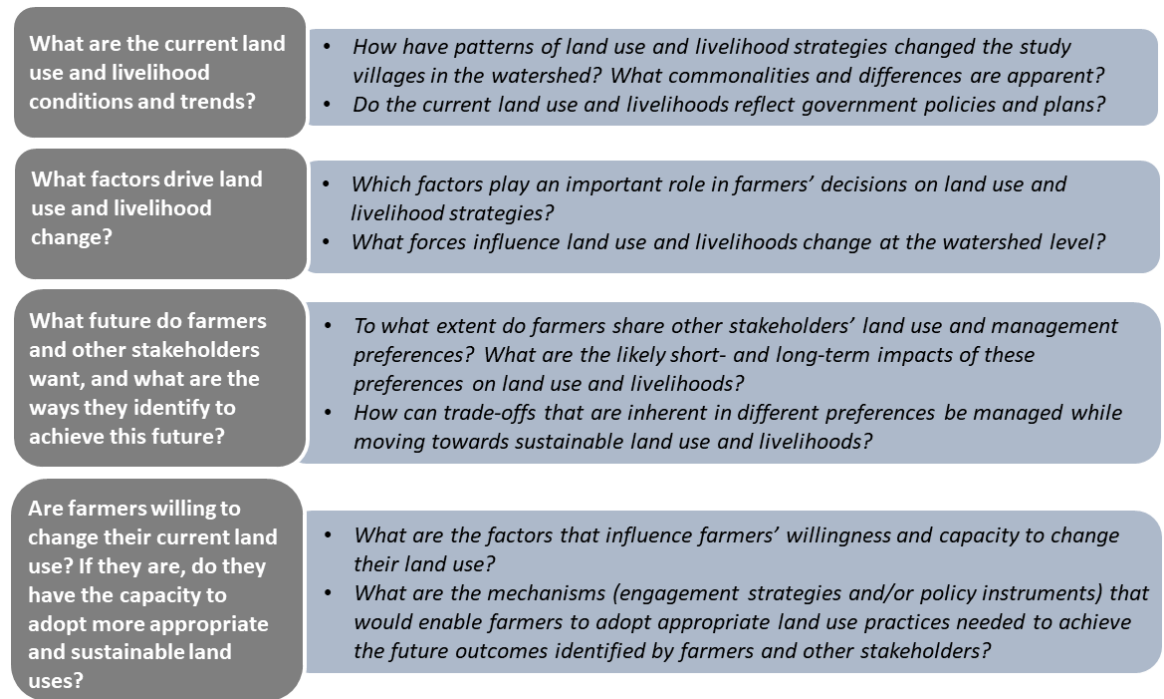


**Figure 1.1** The thesis research questions

## 1.3 Methodology

This research adopted an integrated assessment (IA) lens (see Chapter 2.4.1) to improve understanding of the complex interdependence of biophysical, environmental and socio-economic issues in upland watersheds. Guided by the framework for model development and IA set by Hamilton et al. (2015) and Jakeman and Letcher (2003), respectively, a mixed-methods approach was used to generate and analyze the quantitative and qualitative data needed to answer the research questions (Cheong et al., 2012; Creswell, 1999). There were three methodology components in this research: collection and analysis of household (HH) survey data, qualitative research methods, and Bayesian network modelling.

A HH survey with farmers from six study villages was conducted to provide baseline datasets that inform the breadth of issues considered in this research. Descriptive statistics using SPSS were used to characterize the surveyed farmers, their households, and farming systems, while regression analysis was carried out to support qualitative insights on farmers' willingness and capacity to change land use. Using the land-suitability mapping of Ringrose-Voase et al. (2019), the current and preferred crops of farmers were assessed against their suitability based on biophysical evidence.

Field observations, key informant interviews, and focus groups were conducted to deepen understanding of key issues that had been identified in reconnaissance field work (see Table 3.2). NVIVO was used for descriptive and explanatory analysis to unravel information on determinants of land use decisions, crop and land use preferences, and priorities and farming aspirations. Key

informants were selected from farmers, policymakers and the general public, and experts, while the focus groups mainly involved farmer leaders from the study villages. Cognitive mapping was also used to structure the factors influencing farmers' land use decisions and management practices (Doyle & Ford, 1999; Gray et al., 2013). Desktop research utilizing secondary data was likewise done using content analysis. While the methodology adopted in this research cuts across qualitative and quantitative techniques, data analysis and discussion are primarily taken from the qualitative inquiry.

Bayesian network (BN) modelling was used to explore further the factors influencing farmers' willingness to change land use and their capacity to do so, and identify opportunities and/or constraints of potential interventions that enable farmers to adopt sustainable land use systems.

## **1.4 Motivations for the research**

This research has both scientific and practical motivations. The research applies the IA approach to land use and livelihood changes in the context of an upland watershed in a developing country. Much of the scientific literature on IA in land use focuses on modelling trade-offs on soil fertility management in Africa (Giller et al., 2011), carbon emissions in Latin America (Calvin et al., 2016), or the economics of food production and policy aspects in Asia (Cai et al., 2016; Reidsma et al., 2011). There is limited application of IA to farmers' land use and livelihoods, and how their livelihood capitals, aspirations and external drivers influence farmer decisions and actions. Without an understanding of these key factors and their interactions, the benefits of development interventions may not be fully achieved.

This research makes an important contribution to filling these gaps in the current literature by assessing the current land use and livelihood trends. It seeks to establish the major drivers of land use change at the watershed level, and key determinants of farmers' land use decisions and actions. It attempts to reconcile farmers' crop/land use preferences and aspirations with those of external stakeholders, and to model the key factors and their interactions influencing the willingness and capacity of farmers to adopt sustainable land uses. In doing so, the research builds on notable international literature:

- Garrity and Agustin (1995) studied land use changes in the Claveria municipality, Misamis Oriental (which overlaps the Cabulig watershed), and found that scarcity of arable lands prompts farmers to cultivate ever more steeply sloping land causing soil erosion, and to shorten fallow periods causing nutrient depletion. Once degraded, these lands are very difficult to restore, which eventually affects farm productivity.
- Dixon and Gulliver (2001) provided broad patterns of farming systems from six regions, including East Asia and the Pacific. They considered heterogeneity of landscape



characteristics, challenges, and opportunities to identify strategies for farmers to escape from poverty and hunger.

- Chambers and Conway (1991) highlighted sustainable livelihoods as an important integrating concept in rural development. They set a framework for assessing livelihoods through five capitals, namely natural, physical, financial, human and social. This framework was applied by Ashley and Carney (1999) and expanded by Scoones (2009) to include knowledge, space, dynamics, and politics at the farm, village and watershed scales.
- Foley et al. (2005) provided a qualitative method of analyzing land use change, while Lambin and Meyfroidt (2010) framed the socio-ecological and socio-economic land use transition pathways, which help identify internal or external drivers of change.
- Millenium Ecosystem Assessment (2005) provided methodology for including human well-being in ecosystem assessment, such as security, basic materials, health, social relations, and freedom of choice.

In the case study site, World Agroforestry (or International Centre for Research in Agroforestry, ICRAF) and its various research partners, including ACIAR, have been conducting agroforestry research and development activities in the southern Philippines, providing a valuable source of background information for this research. This research builds on the outputs of an ACIAR project that was implemented in Cabulig watershed, the '*Watershed evaluation for sustainable use of sloping agricultural land in the southern Philippines*' (here-on-in referred to as the ACIAR Watershed Evaluation project). To complement the project's extensive soil characterization using digital soil mapping techniques (Ringrose-Voase et al., 2019), this PhD thesis research was meant to enhance its socio-economic context of land use and livelihoods.

From a practical perspective, this study has direct relevance to the research needs of: (1) the Claveria Municipal Planning and Development Office; (2) the Department of Environment and Natural Resources (DENR) for farmers' baseline socio-economic information to aid in their development and watershed planning; and (3) ICRAF [my home institution] for improving its use and application of decision-support tools. Having worked in various donor-funded projects in Cabulig and other watersheds in the Philippines, I have had opportunities to interact with upland farmers who need timely information and practical advice to improve their farming livelihood. I also interacted with key external stakeholders such as policymakers, government and development workers, private companies and the academe who have their own perceptions and priorities on how land should be used and managed. I realized that there is a need to improve understanding of the relationships between farmers and external stakeholders' decisions, aspirations, and actions about their land and livelihoods, especially the former's willingness and capacity to cope with or adapt to rural development activities and the changing climate.

Consultations with fellow researchers and local partners revealed weak decision making and planning processes due to a lack of holistic approaches.

This research is of direct relevance to policymakers and development practitioners in the Philippines because of the institutional management in the country, in particular, the interplay between government agencies (i.e. local government unit, Department of Agriculture, and DENR), as well as between agencies operating at local, regional and national scales. The study also has broad application to upland watersheds in developing countries because the biophysical, environmental and socio-economic conditions that influence farmers' land use decisions and management practices are often similar. A landscape transformation occurring in an upland watershed of a developing country in Asia and the way its farmer constituents are responding may be similar to those in an upland watershed in Latin America or Africa. This is a good opportunity to feed into key policy and institutional processes related to sustainable land use in watershed management in developing countries.

## **1.5 Thesis structure**

The research consists of nine chapters. This introductory chapter identified major challenges arising in upland watersheds in developing countries and highlighted the importance of addressing these through the aims and objectives of this study. Chapter 2 reviews the academic literature on current knowledge of, and methodological approaches to, land use and livelihood transformation in upland watersheds. Chapter 3 describes the analytical framing of the research and the methodologies implemented to collect and analyze data. The analyses are presented in Chapters 4 to 7 and the linkages between these and the discussion are shown in Figure 1.2. Chapter 4 examines the current land use and livelihood conditions and trends in the case study area. This shows similar and contrasting land uses and livelihoods of villages from different locations in the watershed. Chapter 5 discusses the factors influencing farmers' decisions and actions at the farm level, and the forces that drive land use and livelihood change at the watershed level. Chapter 6 considers the different aspirations of farmers and discusses to what extent their land use preferences are shared by other stakeholders in the watershed. Chapter 7 assesses the willingness and capacity of farmers to adopt their preferred land uses using a Bayesian network model developed from the data and analyses in the preceding three Chapters. Chapter 8 summarises the key findings of the study with the research objectives, and its limitations. Chapter 9 concludes this research and provides research and policy recommendations.

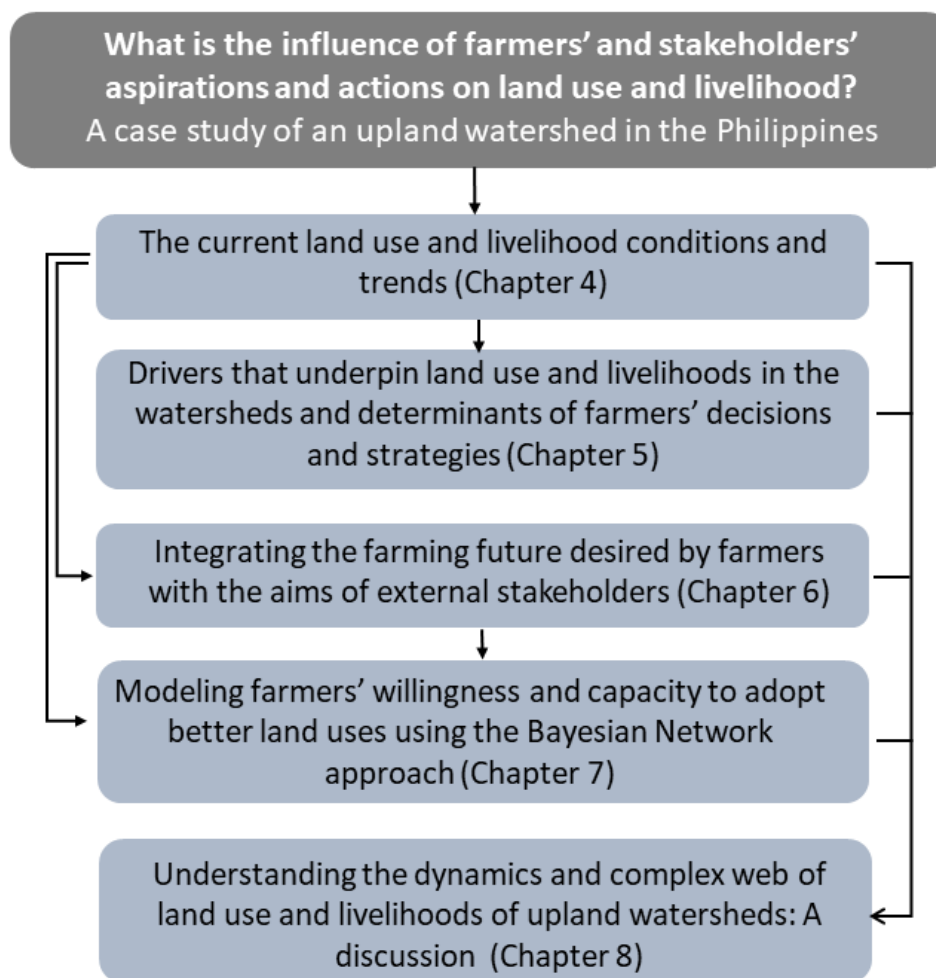


**Figure 1.2 Overview of the results and discussion Chapters and their linkages**

## Chapter 2: Literature Review

*‘A watershed is an area of land, a bounded hydrologic system, within which all living things are inextricably linked by their common water course and where, as humans settled, simple logic demanded that they become part of a community.’*

*John Wesley Powell, American geographer*

### 2.1 Introduction

The dual impacts of rural development and climate change in upland watersheds raise the question of how to sustainably manage land use and land use change, whilst protecting farmers and their farming livelihood. As indicated by the quote of Powell, watersheds are not only about organisms interacting with their physical environment but also ‘humans’ interacting according to the norms and rules of biophysical and social entities that determine their relationships (van Noordwijk et al., 2013). Understanding farmers’ decisions and aspirations for well-being are necessary to design and implement pro-environment and pro-livelihood policies and development investments. However, the ways farmers decide their land use and strategize their livelihoods are complex and dynamic as these are influenced by many interrelated and interacting contextual and driving forces. The contemporary literature has highlighted two key challenges for those who are developing policies and investments: firstly, identifying the most influential forces that impact farmers’ decisions and actions (Rola, 2011), and then finding appropriate analytical frameworks to better understand and influence their relationships and interactions (Baynes et al., 2011). Integrative approaches are needed to investigate such complex and dynamic problems.

Integrative approaches often use holistic assessment frameworks based on combining and interpreting knowledge from several disciplines and communicating useful information to policymakers. They build on the premise that integrating a broader set of studies, approaches and perspectives by engaging stakeholders provides more robust and better information on complex issues such as arise in natural resources management. This chapter aims to provide evidence on the utility of integrative approaches in linking contextual and driving factors that influence farmers’ decisions and actions on land use and livelihood change in the upland watersheds of Southeast Asia (SEA) or other developing regions in the tropics of Asia, Africa or Latin America. Section 2.2 provides an overview of different factors that shape the current status of land health and trends of land use in tropical upland watersheds and highlights the complexity of land use and livelihoods that requires integrative approaches to understand. Section 2.3 probes smallholder farmers’ land use decisions and livelihood priorities, and their interactions with external

stakeholders. Section 2.4 analyses some methodological framings and approaches used to explore and understand complex land use and livelihood problems. Finally, Section 2.5 discusses emerging areas from the literature against the key dimensions of integration (Hamilton et al., 2015) in order to frame the research in the following Chapters.

## ***2.2 Land use and land health in tropical upland watersheds***

Deforestation and forest degradation remain as major environmental problems around the world with agricultural expansion as the main driver (FAO & UNEP, 2020). Considerable removal or degradation of forests is occurring in upland watersheds<sup>2</sup> of developing countries resulting in land and river degradation. In Asia alone, around 74% of the total land area of such watersheds is degraded (Claire & Lynch, 2010). Land degradation reduces the area of arable land over time, which consequently affects land-based livelihoods. The United Nations Convention to Combat Desertification reported that in 2011, around 1.5 billion (B) people lived on these degraded lands worldwide, and that about 42% of these people were considered very poor (Nachtergaele et al., 2010). These pressures on watersheds and the people who live in them are expected to escalate, with the FAO (2009) estimating a 70% increase in food production would be needed to feed the projected population of 9.1 B by 2050.

### **2.2.1 Inherent characteristics of tropical upland watersheds**

Although there are characteristics prevalent in upland watersheds in tropical regions, every watershed is unique given the heterogeneity of their biophysical features, including climate (e.g. rainfall, humidity), physiography (e.g. elevation, slope, size), geology (e.g. drainage, parent rock type), soils (e.g. type, depth), and land use and cover condition (e.g. types, road network, ownership, management practices). All these affect the hydrological function of watersheds, which has bearing on the quality of soils as a basic resource.

Land health refers to the ‘continued capacity of the soil to function as a vital living system, within an ecosystem and land use boundaries, to sustain biological productivity, promote the quality of air and water environments, and maintain the plant, animal and human health’ (Doran & Safley, 1997). This definition recognizes the importance of soil to support other functions (e.g. water quality) over time (Groot et al., 2002) and attributes like soil biodiversity and nutrient cycling, among others, that enable land to continuously produce crops. These attributes also enable healthy land to contribute to climate change mitigation (Groot et al., 2002) by maintaining or increasing

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<sup>2</sup> While Powell’s definition highlights the components of a watershed, the Cambridge Dictionary defines it as ‘an area of high ground from which water flows down to a river’. Often located in upland areas, ‘upland watershed’ usually refer to areas or lands above a high-water mark or flood plain.

nutrient and carbon contents (Claire & Lynch, 2010). Land health is a function of the inherent characteristics of the land and how the land is used and managed over time.

Many developing countries in the tropics have inherently poor soil conditions that are naturally fragile and hard to manage. According to FAO (2011), out of the 3.9 million (M) hectares (ha) (24%) of potentially arable lands around the world, about 2.5 M ha are composed of acid soils<sup>3</sup> and around 1.7 M ha of these are in the humid tropics. Since the 1980s, the Australian Centre for International Agricultural Research (ACIAR) has been investing in research projects on how to manage acid soils in the tropics (Uexkull & Bosshart, 1989) but poor management remains an issue in many upland watersheds. Cramb (2005) notes that managing the acid upland soils of cleared land in SEA is difficult where the underlying soil is inherently infertile and fragile. This is partly attributed to the steepness of the landscapes where about 58% of its landforms have slopes greater than 11% (Pimentel & Burgess, 2013). These areas usually have shallow soils of poor structure with high rates of soil loss, and thus require appropriate management and conservation strategies that reflect the soil characteristics and the high rainfall and monsoonal climate in the tropics.

Although the climate is generally humid all year with temperatures from 25 to 28 degrees Celsius, tropical countries receive highly variable rainfall with seasonal shifts in patterns as influenced by wet and dry seasons and monsoons. The Philippines climate is characterized by relatively high temperatures, high humidity and abundant rainfall, with a mean annual rainfall that varies from 965 to 4064 millimeters (PAGASA, 2021). Climate change is affecting the variability of rainfall and the onset of monsoons in SEA. For example, the onset of the Indian monsoon is predicted to be delayed by 15 days in the future (Loo et al., 2015). All of these contribute to a fragile landscape that is naturally prone to soil erosion, flooding, landslides and seasonal droughts. With these inherent conditions, the concept of arable lands is of limited value in upland watersheds.

### **2.2.2 Land use and management: drivers of land degradation**

According to FAO (2011), the rate of the increase of arable land and permanent cropping extent is less than the rate of increase of production of globally important crops (e.g. cereals). A farmer's share of arable lands decreased from 0.41 ha in 1961 to only 0.25 ha in 2015, and this is expected to decrease further to 0.20 ha by 2050 (Hens & Quynh, 2016). Referred to as 'any land capable of being plowed and used to grow crops' regularly, upland watersheds have limited arable lands for agricultural cultivation due to topography.

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<sup>3</sup> Acid soils are those that have a pH value of less than 5.5 for most of the year and are associated with toxicities, nutrient deficiencies and other conditions restricting crop growth.

The scarcity of arable land prompts farmers to cultivate even steeply sloping land, often with poor management practices, causing nutrient depletion and soil erosion problems (Fujisaka, 1993; Garrity & Agustin, 1995). This is the case with three upland watersheds in Central Java, Indonesia, where various farming systems on steep slopes with cash crops (e.g. vegetables, maize, tobacco) and few conservation practices recorded a very high erosion index of 212 Mg/ha/year (Andriyani et al., 2016). This soil erosion then reduces the productivity of arable lands in upland watersheds. The study by the Management of Soil Erosion Consortium on the impacts of land use and cultivation practices on run-off and erosion rates from 27 watersheds in five countries (Indonesia, Laos, Philippines, Thailand and Vietnam) over five years revealed that soil erosion is influenced largely by land use at both farm plot and watershed levels (Valentin et al., 2008). The authors found that continuous cropping of maize and cassava results in a high rate of soil erosion at the watershed level but may be reduced with conservation measures. In Claveria, Misamis Oriental, Delgado and Canters (2012) reported that soil erosion in conventional up-down and monocropping cultivation is  $12 \text{ mTha}^{-1}\text{yr}^{-1}$ , which results from the high susceptibility of soils to erosion especially in sloping areas. Unsustainable use and inappropriate management of these marginal lands and hard to manage sloping areas further compounds degradation in upland watersheds.

Land degradation not only reduces farm productivity, it also adversely affects downstream communities. In Sub-Saharan Africa, it caused an average crop decline of 6.2% annually in downstream farming, which may increase to 14.5% if soil erosion rates is unabated (Pimentel & Burgess, 2013). Declining productivity encourages farmers, especially the smallholders, to abandon their lands. This was the case in Ecuador where about 60% of the Sierra region was abandoned due to degradation (Pimentel & Burgess, 2013). Impacts include poor water quality and sedimentation of rivers, flooding, landslides and flash floods. For example, land degradation in Manupali watershed in the southern Philippines due to soil erosion led to siltation of the irrigation system (Lantican et al., 2003). Yield in rice paddies decreased by 27% from 1990 to 1995 and the National Irrigation Administration had to renegotiate with farmers the schedule of water delivery, cropping pattern and land allocation. Already affecting downstream communities, the likely impacts are worsening with changing climate (Lo et al., 2017; Yumul et al., 2013). The effects of land degradation on the risk of catastrophic events such as landslides and flood which can cause loss of life, housing, infrastructure, livelihood and others cannot be undermined.

Several studies have shown how the watershed's capacity to provide ecosystem services declines with the inappropriate conversion of forestlands into agriculture and other land uses. In the steep Modjo watershed in Ethiopia, Gessesse et al. (2015) found the expansion of cultivated land by resource-poor farmers without appropriate land management investments contributes to severe soil erosion problems, which in turn worsens land degradation, and over time has negative implications for their livelihood. Similarly, the continued expansion of banana and pineapple

plantations in the uplands of Mindanao, southern Philippines, has associated environmental and social concerns (Havemann & Rosenthal, 2015). This pattern of land use change for livelihood opportunities leading to land degradation and then to loss of livelihood opportunities is repeated in China (Zhai et al., 2014), Laos (Castella et al., 2013), Costa Rica (McLennan & Garvin, 2012) and many other countries. As said previously, food and timber production are some of the major reasons behind large-scale conversions in the uplands. A critical challenge then is how to manage the trade-offs between immediate human needs and sustaining watershed services in the long-term. Another challenge is identifying and implementing supporting ‘mechanisms’ for a given land use change that mitigate the risk of environmental degradation.

### **2.2.3 Addressing the negative spiral of land use and degradation**

The premise of this section is that the key to sustainable land use in upland watersheds is understanding that the land use, land management and degradation are inextricably linked – that every land use decision is a management decision that may or may not lead to degradation. Results of sediment yield studies suggest that the adoption of appropriate conservation technologies can efficiently reduce soil erosion and address land degradation. In tropical regions, this involves site-specific techniques such as contour tillage with grasses and bamboo along slopes and embankments (Valentin et al., 2008), use of fodder grasses in areas with medium erosion, and reforestation in steep areas (Andriyani et al., 2016). The general strategy should be to ‘produce more with less by reducing [production] losses and increasing soil, water, and nutrient use efficiency’ (Lal, 2015).

Despite these well-recognized strategies to address land degradation, the pressures on watersheds are continuously increasing. Although Bruun et al. (2009) and Cramb et al. (2009) focused their research on soil properties and natural processes, and identified land use and management practices to improve soil quality, they implied the need to consider the factors behind farmers’ decisions and actions. Asio et al. (2009), recognising this, acquired data not just on the biophysical characteristics of degraded uplands but also on farmers’ socio-economic conditions to develop their comprehensive and appropriate soil management strategies. This thesis argues that addressing land use, land degradation and management issues requires better understanding of how farmers make land use decisions and livelihood strategies, and how external stakeholders’ mandates, land use policy and interventions could influence farmers actions.



## **2.3 Drivers of smallholder farmers' livelihood and land use decisions**

### **2.3.1 Smallholder farmers and their livelihoods**

In 2010 about two-thirds of the world's three billion agricultural populations came from Asia (Poole, 2017), the majority of which are smallholders located in upland watersheds. In the Philippines, smallholder farmers are defined as those 'cultivating in less than five ha of the land' (Republic Act [RA] 6657<sup>4</sup>), and who depend on subsistence farming with an annual income of not more than Philippine Peso (PhP) 180,000<sup>5</sup> (RA 7607<sup>6</sup>). They typically live in densely populated upland areas, characterized by deforested uplands with steep slopes, degraded soils, extreme weather changes, and with limited economic opportunities. As such, smallholder farmers in these regions are most vulnerable to rapidly changing environmental, socio-economic and political conditions.

In his analysis of global perspectives on smallholder agriculture, Tinsley (2004) identified biophysical and socio-economic factors that influence the farming activities small farmers undertake. He considered the government and its policies as the key determinants that define the economic environment in which smallholders operate. Catacutan and Duque-Piñon (2009) supported this finding in their review of incentives for vegetable-agroforestry policies in the Philippines. They found that while government policies are intended to benefit the smallholders, it is the big farmers who benefit the most because they have the operational resources to develop their lands, the right connections for information and support, and greater responsiveness to suggestions. Appropriate attention and support need to be given to smallholders considering their limited resources and reliance on land and forest resources for food and survival. Such fair and equitable action would enable the smallholders to improve their farming livelihood. However, Poulton et al. (2010) questioned the feasibility of this in the absence of effective and timely delivery of extension services to these small farmers.

Livelihood is described as the 'capabilities, assets, and strategies employed as a means for survival' (Chambers & Conway, 1991). How farmers combine their livelihood assets and activities to improve their economic status is referred to as their livelihood strategy, which is also based on their values and priorities. In upland watersheds, agricultural production or farming is an important component of livelihood strategies, alongside forestry and inland fisheries. Devendra and Thomas (2002) analyzed the smallholder farming systems across Asia and found that the emphasis is on crop production rather than livestock. Monoculture and multiple cropping

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<sup>4</sup> RA 6657 Comprehensive Agrarian Reform Law

<sup>5</sup> AUD 5,143 (1 AUD=PhP 35.00)

<sup>6</sup> RA 7607 Magna Carta of Small Farmers

systems are common in which crops such as rice, maize, cassava and trees are grown for subsistence or cash. These systems are rain-fed, hence vulnerable to climate change. Shifting cultivation is still practiced in SEA although it is decreasing in response to recent policies prohibiting it.

Because of limited landholdings and farm income, farmers are compelled to diversify their livelihood activities by venturing into off- and- non-farm employment to provide for their household daily needs. This is a pattern across Asia and beyond. In Africa, about 35% of rural income comes from non-farm activities, such as trading, agro-processing and labour (Vanlauwe et al., 2014). Loison (2015) added that, again, it is the big farmers with better livelihood assets in Sub-Saharan Africa who have successfully diversified their sources of income by maximizing economic opportunities to synergize farming with non-farm activities, and not the smallholders. Improving and sustaining farming and other livelihood strategies is a major goal in most rural development policies and projects in Asia's upland watersheds.

### ***Factors influencing smallholder land use and livelihoods***

Many forces drive the behaviour of farmers and external stakeholders, or alter the biophysical processes of their watersheds. In this thesis, these forces are categorized as controllable (e.g. soil pH, land cover, farming systems) or uncontrollable (e.g. unusual weather patterns like drought or prolonged rainy season) and are analyzed at farm and watershed levels. They may also be categorized as internal forces or external forces. Internal forces include farmers' cognition (e.g. knowledge, values, priorities) and the farming systems they implement. External forces are caused by natural events (e.g. typhoon, flooding) or external agents (e.g. government policy, market forces) outside their community and/or watershed. Using governance as an example of an external force, Mahdi et al. (2009) revealed that Indonesia's decentralization in the 1990s changed people's livelihoods in Lembang watershed and the sustainability status of their assets. Globalization reduced agricultural activities because cheap imported products flooded their market, which led people to look for alternative livelihoods. Lambin et al. (2003) presented their case as to why globalization and its many processes is a major driving force of land use change rather than simpler reasons of population and poverty. IPCC (2019) also predicted that climate change will intensify in developing countries. For farmers, climate change impacts will exert both uncontrollable and external forces. As a result of rural development, market integration and climate change, upland watersheds are no longer stable but are constantly changing due to these uncertainties. It is important to note that land use change drivers with long turnover times determine environmental sustainability (e.g. land degradation), of whose effects farmers may be unaware, while those with short turnover times can result in changes of ecosystem services (e.g. landslides) where the effects are more radical or dramatic.

The impacts of these driving forces on farmers' land use and their livelihood assets vary depending on their resilience (as individuals or groups). Plummer and Armitage (2007) described resilience as the ability to buffer disturbance, self-organize, and then adapt to imminent changes. In the development literature, resilience is often explored using the lens of sustainable livelihoods. For example, Merritt et al. (2016) studied household resilience to drought in Andra Pradesh, India based on their livelihood assets. They defined resilience as the capacity to survive consecutive drought years and found that households with stronger social capital (e.g. group membership) were more likely to report greater resilience because of their administrative and political connections.

### ***Aspirations for well-being***

The Cambridge Dictionary defines aspiration as 'something that you hope to achieve.' In this thesis, what farmers want (or desire) is often conditioned by their personal experiences or interactions with other people in their communities. This is following Apparudai (2004) who argued that the poor cannot aspire because of limited resources that would enable them to change their conditions, and so their poverty persists. Dalton et al. (2014) analyzed the relationship between poverty and aspirations failure for both the rich and poor, and found that in the case of aspiration failure, the poor suffer the most, which they termed as a 'behavioural poverty trap'.

The concept of aspiration has been explored in farmers and young peoples' quest for a better life in the rural sector (Verkaart et al., 2018; Anyidoho et al., 2012; Leavy & Hossain, 2014). Few studies have considered farmers' aspirations, namely how these are formed and developed in response to different social and environmental contexts. Relating aspirations to farmers' willingness and capacity to manage salinity problems in Australia, Curtis et al. (2001) emphasized the importance of low on-property income as a factor constraining aspirations. Understanding the reasoning behind farmers' behaviours or aspirations may also relate in different ways to personal, household, social, or environmental well-being (MA, 2005). Apparudai (2004) suggested providing poor (farmers) the opportunities and support needed to achieve their aspirations. Although Dalton et al. (2014) suggested that raising aspirations through improved welfare is enough, it is argued that in the context of smallholders, improving livelihood assets is a key to address conflicts between their aspirations and resources.

### **2.3.2 Farmer interactions with external stakeholders**

Rural development has opened upland watersheds to external stakeholders. For farmers, this means interacting and acting reciprocally with the stakeholders for (hopefully) mutual benefits. Stakeholders refer to 'all those who affect, and/or are affected by, the policies, decisions and actions of the systems' (Grimble & Chan, 1995), which may include policymakers, planners or land managers, administrators in government, and other organizations, as well as commercial and

subsistence user groups who are the farmers. This definition is quite broad considering that not all stakeholders can directly participate in land use and management.

Land use and management drives farmer and stakeholder interaction because of their often-competing views on how land should be used and managed. The farmers' priority is enough returns from farming livelihood to survive (Rigg et al., 2016; Roberts, 2015) while the external stakeholders may focus on maintenance of resource base (i.e. government) and risk reduction (i.e. downstream communities) (Harashima, 2000; Leon & Pittock, 2017). External stakeholders interact in different ways to improve the involvement of stakeholders and prevent imminent conflict, with the nature and the level of interaction depending on the forces that drive these initiatives. From top-down agency-led initiatives, the worldwide trend is now towards participatory bottom-up local or citizen-led initiatives (Manasi et al., 2010; Rhoades, 1998), but often this is not fully realised. For example, although the South African National Water Act 1998 emphasized public participation, the limited skills and capacities of constituents from disadvantaged communities affected their understanding and meaningful participation (Boakye & Akpor, 2012). While these interactions link farmers' dynamics to broader institutional and governance contexts, meaningful participation is critical for them to address power and influence imbalances, such that stakeholders' perceptions and aspirations be considered together with their ability to communicate these.

The stakeholders considered in this thesis are the local farming communities, policymakers, private companies, the general public<sup>7</sup> (e.g. downstream communities, church leaders), and experts. As they all rely on the land for living and other purposes, understanding the local farmers' and other stakeholders' decisions, actions and aspirations are vital to managing the complexities and uncertainties of degrading lands and farming livelihoods. Farmers and the external stakeholders operating within the same upland watershed vary in their knowledge of, and values and priorities around, land health and livelihood. Their differences influence how stakeholders behave and affect the environmental conditions of the watershed and therefore other persons. Whilst knowledge and priorities are continuously changing, values are principles or standards of behaviours that are enduring and less easily changed (Seymour et al., 2010). Land use priorities can change in response to household, social, economic and/or environmental pressures (van Noordwijk et al., 2013).

Farmers' knowledge, values and priorities influence the crops, farming systems and technologies that they choose to try and achieve their aspirations which might be good income, reduced vulnerabilities, better community status or other personal wants (Cramb, 2005). Farmers may

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<sup>7</sup> In this thesis, general public includes politicians from village and municipal levels, government staff, and representatives from people's organizations, non-government organizations and private companies.

want to diversify their sources of income as a strategy for coping with future uncertainties such as a trend for more frequent extreme events or to minimize risks from investing in certain land use. For example, the promotion of intensive commercial agriculture in Laos increased farmers' vulnerability to environmental and socio-economic risks (Castella et al., 2013). In response, they diversified their livelihood strategies by engaging with other stakeholders in traditional or new social networks to improve their capacity to respond to unforeseen changes.

### ***The importance of collective actions and effective extension services***

Elevating human and social capital is fundamental to improving land use and livelihoods (Chen et al., 2013; Karki et al., 2011). A common strategy is to establish farmer organizations (FOs) to build individual and group capabilities and/or to create shared values. Farmers participate and maintain these social networks for benefits, such as information, capacity-building and market access, although conflict and disillusionment can arise (Reed, 2008). Social norms guide people's behaviour in social settings, and FOs are often established in part to develop new norms around production and land management. Although they are hard to establish, Minato et al. (2012) showed that social norms, once established, communicated, monitored and enforced, can promote appropriate environmental behaviour, as in the case of Australian Landcare groups. Reed (2008) emphasized the importance of empowerment, equity, trust and learning in the process to develop norms and behaviours, and manage conflicts, which requires highly skilled facilitation.

Poulton et al. (2010) argue that 'service delivery lies at the heart of small farm debate'. This involves disseminating research-based knowledge and technology options to farmers that would develop their capacity to address the issues confronting them and to adapt and innovate appropriate technologies. While this is a major role of the government, other service providers also engage in its delivery from the academe, non-government organizations and private companies. Regardless of the provider, extension services have had a mixed impact. The promotion of privatized agricultural extension services has received mixed responses from the farmers of India (Jiyawan et al., 2009) and Bangladesh (Uddin et al., 2016), whilst in Ethiopia Elias et al. (2015) found that about 55% of the farmers were satisfied with the extension services they received, which led to greater profit, regular interactions and off-farm income. This is in contrast to Lemma et al. (2016) results in Ethiopia that revealed a weak service in terms of advice, training and linkage facilitation, as well as a limitation on storage, processing, value-chain and marketing information. Catacutan (2005) found that external forces can affect social capital where the presence of multinational companies disbanded many of the Landcare groups in the southern Philippines due to employment opportunities. van Noordwijk et al. (2013) also argued that with weak laws or in the absence of incentives to create collaborative mechanisms, stakeholders operate in isolation from each other to serve their interests. It is argued that there is still much to be done structurally to improve the timely and effective delivery of extension services.

### **2.3.3 Bridging the divide between farmer and stakeholder priorities**

In various social processes, farmers interact and negotiate with external stakeholders as they face opportunities and challenges that require land use decisions and frame their livelihood strategies. Reconciling the differences and improving the synergies of these actors' decisions and aspirations are fundamental to sustain their interests in the watersheds.

There is a need to comprehensively analyze the underlying factors encompassing not only the current land use and livelihood conditions and trends in upland watersheds but also the decision making processes of farmers and motivations of external stakeholders. Such factors may vary at the farm and at a watershed level where social processes often occur. Addressing issues of land use and management practices in scarce productive lands, and improving these with limited livelihood capital, especially under watershed governance with policy and institutional constraints, in order to provide incentives for smallholders, are crucial. To bridge the context of scale and the complicated stories of upland people, their values and aspirations, an integrative approach is needed to address key research questions.

## ***2.4 Methodological framings and approaches for understanding complex land use and livelihood problems***

This section sets out the approaches and methods for research connecting land use and livelihoods that lead to inferences about their links and interactions. In this thesis, land use refers to farmers and external stakeholders activities (i.e. corporate plantations) that are directly related to land, making use of its resources, or having an impact on them to pursue a farming livelihood (FAO, 1994). Livelihoods constitute the capabilities, assets and activities that are necessary for farmers to make a living and survive (Chambers & Conway, 1991).

The dynamics and complexity of land use and livelihood change in upland watersheds make it a 'wicked problem' to resolve (Rittel & Webber, 1973). While these two systems used to be researched or managed separately in the past, recent learnings suggest that they should be explored using interdisciplinary approaches (Petrosillo et al., 2015). Issues like these were often addressed through reductionist methods (as simple systems) or by aggregating through statistical analysis (as an unorganized system) when composed of different interacting aspects (GuoDong & Xin, 2015). The problem with such approaches is they do not recognize the value-laden nature of the problem and solution. From one site, ecosystem, ethnicity and other settings to another, some requirements to resolve the problem are contradictory, dynamic, difficult to reconcile and not well understood. In some cases, it requires farmers and external stakeholders to change mindsets and behaviours. Exploring these requires a holistic approach that considers how each aspect contributes to the complexity and dynamics.

### 2.4.1 Overarching frameworks

Several integrative approaches exist that attempt to holistically understand and address complex and dynamic socio-ecological problems: two overarching approaches are considered here.

Integrated Assessment (IA) can integrate different disciplines across different scales (e.g. field, local, watershed) in understanding complex relationships between natural and human environment, their behaviour and cascading effects both spatially and temporally (Kelly et al., 2013). The participation of diverse stakeholders, with different knowledge and views about the issue and solutions, is one of its strengths that makes it useful for understanding, integrating and communicating diverse knowledge and perceptions to support decision making in an iterative and adaptive process (Hamilton et al., 2015; Jakeman and Letcher, 2003)<sup>8</sup>. Stakeholder participation occurs at one or more stages in the modelling process for a range of purposes, including promoting social learning<sup>9</sup> (Voinov et al., 2016; Slater et al., 2013; Voinov & Bousquet, 2010). Modelling is often a core component of IA methodologies to predict the value of a component of a system, forecast the value of a system in a given period, manage and make decisions under uncertainty, promote social learning and understand how a system works as influenced by different drivers (Kelly et al., 2013). While serving one or more of these purposes provides important information in the IA process, doing such can be time-consuming, and results may be affected by wrong assumptions, lack of input data, use of wrong indicators and unrealistic models (too simple or too complex) among others.

Sustainability Science (SS) is another integrative approach that ‘seeks to understand the fundamental character of interactions between nature and society’ (Kates, 2011) and find a solution to complex challenges including land use and livelihood change. Like IA, it considers the ecological and social aspects of the problem being studied across levels, space and time, deals with functional complexity, and is concerned with knowledge usable within both science and society. It is problem-focused, such that it employs advanced analytical-descriptive tools, such as the vulnerability analysis framework for environmental hazards, to better understand the problem and create a better solution (Turner II et al., 2003). From being problem-focused, it expanded to include transformational change and become solution-oriented (Clark & Dickson, 2003), and

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<sup>8</sup> An International Society of practitioners is advancing the methodologies and applications of this integrative framework (<https://www.tias-web.info/integrated-assessment/>)

<sup>9</sup> Defined as “achieving concerted action in complex and uncertain situations” (Ison & Watson, 2007), Reed et al. (2010) proposed three ways to assess that social learning has occurred: (1) change in understanding of the individuals involved; (2) change is situated within communities of practice; and (3) change through social interactions and processes between individuals within a social network. In the context of this thesis, a social network may include a community, organization, tribe and others. As in developed countries, social network and learning is influenced by culture, such as norms, traditions, ceremonies and hierarchies and others (Minato et al., 2012, Reed et al., 2010).

recently, as a user-oriented science emphasizing the use of knowledge to drive societal action (Kates, 2011).

While these two broad approaches follow the same non-linear process of integrating different aspects of a complex problem from multiple disciplines with the involvement of stakeholders to better understand a system and improve it, IA is considered most relevant for this thesis. It encompasses the key biophysical, environmental, socio-economic and cognitive aspects of land use and livelihood change. IA that integrates the diverse perceptions and interests of stakeholders can be used for system understanding around current land use and livelihoods condition and trends, to explore the land use and livelihood futures based on cognitive drivers such as their land use/crop preferences (Popp et al., 2017), to identify indicators or drivers that are most sensitive to a desired outcome or policy and their interrelationship (Reidsma et al., 2011), to study potential effects of an intervention (Giller et al., 2011), or to promote social learning (Kraker et al., 2011). The use of IA has been limited in upland watersheds in developing tropical countries to a few research studies in Africa, China and Thailand (Giller et al., 2011; Letcher et al., 2002; Merritt et al., 2004; Reidsma et al., 2011). Works in the late 1990s were focused on participatory approaches to watershed management (Rhoades, 1998), then econometric studies around land use and livelihood change (Jansen et al., 2006), while recent academic studies are into sophisticated remote sensing and GIS methods or models but lack depth into the reasoning behind the resulting maps (Malczewski, 2004). Hence, there is still a need to demonstrate the practical value of integrated approaches in developing countries, at least outside of research projects, particularly in upland watersheds where farmers' and other stakeholders' involvement is needed to bring about the appropriate understanding of, and change in, land use and livelihoods.

### 2.4.2 Analytical frameworks

There are many socio-ecological frameworks available that can be applied to land use and livelihoods (within an IA framing) to further understand the complex and dynamic interrelations of social, economic, ecological, political and cultural aspects across spatial and temporal scales (Binder et al., 2013; Petrosillo et al., 2015). Some of these are described briefly below and in Table 2.1.

**Driver-Pressure-State-Impact-Response (DPSIR)** is a conceptual framework that shows the cause-effect relationships between social and environmental systems (EUROSTAT, 1999). It is widely applied in problem framing, as well as in identifying, structuring, and analyzing information in coastal and marine management and decision making (Gari et al., 2015; Patrício et al., 2016). It is relevant to this thesis as it can provide an analytical framework for gathering and organizing indicators in a way that is useful and meaningful in the conceptualization of models (Zare et al., 2019). However, as this thesis builds on the perceptions of farmers and external stakeholders, DPSIR is not used as it cannot be used to consider the multiple attitudes



and perceptions of different stakeholders in an analysis (Svarstad et al., 2008), or socio-political aspects (Spangenberg et al., 2015). It also requires an external model that can assess the links between pressure-state change (Patrício et al., 2016).

**Table 2.1 Socio-ecological systems frameworks, some strengths, and weaknesses**

| Frameworks                            | Strengths                                                                                                                                                                                  | Weaknesses                                                                                                                                                                                                                                       | References                                                                                                |
|---------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------|
| Driver-Pressure-State-Impact-Response | <ul style="list-style-type: none"> <li>• Can provide a causal framework of key variables and their interactions</li> <li>• Can be effective in framing or structuring a problem</li> </ul> | <ul style="list-style-type: none"> <li>• Inability to integrate multiple perceptions of stakeholders and socio-political aspects in the analysis</li> <li>• Requires a separate model to assess the links between pressure and states</li> </ul> | Eurostat, 1999; Patrício et al., 2016; Spangenberg et al., 2015; Svarstad et al., 2015; Zare et al., 2019 |
| Vulnerability framework               | <ul style="list-style-type: none"> <li>• Flexible to use whether in natural or technological aspects</li> </ul>                                                                            | <ul style="list-style-type: none"> <li>• Does not consider access and power issues</li> </ul>                                                                                                                                                    | Islam and Lim, 2015; Turner II et al., 2003                                                               |
| Social-ecological system framework    | <ul style="list-style-type: none"> <li>• Considers interactions between stakeholders</li> </ul>                                                                                            | <ul style="list-style-type: none"> <li>• Inclination towards socio-economic and political aspects; missing ecology and natural systems</li> </ul>                                                                                                | Epstein et al., 2013; McGinnis and Ostrom, 2014; Ostrom 2009                                              |
| Land transition                       | <ul style="list-style-type: none"> <li>• Effective at using qualitative and narrative data</li> <li>• Can complement GIS-based land use change</li> </ul>                                  |                                                                                                                                                                                                                                                  | Foley et al., 2005; Lambin & Meyfroidt, 2010; Fox et al., 2014; van Noordwijk et al., 2014                |
| Sustainable livelihood approach       | <ul style="list-style-type: none"> <li>• Can explain the relationships and interactions of environmental, socio-economic, and governance in livelihoods</li> </ul>                         | <ul style="list-style-type: none"> <li>• Does not consider knowledge, politics, scale, dynamics and power relations in the analysis</li> </ul>                                                                                                   | Ashley and Carney, 1999; Chambers and Conway, 1991; McLean, 2015; Scoones, 2019                           |
| Millennium ecosystem assessment (MA)  | <ul style="list-style-type: none"> <li>• Can explain the links of ecosystem services (ES), livelihoods, and well-being</li> <li>• Can capture complexities in case studies</li> </ul>      | <ul style="list-style-type: none"> <li>• Cannot measure the links between ES, livelihoods, and well-being</li> <li>• Difficult to generalize in regional or national settings</li> </ul>                                                         | Abunge et al., 2013; MA, 2005; Sangha et al., 2011                                                        |

The **vulnerability framework** assesses the vulnerability of human-environment systems including the capacity of linkages within and without the system that influence such conditions in terms of hazards, sensitivity and resilience (Turner II et al., 2003). Most literature on this framework comes from ecology, disaster management, hazards, and especially climate change (Adger, 2006; Fekete et al., 2014; Islam & Lim, 2015). One advantage of this framework in

relation to this thesis is its flexibility, whether based on natural or technological aspects. However, it is not applied because it does not cover the issues of access and power within the larger contexts of socio-political and economic conditions (Islam & Lim, 2015). In this thesis, access to livelihood assets is key in the discussion and power-relations on farmers' interactions with external stakeholders.

The **social-ecological system framework** (SESF) builds on four levels of sub-systems (i.e. resource system, resource units, users, governance system) in analyzing their links and interactions (Ostrom, 2009). It builds on institutional analysis and development frameworks (Ostrom, 2011), which would make it useful for this thesis as it considers how actors interact in the 'action situation' to jointly affect outcomes that they value. One of the critiques of this framework is its leaning towards socio-economic and political aspects and not so much on ecology and natural systems (Epstein et al., 2013), to which McGinnis and Ostrom (2014) responded by adding ecological rules to the framework. It can accommodate an array of methods and data analysis but also poses a challenge in synthesis and data comparison (Partelow, 2018). While this thesis could have explored the feasibility of nesting SESF within the broader IA framework, it is not used because this thesis focuses more on factors influencing farmer decisions around land use and livelihoods and not so much on governance at an institutional level.

The three frameworks that are used in this study are land transition, sustainable livelihoods and Millennium Ecosystem and Assessment (MA). The **land transition** framework represents any change in land use systems from one state to another, for example, forest to agriculture. The timeline of land transition proposed by Foley et al. (2005) starts from natural ecosystems to frontier clearing, followed by subsistence to small-scale agriculture, and finally intensive agriculture, urbanization, and the declaration of remaining primary forests as watershed reserves or protected areas (Figure 2.1). Using this framework in this thesis is warranted as the framework can be used with qualitative and narrative data supported by the analysis of available secondary data (Chapter 4.3).

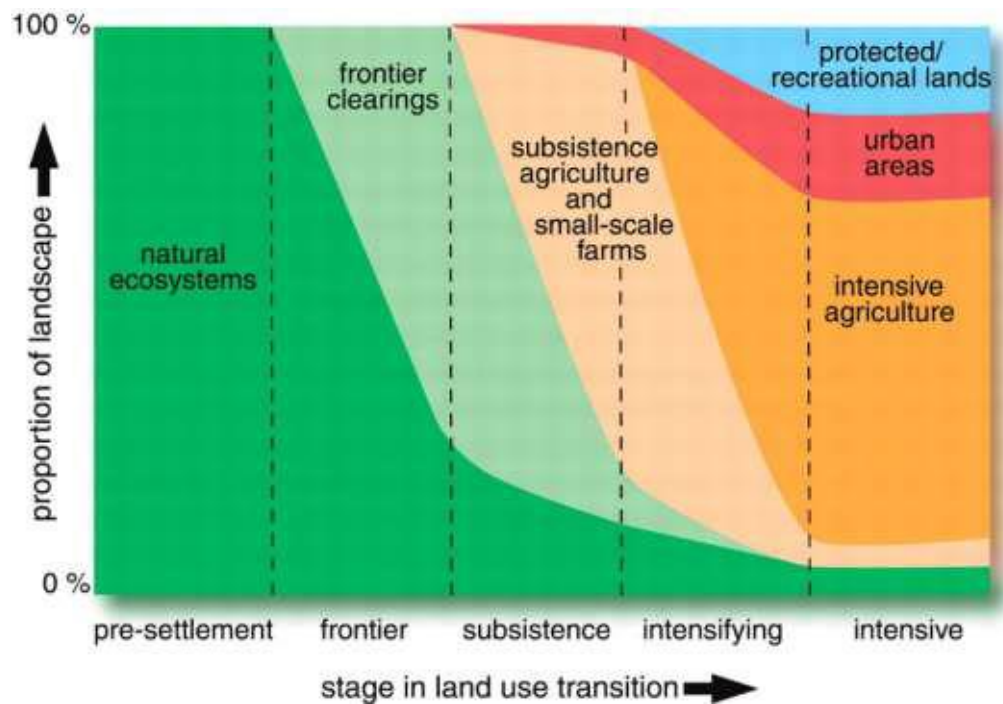


**Figure 2.1 A qualitative model of land use transition (Source: Foley et al., 2005)**

This framework is widely used to examine the forest transition of many Southeast Asian countries because of policy and economic incentives (Fox et al., 2014; Lambin & Meyfroidt, 2010; van Noordwijk et al., 2014). It has also been applied to drylands (Schulz et al., 2010), mountainous regions (Fox et al., 2014; Kim et al., 2015), urban areas (Zhu et al., 2014), and its relationship with climate change (Nobre et al., 2016), hydrology (Cuo et al., 2013), and ecosystem services (Balthazar et al., 2015). A research application that deserves more attention is to examine the social and local dynamics driving the transition using the framework.

The concept of land use transition emerged in the early 2000s and its application has been focused on global environmental change and sustainability paradigms. Lambin et al. (2003) claimed that past understandings of the causes of land use change are ‘dominated by simplification’ with population, poverty, and technology advancement as the main reasons. With a limited understanding of the biophysical characteristics of watersheds, particularly soil conditions (Ringrose-Voase et al., 2019), environment-related programs and policies funded by the government and international donors’ risk being ineffective. While capturing the dynamic and complex biophysical and socio-economic drivers of land use change is necessary (Foley et al., 2005; Lambin & Meyfroidt, 2010), it is equally important to consider specific human-environment conditions under which the drivers of change operate. These place-based, human-environment conditions can be addressed by conducting case studies that integrate contextual and driving factors, and farmers’ aspirations for land use and livelihoods as influenced by global factors, such as climate change and globalization.

The **Sustainable Livelihood Approach** has been widely used to reconcile the complexities and interactions of environmental, socio-economic and governance interventions (Figure 2.2) (Ashley & Carney, 1999; Chambers & Conway, 1991). It incorporates the effects of tangible (i.e. natural, physical, human, financial, social) and intangible (e.g. claims, access) capitals on livelihoods. This framework is used to examine farmers' livelihood assets in this thesis, particularly their natural (e.g. land health) and social (e.g. membership to FOs, access to extension) capitals, and to evaluate their benefits (Chapter 4.4). Incentives and other factors that drive their choices of livelihood strategies are also considered. These capitals are key reflections of rural development, but their attribution has to be situated in the context of the political economy of environmental and agrarian change (Hall et al., 2015). Scoones (2009) had earlier alluded to the need for the inclusion of knowledge, politics, scale and dynamics for a more rigorous analysis of livelihood perspectives. McLean (2015) also suggested considering power relations that encompass the relations between and among these capitals. Applying this framework to this thesis provides a critical understanding of how assets, vulnerabilities, and socio-economic and policy-institutional processes shape land use and livelihoods while allowing for the inherent uncertainties. Recent livelihood analyses have focused on examining the assets as affected by the uncertainty associated with climate variability and extremes (Saldajeno et al., 2012).

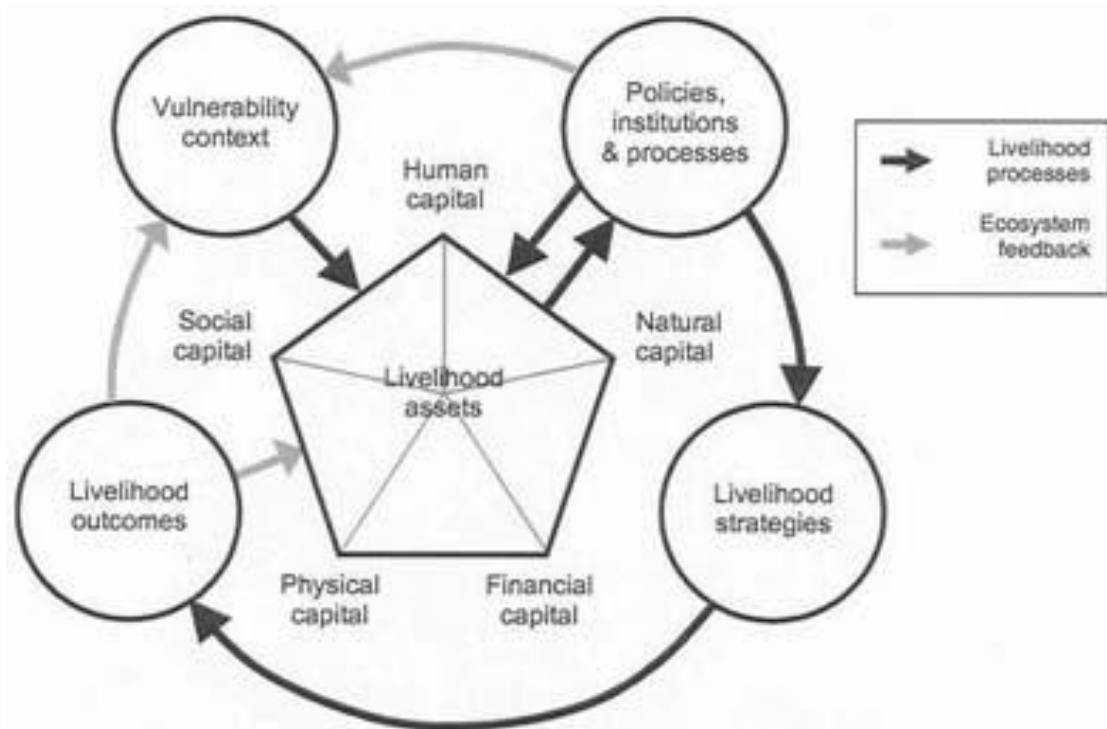


**Figure 2.2 The sustainable livelihood framework (Source: Chambers and Conway, 1991)**

The **Millennium Ecosystem Assessment (MA) framework** (2005) links spatial and temporal ecosystem services and their beneficiaries where associated benefits for well-being are considered (Figure 2.3) (MA, 2005). This tool was found valuable for qualitatively interpreting links between

ecosystem services and livelihoods and well-being, both of Aboriginal communities in Australia (Sangha et al., 2011) and a small-scale Kenyan coastal fishery (Abunge et al., 2013). However, the framework does not provide any method to measure the linkages. It is effective for case studies as it can capture complexities, but may be challenging to apply in regional or national settings (Sangha et al., 2011). In this thesis, this framework is used in Section 6.2 to assess the aspirations of farmers for their farming livelihood by using its five constituents of well-being – namely, freedom of choice and action, security, good health, material enough for a good life, and good social relations – and analyze how these influence their land use decisions and management practices in the context of biophysical, social and technical limitations, as suggested by Abunge et al. (2013).

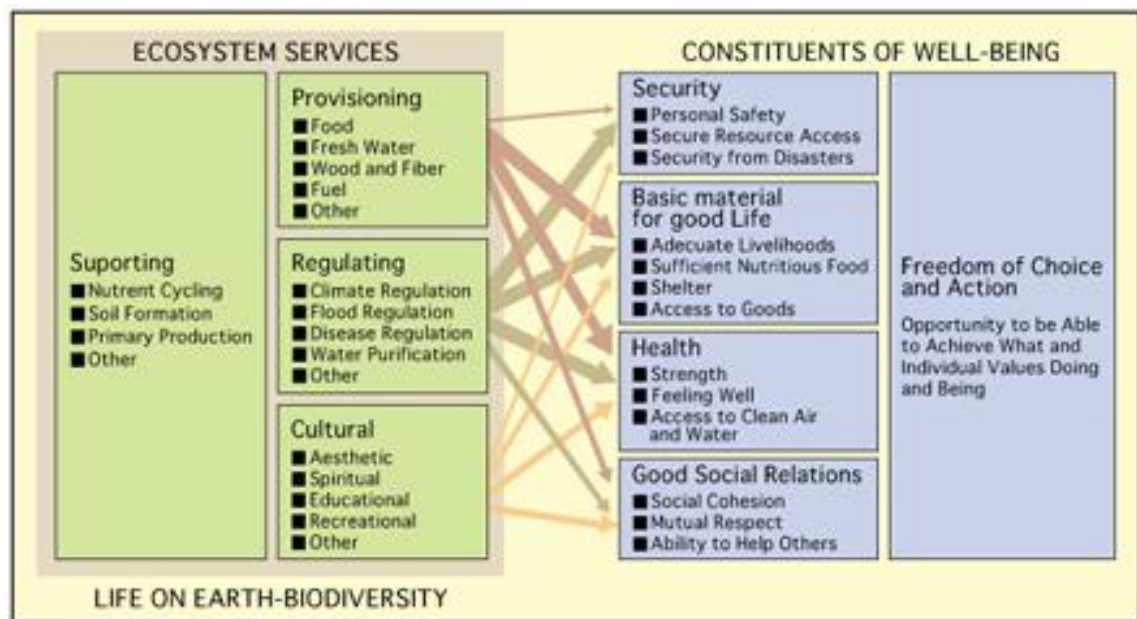


**Figure 2.3 The linkages between ecosystem services and well-being (Source: MA, 2005)**

For strategies aimed at sustainable land use and livelihood development to be effective, there is a need to include activities that are acceptable to and feasible for farmers and external stakeholders in the watershed. SLA's fundamental concepts of capabilities, assets, equity and sustainability are important (Chambers & Conway, 1991). As mentioned, the key roles of economic, political and agrarian change need to be integrated for better analysis (Hall et al., 2015). Adding the concepts of power relations and rights also enriches the understanding, as does that of aspirations for well-being (Appadurai, 2004; MA, 2005). It is argued that the interdependence and interactions between farmers and external stakeholders, their livelihood assets, and other driving forces influencing their decisions and actions require that they are understood and addressed in a combined way.

### 2.4.3 System models, tools, and analytical methods

Several models, tools and methods can be used in conjunction with the analytical frameworks in Section 2.4.1.

#### *System models and tools*

Several system modelling approaches exist including Coupled Component Models, Agent-Based Models, Bayesian networks, Systems Dynamics and Fuzzy Cognitive Mapping; the latter three network-based approaches are introduced in Table 2.2.

**Table 2.2 Some examples of systems models, their strengths and weaknesses**

| Frameworks              | Strengths                                                                                                                                                                                                                                                                                                                                        | Weaknesses                                                                                                                                                                                                      | References                                                                            |
|-------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------|
| Bayesian networks       | <ul style="list-style-type: none"> <li>• Can use qualitative and quantitative data from multiple sources</li> <li>• Deals with uncertainties</li> <li>• Can be integrated with conventional statistical analysis</li> <li>• Can be nested within SLA framework</li> <li>• Can engage the participation of stakeholders in the process</li> </ul> | <ul style="list-style-type: none"> <li>• Probabilistic links of variables may be difficult to understand for non-modelers</li> <li>• Does not deal with feedback loops, spatial or temporal dynamics</li> </ul> | Pollino and Henderson, 2010; Ticehurst et al., 2011; Merritt et al., 2016             |
| Systems Dynamics        | <ul style="list-style-type: none"> <li>• Can predict/simulate the dynamic behaviour of a system through time</li> <li>• Cause-effect and feedback loops</li> <li>• Can engage the participation of stakeholders in the process</li> </ul>                                                                                                        | <ul style="list-style-type: none"> <li>• Requires mathematical skills for the calculations</li> <li>• Calculations made may be difficult to understand for non-modelers</li> </ul>                              | Doyle and Ford, 1998; Forrester, 1994; Elsayah et al., 2017                           |
| Fuzzy Cognitive Mapping | <ul style="list-style-type: none"> <li>• Structures a complex problem and the reasons in a model</li> <li>• Represents both quantitative and qualitative data from stakeholders</li> <li>• Illustrates the effect of a factor changing in the whole system</li> <li>• Predicts the effect of a policy in a scenario analysis</li> </ul>          | <ul style="list-style-type: none"> <li>• Calculations made may be difficult to understand for non-modelers</li> <li>• Cannot make quantitative predictions in the scenario analysis</li> </ul>                  | Dickerson and Kosko, 1994; Ozesmi and Ozesmi, 2004 Papageorgiou and Kontagianni, 2012 |

Bayesian networks (BN) are graphical models that structure environmental and societal problems into cause-and-effect relationships to examine how a change in one variable affects the others in the network (Pollino & Henderson, 2010). Their joint probability distributions express the strength of the links quantitatively, as well as the degree of belief that is the stakeholder understanding of the strength of causality. BNs are valuable modelling tools for several reasons (Barton et al., 2012; Chen & Pollino, 2012; Kelly et al., 2013; Voinov & Bousquet, 2010). They can integrate multiple problems, interactions and outcomes, and analyze trade-offs. They can also

use both quantitative and qualitative data from different sources, and their simple graphical representations of the processes involved and the relationships between variables make them easily understood by stakeholders. Some BN limitations are that their probabilistic form may make it difficult for stakeholders to understand, and there are challenges in representing spatial or temporal dynamics. These challenges can be addressed by replicating variables to represent different spatial elements and times although this can make models complicated. Hamilton et al. (2015) provide principles of good BN practices.

BNs have been widely used in environmental and resource management (Barton et al., 2012). Ticehurst et al. (2011) used a BN to understand how different types of landholders in the Wimmera region in Victoria, Australia, would likely respond to different kinds of policy instruments for the management of native vegetation, and their motivations behind such decisions. They used the BN to complement conventional analyses to better explore farmer behaviour and achieved more robust results. Using SLA, Newton et al. (2006) developed a BN model to predict the impact of commercializing non-timber forest products (NTFP) on livelihoods, with cases from Mexico and Bolivia, and found that livelihood assets were affected by various environmental, socio-economic and political factors. The results enabled them to diagnose the causes of success and failure of commercializing NTFPs, as well as explore the potential impacts of policy options and other interventions on livelihoods. Similarly, Merritt et al. (2016) developed BN sub-models to demonstrate the impact of watershed development on livelihood capital and resilience, which they defined as the capacity of the households to survive several consecutive drought years. In the Philippines, the few application of BNs focused mostly on forestry applications (Baynes et al., 2011; Gregorio et al., 2015; Le et al., 2015).

In Systems Dynamics (SD), a conceptual description of a system leads to numerical equations of a model and simulations to understand its dynamic behaviour aimed to evaluate options for improvement (Forrester, 1994). It builds on feedback interactions, understanding the decision making process, and the use of computer-based technologies. This starts in the initial phase of conceptualization, converting a real-world situation into a conceptual model (Doyle & Ford, 1998). Thus, it combines with other frameworks or models in some applications to help organize that interface of the model with people in the real system, such as DPSIR (Zare et al., 2019) and agent-based modelling (Martin & Schlüter, 2015). Elsayah et al. (2017) suggested knowledge tools and guided how to effectively design and implement SD modelling. Although it was first developed to solve industrial problems, it is increasingly used in environmental modelling to understand complex water management issues (Kotir et al., 2016; Zare et al., 2019).

Like BN and SD, the Fuzzy Cognitive Mapping (FCM) is also a network model that structures multiple sources of knowledge about a problem from both experts and locals and captures these perceptions in a graphical representation to facilitate suitable interventions (or policy) (Özesmi &

Özesmi, 2004). The interrelations and interdependencies of concepts (or nodes) are illustrated, revealing how a change of one concept could affect the others. This visually describes the model's behaviour in a symbolic but simple way. Papageorgiou and Kontogianni (2012) summarized the FCM model design into identifying factors of an issue, clustering of factors into general concepts, estimating the strength of causal links in the model, and simulating the model. Methodologically, FCM has been hybridized with other approaches, such as the agent-based model (Giabbanelli et al., 2017), to benefit from the advantages of the other model. In terms of application, FCMs have been used in marine studies (Dickerson & Kosko, 1994; Papageorgiou & Kontogianni, 2012), in managing environmental conflict (Özesmi & Özesmi, 2004), and hunting problems in a protected area (Gray et al., 2015).

While all three models are similar in that they are aimed to improve systems understanding and promote social learning, the BN is considered as the most appropriate type of model to use in this thesis because it aims to understand the likely outcomes of decision making, which BNs can do more effectively than SD which focuses on the accuracy of the assumptions made in the model. The BN also allows the use of both quantitative and qualitative types of data, unlike SD and FCM that rely mainly on quantitative data. There are uncertainties involved in land use decision making, and BNs can provide information on their possible causes in the model which SD and FCM cannot do as well. The framework of Kelly et al. (2013) was used to guide selection of the most appropriate modelling approach in this thesis.

### ***Analytical methods***

For quantitative data, regression analysis in statistical modelling involves the estimation of the relationship between a dependent (or outcome) variable and one or more independent variables (or predictors) (Agarwal et al., 2002). Generalized linear modelling is an example of a regression analysis that extends the linear modelling framework to include variables that are not normally distributed. Aspinall (2004) used this method in developing a series of different 'best' models to reflect the drivers of land use change at different periods in Montana, USA. In coupling spatial analysis with regression techniques to project land use and land use change in the Mediterranean, Millington et al. (2007) emphasized the importance of available data on the performance of the statistical models used. For this thesis, regression modelling is used to identify significant factors influencing land use decisions and analyze their relationships with other factors.

Econometric modelling utilizes quantitative data to forecast economic events using techniques of statistical inference. The models are aimed to optimize the behaviour of economic agents (or factors). This technique has been increasingly used since the mid-1980s, including the use of econometric spatial modelling in the land market and land use change (Chomitz & Gray, 1996; Nelson & Geoghegan, 2002; Nelson & Hellerstein, 1997). Its wide application over the years has advanced economic land use models (Brady & Irwin, 2011) that consider heterogeneity (Irwin,



2010), especially with the availability of finer spatial information on the location and microeconomic data sets on individuals and households.

A household survey is commonly the data collection method used to collect numerical data that can be analyzed statistically, for example through regression and econometric modelling techniques. Among others, conducting a survey is labour-intensive and requires financial resources and sufficient time. In contrast, the qualitative approach to research is people-centered and is meant to understand concepts, their perceptions, and experiences to have in-depth insights into a problem. Data collection is commonly done through observation (Marshall & Rossman, 2016), key informant interviews (Legard et al., 2013; Kumar, 2011), focus groups (Krueger, 2015; Finch & Lewis, 2013; Morgan & Krueger, 1998) using PRA tools (Galudra et al., 2010; Chambers, 2007), and gathering of secondary information. While employing qualitative approaches can be flexible and provide natural and grounded insights, they can be associated with the issue of subjectivity, and, because of limited samples with specific contexts, it can be difficult to draw generalizations. To maximize the advantages and address the disadvantages of each approach, mixed methods can realise their integration value (Fielding, 2012). Hong (2014) and Small (2011) have suggested strategies to effectively design and implement mixed methods. This method has been used widely, including on land use and livelihood change in Latin America, Africa, and SEA (Cheong et al., 2011; Oestreicher et al., 2014; Toillier et al., 2011; Turner & Pham, 2015).

## **2.5 Synthesis**

The literature has revealed the challenges in understanding the continued transformation of land use and livelihoods in upland watersheds of developing countries in the tropics. The problem involves a complex web of biophysical, environmental and socio-economic factors – some controllable while others are not; some internal while others are external. These are closely interlinked so that a change in one aspect could affect the others and the whole watershed. Despite this, there has been limited application of an IA framework in upland watersheds, particularly in developing tropical countries.

The trend in rapid land use change towards agricultural expansion in the uplands can potentially help satisfy the rapidly growing demands for food from urban consumers. However, there is also good evidence that land resources and the watersheds in general may be suffering, as well as the smallholder farmers themselves and their farming livelihoods. Several causes have been suggested. Among these are combinations of site-specific natural biophysical conditions that are inherently limiting, such as acidic soil and steep slopes that are prone to soil erosion. But there are also contextual factors including farmers' inherent land-values, knowledge and aspirations, and their acquired limited livelihood capitals, not to mention lack of extension services and timely information resulting from political and institutional weaknesses and complexity. On the global

scale, climate change and globalization also intensify the impacts of these drivers of land use change and farming livelihoods.

Overcoming the complex and dynamic challenges around land use and livelihood change (i.e. agricultural expansion) requires an integrative approach. In particular, integrated assessment (IA) ensures that all key aspects are considered at different levels through space and time. Adapting the ten dimensions of integration of Hamilton et al. (2015) as the overarching framework has enabled this literature review to summarize the emerging areas for each dimension (Figure 2.4). Under key drivers, it was found that smallholder farmers have a key role in the ways lands are used and managed for their farming livelihoods but that their interactions with external stakeholders may also influence their decisions and actions. Policies and governance in watershed management may likewise determine these, particularly in how extension services are delivered to farmers and/or farmer livelihood capitals are improved. It was also shown that human and natural aspects around land use and livelihood change should be considered and integrated. This includes the farmers' needs and farming aspirations as well as the external stakeholders' land use priorities. The impacts of these preferences on land resources should be reflected in the analysis across the landscape, including downstream and beyond the watershed, and at different times (short-, medium-, and long-term). The interplay of farmers and external stakeholders in the upland watershed system requires simple integrative tools and methods to better understand how their values and priorities, demonstrated in their land use decisions and livelihood strategies, contribute to landscape transformation. The methodological aspects showed that integration should be interdisciplinary with integrative methods that use data from different sources. Figure 2.4 reveals that employing an IA framework can effectively identify the different dimensions of land use and livelihood change and provide an opportunity to explore the impacts of contextual factors and other drivers on farmers' land use decisions and actions.

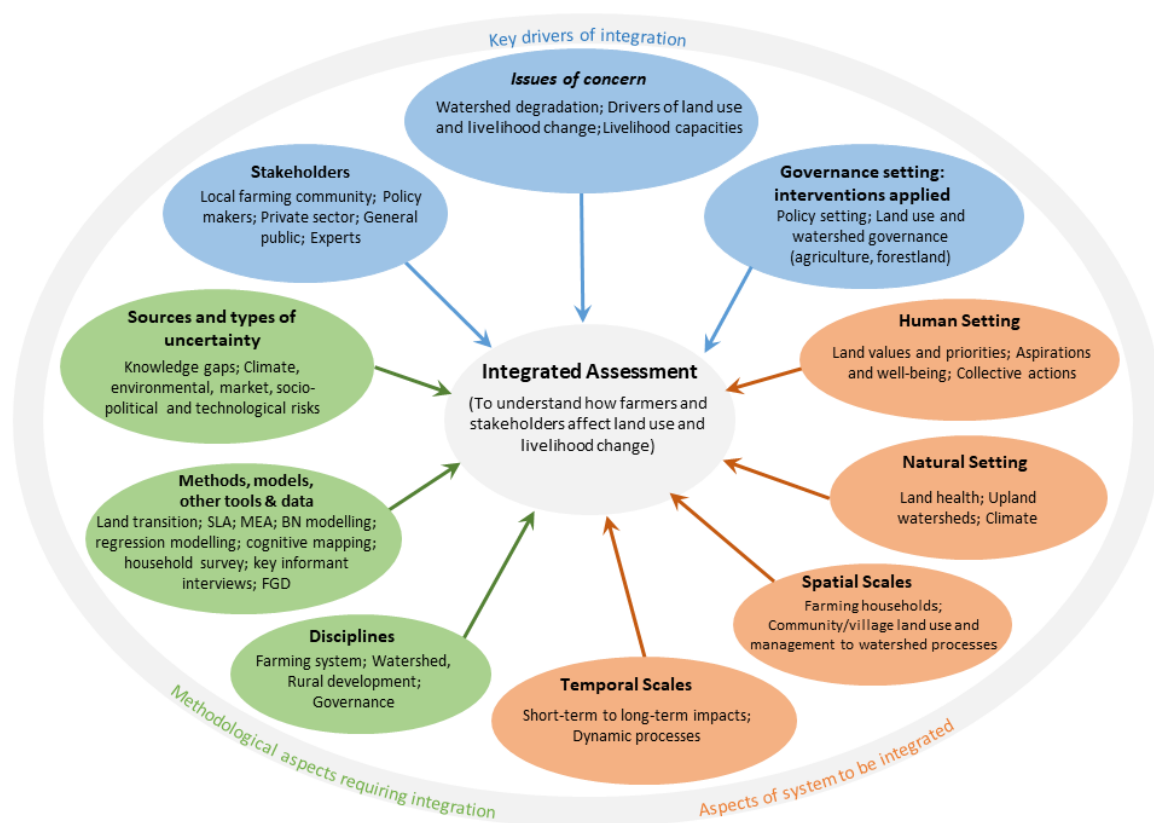


**Figure 2.4 The key dimensions of upland watersheds' land use and livelihoods integration in integrated assessment (adapted from Hamilton et al., 2015)**

## Chapter 3: Study Area and Methods

### 3.1 Introduction

As noted in Chapter 2, the literature has generally considered land use and livelihoods separately, largely with technical approaches for the former and economic analyses for the latter. This thesis uses methods and frameworks that can capture biophysical, environmental and socio-economic dimensions of land use and livelihoods and their interactions. This chapter describes the integrated assessment (IA) framework applied in this thesis and the mixed-methods case study approach used to collect data. The methods and analyses used in the thesis and their relation to the objectives and research questions are summarized in Table 3.1, and the number of participants is listed in Table 3.2. I conducted two fieldwork campaigns across six study villages for this thesis (Figure 3.1). The first was the scoping study (May-June 2015) to ‘map rapidly the key concepts underpinning a research area and the main sources and types of evidence available’ (Arksey & O'Malley, 2005). In that trip, data gaps and issues were identified, and that informed and prioritized my research questions from the initial thesis proposal. The second was the major fieldwork to gather primary data and answer my research questions (January to April 2016). In this chapter, Section 3.2 introduces the case study site, Section 3.3 presents the conceptual and methodological approach, Section 3.4 describes the data collection methods, and Section 3.5 discusses the analytical methods used to answer the research questions.

### 3.2 The Cabulig watershed

#### 3.2.1 Location and biophysical profile

The Cabulig watershed is in northern Mindanao, southern Philippines, and has a total land area of about 22,000 hectares (ha). It includes parts of three municipalities in Misamis Oriental province, with 70% of the area in the Municipality of Claveria (Figure 3.1). Misamis Oriental is one of five provinces making up Region<sup>10</sup> X (ten) – Northern Mindanao. The watershed is composed of 23 barangays or villages<sup>11,12</sup>. There are two extinct volcanos, namely Mt. Sumagaya and Mt. Balatucan rising to more than 2,000 metres above sea level (masl). The Cabulig River and its steep topography act as a physical barrier separating many villages (especially Malagana and Aposkahoy) from the main part of Claveria. The poor transport infrastructure, especially north

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<sup>10</sup> Regions are administrative groupings of provinces primarily used for national agencies to provide services at a more local level. Unlike provinces, most regions do not have an elected government.

<sup>11</sup> A barangay or village is the Philippines' smallest political administrative unit composed of sitios (i.e sub-villages).

<sup>12</sup> A Mayor administers a municipality and is supported by a Vice-Mayor who heads the Legislative Council, together with its eight Councillors; a Captain heads a barangay and is supported by seven Councillors and sitio leaders.

**Table 3.1 The objectives, research questions, and data collection methods (\* indicates the main data source used to address each research question)**

| Objectives                                                                                                  | Research questions                                                  | Methods                        | Analyses                                                                                                | Purpose                                                                                                                            |
|-------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------|--------------------------------|---------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------|
| Understand factors influencing farmers and other stakeholders' land use decisions and livelihood strategies | What are the current land use and livelihood conditions and trends? | Literature review              | Pre-and-colonial land use and livelihood changes, and events that caused these                          | Understand Cabulig's historical context, and identify initial trends                                                               |
|                                                                                                             |                                                                     | Household (HH) survey*         | Current land use, dominant crops, and livelihoods; crop-soil suitability; livelihood capital assessment | Examine land use and livelihood capitals variations within the watershed, and crop-soil suitability                                |
|                                                                                                             |                                                                     | Key informant interviews (KII) | Changes in land use, dominant crops, and livelihoods                                                    | Explore changes and variations over the years                                                                                      |
|                                                                                                             |                                                                     | Focus group                    | Changes on land use after World War II                                                                  | Construct a historical timeline of land use and livelihoods                                                                        |
|                                                                                                             | What are the drivers of land use and livelihood change?             | KII*                           | Drivers of land use and livelihoods condition and trends, and determinants of farmers' decisions        | Examine major drivers of land use and livelihoods condition and trends in Cabulig, and determinants of farmers' decisions          |
|                                                                                                             |                                                                     | Focus groups                   | Major drivers of land use and livelihood change                                                         |                                                                                                                                    |
|                                                                                                             |                                                                     | Case study                     | Governance (land use) and globalization through plantations (livelihood change)                         | Analyze the connection and interaction of land use and livelihood change as influenced by knowledge, space, dynamics, and politics |
|                                                                                                             | What is the future that farmers want, and how to achieve this?      | HH survey                      | Farmers' aspirations, preferred land uses and crop choices                                              | Understand farmers' aspirations and identify preferred land use and crop choices                                                   |
|                                                                                                             |                                                                     | Regression model               | Factors influencing farmers' willingness and capacity to change                                         | Identify factors influencing farmers' willingness and capacity to change                                                           |
|                                                                                                             |                                                                     | KII*                           | Farmers and external stakeholders' land use and crop preferences, and ways to achieve these             | Explore differences between land use and crop preferences of farmers with those of external stakeholders, and investigate options  |
|                                                                                                             |                                                                     | Cognitive mapping              | Factors influencing land use and crop preferences                                                       | Identify factors influencing land use and crop preferences and their interactions                                                  |

| Objectives                                                                                                                              | Research questions                                                                                   | Methods      | Analyses                                                                        | Purpose                                                                                                                        |
|-----------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------|--------------|---------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------|
| Investigate land use options that will likely be adopted by farmers and achieve environmentally and socio-economically desired outcomes | Are farmers willing to change to their land use? Do they have the capacity to adopt better land use? | HH survey*   | Significant variables to farmers' willingness and capacity to change land use   | Identify variables to populate Bayesian network (BN) and scenarios                                                             |
|                                                                                                                                         |                                                                                                      | KII*         | Cognitive maps of factors affecting farmers' willingness and capacity to change | Identify variables and their interactions to inform BN structures                                                              |
|                                                                                                                                         |                                                                                                      | Focus groups |                                                                                 |                                                                                                                                |
|                                                                                                                                         |                                                                                                      | BN modelling | Variables significant to farmers' willingness and capacity to change land use   | Understand the interaction of variables to farmers' willingness and capacity to change land use, and under different scenarios |

**Table 3.2 Total thesis participants**

| Participants                          | Gender |      | Total |
|---------------------------------------|--------|------|-------|
|                                       | Female | Male |       |
| Key informant interviews <sup>#</sup> | 24     | 43   | 67    |
| Farmer group discussions              | 6      | 14   | 20    |
| Farming household surveys*            | 140    | 464  | 604   |
| Total                                 |        |      | 691   |

<sup>#</sup>Includes the 43 interviews during the reconnaissance fieldwork (2015)

\*Includes the 104 farmers surveyed for the baseline study under the ACIAR Watershed Evaluation Project (2012-2014)



**Figure 3.1** The Cabulig River Watershed in northern Mindanao, the southern Philippines showing study villages (red dots), other villages (blue dots), and municipal town (yellow dot). Map data ©2019 Google.

of the river, limits farmers' access to most of the social services and economic activities from the mainland Claveria including markets to sell their produce. Climate has changed in Cabulig and surrounding regions with more frequent extreme events (e.g. Typhoons Sendong in 2011 and Pablo in 2012, drought in 2015-2016) and greater climate variability. The previously distinct wet and dry seasons of the watershed have become unreliable.

### 3.2.2 Socio-economic and cultural conditions

Cabulig is an important watershed in the region because of the various ecosystem services it provides such as land health for food production, water supply and flood mitigation. Farming is the primary livelihood of the Higaonon indigenous communities and mixed migrant farmers. The most commonly planted crop is corn, which provides an average income of \$332<sup>13</sup> per ha after a four-month growing season (Philippine Statistics Authority, 2019).

Over the past five years, rapid development has occurred in Cabulig. Land use systems have changed with the expansion and intensification of commercial crops (e.g. maize, vegetables, cassava) by wealthy migrant farmers and investors from Cagayan de Oro City (CDOC), and of plantation mono-crops such as pineapple, banana and tobacco, by multinational companies (e.g. Del Monte Philippines Inc., DOLE-Philippines, Phillip Morris Fortune Tobacco Corp.). These agribusiness activities have occurred at the same time as major infrastructure projects, which is likely to further intensify and expand agriculture. One of these major projects was the construction of a national road through the watershed connecting the region's capital of CDOC to Gingoog City north of the watershed. Another notable project was the construction of the Mindanao Energy Systems, Inc. hydroelectric power plant in the mid-stream of Cabulig, designed to combat power shortages in northern Mindanao.

There is little information to appraise how best to allocate land uses across the landscape or to guide the development of improved watershed management strategies. Not much has been written about land use allocation efforts, except for *The Cabulig Watershed Characterization/Profile* (DENR-CENRO, 2003). There was some development and extension work by World Agroforestry (ICRAF) through the Landcare Program<sup>14</sup> ten years ago, as well as by some government and non-government organizations (NGOs) (e.g. Balay Mindanaw). However, no effort has been made to understand the nature of the many natural and human-induced changes in Cabulig, including land use and livelihood change and development trends. This thesis is therefore

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<sup>13</sup> This is higher than the locally reported \$151 average income on corn in a household survey (2013-2014) in Cabulig conducted for the ACIAR Watershed Evaluation project, which was even higher compared in other similar maginal areas such as in Zamboanga Peninsula with an average net income of \$14.2 per ha – the lowest in the country in 2019 (Arcalas, 2021).

<sup>14</sup> Funded by ACIAR and the Agencia Española Cooperacion Internacional (AECI)



timely, considering that agricultural and forestry development projects are now moving into more remote regions such as the Cabulig Watershed. In 2011, Australia's Commonwealth Scientific and Industrial Research Organisation (CSIRO) led the implementation of the Australian Centre of International Agricultural Research (ACIAR) funded project on '*Watershed evaluation for sustainable use of sloping agricultural land in the southern Philippines (SMCN/2009/031)*' (the ACIAR Watershed Evaluation project) (ACIAR, 2014). Together with local research partners, CSIRO conducted digital land resource mapping to characterize Cabulig's soil attributes and produced suitability maps for a variety of crops and cropping systems<sup>15</sup>. This thesis extends the limited socio-economic analyses of ACIAR Watershed Evaluation project to gain an understanding of the relationships between environment and livelihood in the watershed, which should inform land use planning and decision making at farm, community and watershed scales.

### 3.2.3 Characteristics of studied villages and sampled respondents

To allow for comparative analysis of villages within Cabulig, six villages were chosen in different locations across the landscape (Table 3.3). Their selection was based on the following criteria: representative of different landforms, locations across the landscape, variety of land ownership and land use, and (from the researcher perspective) accessibility and safety. A total of 604 farmers were interviewed, which represents 29% of the total number of household from these villages (Table 3.4). They were selected through stratified random sampling, following the geographical sampling design of the ACIAR Watershed Evaluation project's digital soil mapping (Ringrose-Voase et al., 2019). The objective was to ensure all parts of the landscape is represented; in the case of the household survey, this ensured farmers living and cultivating in remote areas were sampled.

About 58% of the farmers interviewed were non-indigenous, while the remaining 42% belong to the Higaonon indigenous tribe. The average age of interviewees was 48. The mean household size was five, with little variation among households. Their education level was relatively low with about 56% having attained or finished elementary and 3% being unable to read or write. Their average land ownership was two ha, while the actual area cultivated was smaller at one ha.

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<sup>15</sup> Includes the Inabanga Watershed in Central Visayas

**Table 3.3 Comparative characteristics of research villages in Cabulig (2018)**

| Village     | Land area (ha)* | No of households (2010) | Major ethnicity | Land ownership                        | Major land use                                                      | Road access                                                                                                        | Presence of plantations                                  | Key features                                                            |
|-------------|-----------------|-------------------------|-----------------|---------------------------------------|---------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------|-------------------------------------------------------------------------|
| San Nicolas | 357             | 231                     | Dumagat**       | Forestland (riverbank); private lands | Coconut, cassava, agroforestry                                      | Difficult (paved road but long-and-winding down to the valley)                                                     | Contracted papaya growers by DMPI but flooded (Dec 2014) | Flood-prone; diverse livelihoods being close to Jasaan                  |
| Plaridel    | 992             | 267                     | Dumagat         | Forestland (riverbank); private lands | Corn, cassava, poultry farms, tree farms                            | Interior village; main roads maintained by DMPI and Minergy; poor interior roads                                   | Pineapple (DMPI); tobacco (Phillip Morris); Minergy HEPP | Higher-income due to Minergy; small rose gardens                        |
| Luna        | 299             | 251                     | Dumagat         | Forestland (riverbank); private lands | Vegetable gardens; agroforestry and forest (riverbank)              | Near/located in mainland Claveria; a good paved road along the highway; very difficult towards villages in Cabulig | Tobacco (Phillip Morris)                                 | Farming in the steep slopes towards Cabulig River                       |
| Mat-i       | 3008            | 537                     | Higaonon tribe  | CADC; CBFM; ARCs                      | Forest, abaca, grasslands, agroforestry, vegetables, irrigated rice | Good paved road along the highway; difficult interior roads                                                        | Banana plantation (Dole)                                 | Mt. Sumagaya; the centre of the Higaonon tribe; rose gardens            |
| Aposkahoy   | 4561            | 380                     | Higaonon tribe  | CADC; CBFM; ARCs                      | Forest; coffee, grasslands; agroforestry; vegetables                | Good paved road along the highway; difficult interior roads                                                        | Tobacco (Phillip Morris)                                 | Mt. Balatukan; Doal Nara Restoration Society                            |
| Malagana    | 1852            | 391                     | Higaonon tribe  | CADC; ARCs                            | Corn, rubber, agroforestry                                          | Interior village; poor roads                                                                                       | Pineapple (DMPI); Tobacco (Phillip Morris)               | Center of trading in Cabulig; wealthy farmers financing smaller farmers |

\*\*Migrants

**Table 3.4 Farming household's demographic and socio-economic characteristics in Cabulig (2016)**

| Characteristics            | Village     |          |      |       |           |          |        | Cabulig |
|----------------------------|-------------|----------|------|-------|-----------|----------|--------|---------|
|                            | San Nicolas | Plaridel | Luna | Mat-i | Aposkahoy | Malagana | Others |         |
| Total N                    | 93          | 104      | 75   | 89    | 102       | 114      | 27     | 604     |
| Age                        |             |          |      |       |           |          |        |         |
| Mean                       | 47          | 48       | 48   | 48    | 47        | 47       | 47     | 48      |
| Minimum                    | 21          | 20       | 21   | 25    | 20        | 26       | 25     | 20      |
| Maximum                    | 73          | 82       | 72   | 83    | 74        | 76       | 79     | 83      |
| Ethnicity (%)              |             |          |      |       |           |          |        |         |
| Higaonon                   | 26          | 55       | 79   | 33    | 36        | 38       | 18     | 42      |
| Non-Higaonon               | 74          | 45       | 21   | 67    | 64        | 62       | 85     | 58      |
| Mean household: size       | 5           | 5        | 5    | 5     | 5         | 5        | 5      | 5       |
| labour                     | 3           | 2        | 3    | 3     | 3         | 3        | 2      | 2       |
| Educational attainment (%) |             |          |      |       |           |          |        |         |
| Illiterate                 | 4           | 3        | 4    | 2     | -         | 4        | -      | 3       |
| Elementary                 | 66          | 45       | 75   | 63    | 58        | 45       | 33     | 56      |
| Secondary                  | 28          | 41       | 17   | 30    | 30        | 38       | 37     | 32      |
| Vocational                 | 1           | 2        | -    | -     | 3         | 2        | 4      | 1       |
| College                    | 1           | 9        | 4    | 4     | 9         | 12       | 19     | 7       |
| Post-graduate              | -           | -        | -    | -     | -         | -        | 7      | 0       |
| Landholdings (hectare)     |             |          |      |       |           |          |        |         |
| Mean                       | 1.66        | 3.10     | 2.21 | 2.03  | 1.91      | 2.62     | 4.45   | 2.22    |
| Minimum                    | 0.10        | 0.25     | 0.25 | 0.25  | 0.10      | 0.5      | 0.5    | 0.10    |
| Maximum                    | 33          | 15       | 33   | 4.75  | 11        | 10       | 16     | 33      |
| Cultivated farm (hectare)  |             |          |      |       |           |          |        |         |
| Mean                       | 1.22        | 1.46     | 1.01 | 1.18  | 1.09      | 1.51     | 3.16   | 1.24    |
| Minimum                    | 0.10        | 0.25     | 0.25 | 0.10  | 0.03      | 0.13     | 0.5    | 0.03    |
| Maximum                    | 14          | 6        | 5    | 3     | 6         | 9        | 14     | 14      |

### 3.2.4 Land and environmental governance

#### *Segregated agriculture and forest management*

The 1986 Philippine Constitution classifies land within watersheds as either alienable and disposable (A&D) lands or forestlands. The former is privately-held land, much of which is used for agriculture. The Department of Agriculture (DA) at the national and regional levels, and the Provincial, City or Municipal Agriculture's Office (MAO) at the local level,<sup>16</sup> are responsible for policies covering such agricultural land and for supporting the farmers managing it. The latter are State lands managed by the Department of Environment and Natural Resources (DENR). Ancestral lands that may be on either A&D or forestlands are managed by the National Commission on Indigenous Peoples (NCIP) and/or Agrarian Reform Communities under the Department of Agrarian Reform (DAR). In reality, the distinction between these land classes is

<sup>16</sup> Republic Act 7160 devolves the functions of the Department of Agriculture to the Provincial, City or Municipal Agriculture Office

no longer evident because agricultural production has encroached into forestlands, even on slopes above 50% and/or 1000 masl (both of which are designated for protection). Compounded by institutional issues, the opposing production-protection mandates of DA and DENR have affected the effectiveness of their extension service delivery to farmers, resulting in inappropriate land uses and/or poor farming practices (See Section 4.3.1).

### ***Agricultural and environmental extension service delivery***

The Republic Act 7160, otherwise known as the Local Government Code of 1991, imposed a decentralization system where ‘the local government units (LGUs) are given more powers, authority, responsibility, and resources’ to plan, decide and manage their affairs, and in the process, engage and strengthen its people and stakeholders in local development. It devolved<sup>17</sup> basic services and facilities from national government agencies (NGAs), including the extension delivery services of Agriculture and Environmental Protection Offices among others (e.g. health, social services, and maintenance of public works and highways). Figure 3.2 shows the functions and linkages of the local agriculture’s offices from the provincial down to city/municipal and village levels. Through ‘self-reliance’, the Code encouraged the MAOs through their Agricultural Technicians (ATs) to respond to agricultural issues that farmers face and involve farmers more directly in establishing priorities for agricultural development and extension support. In practice, although most rural households depend on the environment and natural resources for their livelihoods, the creation of the City or Municipal Environment and Natural Resources Office (MENRO) is only optional. Across the country, few LGUs have created this office, and some of those who have done so have not provided a regular staff or budget. With little manpower, technical capability, funding and facilities, such offices cannot support farmers as intended.

The current status of the MAO and MENRO in Cabulig reflects the country’s extension service delivery. Three LGUs manage different parts of Cabulig’s A&D land and forestlands, together with the NCIP and DAR. In Claveria Municipality, the MAO has only five regular staff, and 14 casual positions that are designated as ATs to provide extension services to farmers in 24 villages covering a total land of about 88,000 ha. With a total population of almost 50,000, each AT is expected to serve more than 5,000 farmers. Expectedly, a large number of these farmers are not reached by the limited number of ATs. While the municipality has created a MENRO, its staff are solely focused on implementing its solid waste management program.

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<sup>17</sup> Section 17 of the Code refers to devolution as the ‘act by which the national government confers power and authority upon the various LGUs to perform specific functions and responsibilities’.

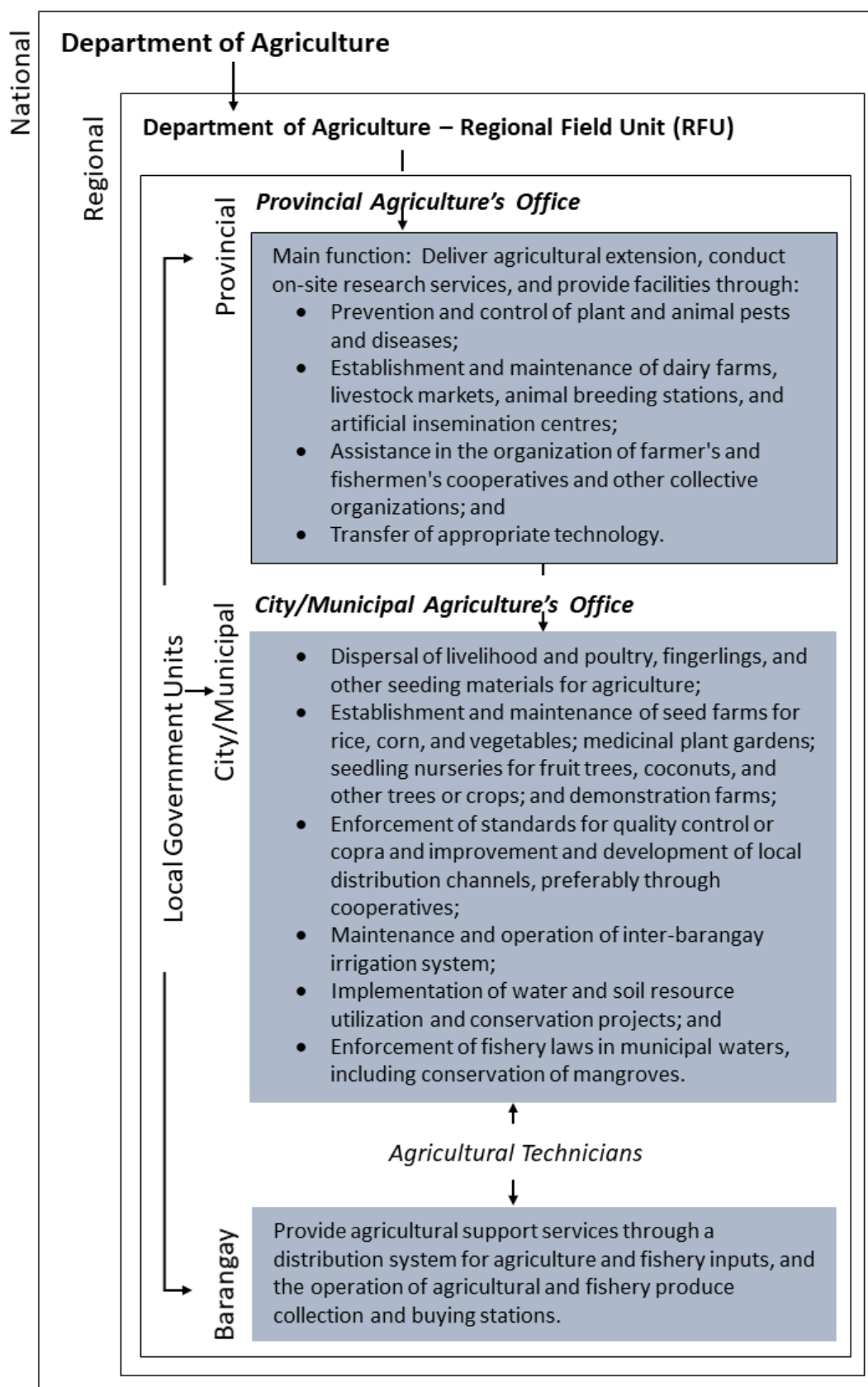


**Figure 3.2 The function and linkages of local agriculture's office, and their connection to the regional and national office of the Department of Agriculture**

## ***Watershed management***

The DENR is tasked with managing watersheds in the country through its River Basin Coordinating Office. However, this Office is based in Manila and expects its Community Environment and Natural Resources Officers to perform its task of *“rationalizing various research and development projects and advocate an integrated river basin management...”* (Executive Order 510, March 2006). In Cabulig, there is only one Watershed Focal Person assigned to manage the watershed; the forester is based in CDOC where they also manage other watersheds among other tasks such as facilitating LGUs in developing their Forest Land Use Plans.

As in DENR, other NGAs like DA, NCIP and DAR are also based in CDOC (Table 3.5). Their staff only travel to Cabulig when there are specific activities to be implemented related to their programs and projects. As they are not based in Cabulig, they have limited direct interactions with the farmers and other stakeholders and consequently limited influence on land use decisions and livelihood strategies. Only the LGUs are based in Cabulig, but, even so, their limited human and other resourcing affects the quality of land governance and delivery of effective extension services.

## ***3.3 Conceptual and methodological approach***

### ***3.3.1 Conceptual framework***

As stated in Chapter 1, the goal of this study was to integrate biophysical and socio-economic dimensions of land use and livelihood change in watershed management to investigate the value of involving farmers and external stakeholders in planning and decision making. I was interested in understanding the transformation, complexities and dynamics of land use and livelihoods in the Cabulig watershed by eliciting their knowledge and perceptions about these. This requires highly interactive relations with stakeholders to know the real context of the watershed. To achieve this, I conducted four interrelated research activities using rural development and climate change as the theoretical grounding for this study (Figure 3.3).

First, I sought to find out the current land use and livelihood conditions and trends in Cabulig. Sequentially, I used the concepts of land use transition (Foley et al., 2005) and a Sustainable Livelihoods Approach (Chambers & Conway, 1991) to understand the factors that influence the changes over the years. The SLA assesses the farmers' livelihood assets in terms of natural (land, trees), physical (equipment, vehicle), human (age, household labour), financial (income, sources of income), and social (access to extension services, access to credit) capitals. Farmers use these assets to strategize their farming and other livelihood activities (off-farm, non-farm), as well as respond to various changes. I combined the SLA and the FSA to investigate the interaction between land use and farming system changes, and livelihood diversification in Cabulig.

**Table 3.5 Government agencies influencing land use and management in Cabulig (2018)**

| Key agencies                                                      | Responsibilities                                                                                                                                                 | Local presence in Cabulig                                                                                     | Key activities                                                                                                                            |
|-------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------|
| Department of Agriculture – Region X                              | Promote agricultural development by providing a framework, public investments, and support services needed for domestic and export-oriented business enterprises | No (Based in Cagayan de Oro City [CDOC]); works closely with MAO)                                             | Convergence Program with DAR, DA, and DENR                                                                                                |
| Department of Environment and Natural Resources – Region X        | Manage and protect the country's environment and natural resources (EO 192)                                                                                      | No (Based in CDOC with CENRO Office in Gingoog City)                                                          | Community-Based Forest Management Program; National Greening Program; and Integrated Environment and Natural Resources Management Project |
| Department of Agrarian Reform – Region X <sup>#</sup>             | Holds and implements comprehensive and genuine agrarian reform                                                                                                   | Part-time (LGU created the Municipal Agrarian Reform Office manned by a regional staff that is based in CDOC) | Distributes agrarian lands and facilitates the Agrarian Reform Communities.                                                               |
| National Commission on Indigenous Peoples – Region X <sup>*</sup> | Promote and protect the rights and well-being of the ICCs/IPs and the recognition of their ancestral domains and rights                                          | No (Based in CDOC)                                                                                            | Facilitates IP communities and their application for land ownership                                                                       |
| Local Government Unit                                             | Provide for a more responsive and accountable local government structure                                                                                         | Yes                                                                                                           | Provides various projects to support farming livelihoods                                                                                  |

<sup>#</sup>Claveria has created its Municipal Agrarian Reform Office

<sup>\*</sup>Some LGUs have created Municipal Tribal Office but not in Claveria

Second, I examined the drivers that might influence the land use transition and livelihood diversification in Cabulig watershed. These drivers can be internal or external to the watershed. At the farm level, I studied the determinants influencing farmer decisions and strategies, which may evolve or change their land use and livelihoods. These determinants may be controllable or uncontrollable by the farmers. I used the SLA to explore the importance of access and claims to resources in framing these.

Third, I explored the farmers' life aspirations using the parameters of well-being (MA, 2005) and developed an understanding of how their current land use and livelihoods, and land ownership

shape these. I also developed cognitive maps using the Mental Modeler tool<sup>18</sup> to reconcile the land use aspirations of the farmers with the aims of the external stakeholders.

Finally, I invoked the Bayesian network (BN) modelling approach to identify the factors influencing farmers' willingness and capacity to adopt more appropriate land use for the environment. The developed models were used to explore possible interventions that concerned agencies could apply to better influence farmers' land use decisions and livelihood strategies.

### 3.3.2 Methodological framework

As mentioned in Chapter 2, an IA framework provided the methodological grounding for this thesis. Under this overarching framework, I employed a mixed-methods case study approach to triangulate different data types from diverse sources, combined with an instrumental case study to allow in-depth analysis (Zainal, 2007). The case study enabled the use of both objective methods of measurement and detailed probing of attitudes and backgrounds. I took the caution of Casley and Lury (1987) that the flexibility of a mixed-methods case study approach can provide challenges in choosing appropriate methods and data collection, and remained focused on gathering only the information that would be useful for the issues being studied.

Qualitative data collection, through key informant interview (KIIs) and focus groups, and analyses were used to develop an in-depth understanding of the land use and livelihood contexts in Cabulig watershed. This allowed examination of the factors leading to the current conditions. It also allowed appraisal regarding the suitability of these livelihoods and land use from a sustainability perspective. Meanwhile, quantitative data collection through household (HH) survey and analytical methods was used to provide measurement of farmer land uses and livelihoods, their distributions among the farming population in Cabulig and by village, and the extent of similarities of their preferred land use and crops with the external stakeholders.

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<sup>18</sup> Mental modeller is a modeling software that helps capture knowledge in a standardized format that can be used for scenario analysis (<http://www.mentalmodeler.org/>)



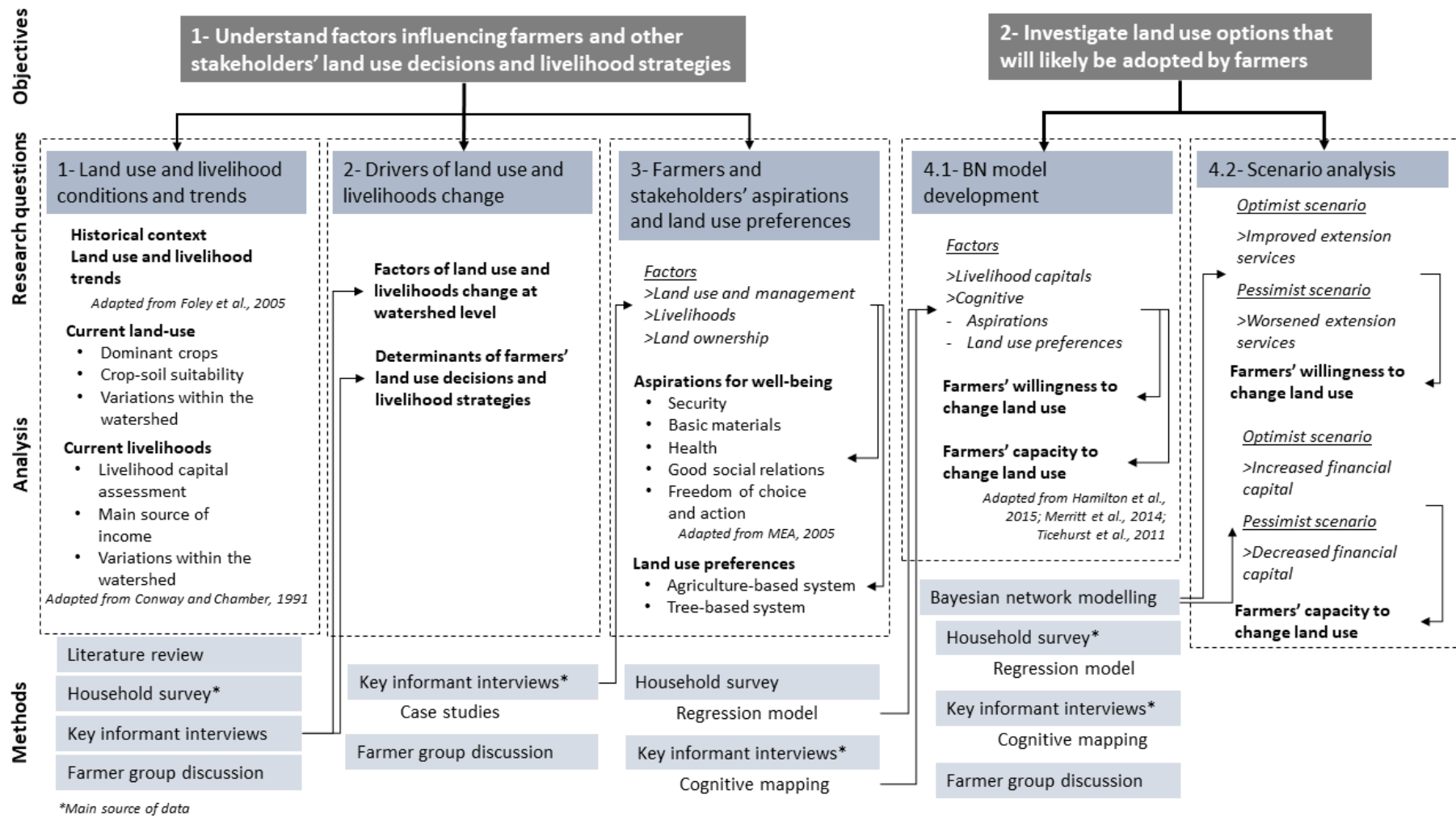


**Figure 3.3 Conceptual and methodological framework to understand factors influencing farmers' and external stakeholders' land use decisions and livelihood strategies in Cabulig watershed, southern Philippines.**

### **3.4 Data collection methods**

#### **3.4.1 Secondary data collection**

A desktop review of scientific and grey literature was conducted to establish the background theories and concepts for this research and to document the biophysical and socio-economic context of the case study site. Grey literature included policies, development plans and project reports located in the offices of government agencies, local NGOs and ICRAF's Claveria research station.

#### **3.4.2 Qualitative data collection and sampling methods**

##### ***In-depth interviews through key informant interviews (KII)***

In-depth KIIs use a semi-structured interview technique that allows person-to-person discussion at length about the topic of interest (Legard et al., 2013). The flexibility and ability of the researcher to probe encourages the key informants (KI) to explore their feelings, thoughts, and perspectives, and make the interview interactive and not one-sided. According to Kumar (2011), continued interactions between the researcher and the KIs through formal interviews and informal talks enable the latter to gain confidence, which leads to in-depth and generative conversations that can lead to the creation of new ideas or knowledge.

In this thesis, 67 KIs were interviewed including farmers, farmer leaders, policymakers, representatives from local and NGAs, NGOs and private companies, and researchers from academe and international research institutions. Interview questions were prepared and used to frame discussions with three KI groups: farmers, policymakers and researchers (Appendix 1). Forty three interviews with farmers were conducted during the reconnaissance fieldwork. In the main fieldwork, another 14 interviews were conducted with individual farmers whose lands had been sampled during the ACIAR Watershed Evaluation project soil survey activity. Six interviews were held with policy makers and the general public who had diverse experience and professional profiles with varying levels of knowledge of Cabulig's land uses and livelihoods, including the development and environmental policies and programs in the area. They were interviewed given their institutions' historical legacies and power relations. The final four interviews were with experts from government agencies, academe, or an international research organization.

Many of the questions were relevant to all KIs and were open-ended to allow for discussion and to encourage dialogue. Each interview was conducted face-to-face and lasted for approximately one hour. I noted their key ideas while audio recording allowed me to capture and revisit the full discussion; this helped the conversation to be free-flowing and not too formal. I conducted all the KIIs in the local dialect, transcribed the interviews, and translated them into English.

### ***Focus groups with farmers***

Focus group is a method used for gathering in-depth information by tapping the subjective opinions on a defined issue or topic of participants who have common characteristics in a ‘permissive, nonthreatening environment’ (Krueger, 2015). It encourages spontaneous discussion between the participants to frame, express and share their ideas and perceptions collectively (Finch & Lewis, 2013). The researcher’s role is to facilitate the discussion and listen and learn to the responses (Morgan & Krueger, 1998). These lines of communication and interactions generate important data and insights.

For this thesis, focus groups with farmer leaders were conducted to deepen my understanding of issues raised by the farmers during the HH survey and KIIs. In a one-day workshop using various Participatory Rural Appraisal (PRA)<sup>19</sup> methods (Galudra et al., 2010; Chambers, 2007), two focus groups were held with a total 20 farmer leaders from the six villages, six of them were female (see Table 3.2). The Barangay Government identified the participants based on the criteria given (e.g. gender, farmer leaders). These were conducted in the Barangay Halls of Mat-i for middle and upper villages (Luna, Mat-i, Aposkahoy, and Malagana), and in San Nicolas for villages downstream (San Nicolas and Plaridel). I prepared guide questions and used some PRA tools, such as historical mapping, participatory soil mapping, seasonal calendar, and Venn diagramming to generate discussion (Appendix 2). Outputs from the focus groups were used to construct a historical timeline that aimed to capture land use and livelihood changes. These events informed the framework of drivers responsible for land use and livelihood change. The timeline represents subjective views, but it incorporates local historical knowledge unobtainable elsewhere.

The local dialect (Visayan) was used during the six hour long discussion. The meeting started with an introduction of the focus group purpose and how the outputs of the day would be used in my thesis. Permission to use these outputs was obtained before the activities commenced. The focus groups were audio-recorded and I hired one of my enumerators from the HH survey to help me facilitate the discussions, including managing the recording and photographic documentation.

### ***Participant/field observation***

Marshall and Rossman (2016) considered participant/field observation as a ‘fundamental and highly important method in all qualitative inquiry’. It involves a systematic noting and recording of events taking place in the social setting under study. During fieldwork to conduct the HH surveys, KIIs and focus groups, I stayed in the villages and interacted with the farming

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<sup>19</sup> Considering limited time for fieldwork, the use of PRA tools enabled me to collect and analyze data through focus groups in terms of past, present and future situations on land use in Cabulig through the eyes of farmers.

community. I visited their farms and was able to observe aspects of their perceptions and aspirations, and their behaviours and interactions with other people from different social groups. With permission I also took photographs and videos of their land use and livelihood activities to enrich and complement the qualitative analysis. This helped me to refine and adapt the data collection methods and content as needed.

### 3.4.3 Quantitative data collection and sampling methods

While HH surveys can provide rich information when implemented properly, they can also be time consuming and expensive. I conducted a survey to provide a baseline data set that informs the thesis. I received help from six local enumerators<sup>20</sup> in conducting the survey. The survey gathered information about farmers' demographic and farm profile, soil knowledge, farm production, land use and management practices, livelihood assets, and factors that affect their farming and livelihoods (Appendix 3). Stratified random sampling was used to identify farmer interviewees to ensure that statistical conclusions from the survey are representative of the farming population in Cabulig as much as possible. *Geographic strata* were used to maximize the utility (for this thesis) of the socio-economic survey conducted for the ACIAR Watershed Evaluation project, and *social strata* were used to capture the representation of farmers based on socio-economic factors like wealth, ethnicity and gender, among others.

The interviews I undertook were conducted in the local dialect at places and at dates and times convenient to the farmers. The structured questionnaire consisted of six sections: (1) personal and household information; (2) soil knowledge, values and aspirations; (3) farm profile, land use and production; (4) livelihood assets; (5) credit, policy, and institutional support; and (6) drivers of change and risk perception of farming-based livelihoods. The locations of the interviewees' farms were recorded by GPS so that their data could be linked to biophysical data about their farms that was generated by the ACIAR soil survey. This was challenging for farms that were remote from the barangay center and required walking several kilometres across rugged terrain (Luna), through forests (Mat-i) or crossing the Cabulig River several times (San Nicolas). The advantage of the stratified random sampling approach was that we included farmers whose perceptions, aspirations and plights had not been heard before due to the extreme remoteness of their farms. This made the survey more inclusive and representative of the range of smallholder farmers in upland watersheds. I interviewed a total of 500 farmers across the six villages for this thesis<sup>21</sup>.

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<sup>20</sup> They were college graduates (e.g. Agriculture, Agroforestry, Education, Midwifery, and Accounting) from the studied villages recommended by the Barangay Captains. They had previously conducted household surveys as part of their thesis or in part-time work for the Government's Population Census.

<sup>21</sup> In Table 3.2, the 604 respondents includes these 500 that I interviewed as well as the 104 respondents from the ACIAR Watershed Evaluation project.

The raw data consists of the encoded farming HH survey data, and the original transcriptions and translated versions of the in-depth interviews with KIIs and focus groups. De-identified data sets were generated from these to ensure respondents' anonymity in the written thesis. Pseudonyms are used in this thesis when citing individuals' statements from the KIs (e.g. F01 for farmers, P01 for policymakers, R01 for experts) and for focus group participants. In the HH survey, the label for each respondent is the same as the label of the ACIAR Watershed Evaluation project's soil sampling site (e.g. 1621, 1622...). This coding allowed the household data to be matched with the biophysical information collected by the ACIAR Watershed Evaluation project that included maps of soil and terrain properties, as well as crop suitability.

### ***3.5 Data management and analysis methods***

#### **3.5.1 Data management**

Managing a good database enhances the whole scientific inquiry by ensuring the reliability of data, increasing its longevity, and creating opportunities for it to be shared and used again (Corti et al., 2014). Before data collection, I obtained ethical clearance from the ANU's Human Ethics office on how to secure consent and practice confidentiality and ethics during fieldwork<sup>22</sup>.

The data I collected were both in hardcopy and digital formats. The hardcopy data included the HH survey questionnaires, the focus group results and my field notes, as well as the photocopied villages profiles, reports, plans and other secondary documents. The digital data included the encoded HH survey questionnaires in Excel format and transcribed KIIs and focus group discussion in Word format. I also had a picture library. These digital data were organized by folder (i.e. HH survey, KIIs, Focus groups, Photos, Audios) according to the fieldwork during which they were collected (i.e. scoping fieldwork, major fieldwork).

#### **3.5.2 Qualitative analysis**

##### ***Content analysis***

I used content analysis in my literature review to systematically code, identify and analyze important themes or patterns (Hsieh & Shannon, 2005) of farmers' decision making, and changes in land use and livelihoods in upland watersheds. I used three different approaches to content analysis: (1) using the conventional approach, I derived the factors directly from the text data of

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<sup>22</sup> I secured approval from ICRAF (my institution), Municipal Mayors of Claveria and Jasaan, and the Barangay Captains of studied villages, including the military camp in Malagana. I also asked for oral consent from the farming households, written approval for the KIIs and focus group participants, and committed to them on the confidentiality of the information they shared. Likewise, my enumerators signed for agreements agreeing to keep confidential all that they heard.

journals and other publications, such as reports and plans during the data analysis; (2) with directed analysis, I developed initial codes in understanding my KII and focus group transcripts through NVIVO; and (3) using summative analysis, I looked at the factors or patterns and interpreted these concerning a particular content.

### ***Descriptive and explanatory analysis***

The KII and focus group transcriptions were input to NVIVO to help me manage and analyze the rich information gathered (Bazeley & Jackson, 2013). These descriptive accounts were analyzed using descriptive analysis. NVIVO helped me explore the data by indexing, tagging, labeling and sorting (i.e. similar, different) the ideas by themes or concepts (e.g. land use change, drivers of change) following these steps: detection, categorization and classification (Ritchie et al., 2013). The classified data also enabled me to establish typologies on relevant aspects, for example, the case study on the plantation economy involving a group of farmers. From the classified or synthesized data, I generated simple outputs like tables or diagrams to aid my analysis. In some cases, the frequency count was used to identify the importance of an idea based on its recurrence during the interview or discussion (e.g. KI). Finally, from the descriptive data and typologies, I used explanatory analysis to understand the meaning of the patterns and build explanations based on other studies (e.g. drivers of land use and livelihood changes, farming livelihood aspirations).

### ***Cognitive mapping***

The transcripts from the KIIs were used to develop the cognitive models of farmers' and external stakeholders' land use/crop decision making using the Mental Modeler tool (<http://www.mentalmodeler.org/>, accessed 8 December 2020). It allowed me to map the factors that influence their choices on what crops to grow to achieve their desired land use and livelihood aspirations. The maps of farmers were synthesised into one map which informed the BN structure to model farmers' willingness and capacity to change land use.

## **3.5.3 Quantitative analysis**

### ***Descriptive statistics***

The statistical software package SPSS was used to calculate descriptive statistics from the HH survey data, to characterize the farmer respondents, their households, and farm characteristics (e.g. age, education, available household labour, farm size). This included simple statistics such as frequency distribution, mean, median, and others.

## ***Land suitability mapping***

The ACIAR Watershed Evaluation project's land suitability maps adapted the FAO 1976 land suitability definitions, as follows:

1. **Highly suitable** – with no significant limitations to sustained application of the specified use.
2. **Suitable** – with minor limitations to the sustained application of the specified use that will cause a minor reduction of productivity or benefits and will not raise inputs above an acceptable level.
3. **Moderately suitable** – with major limitations to the sustained application of the specified use that reduce productivity or benefits and increase required inputs so that the overall benefit, although still attractive, will be significantly less than from Class 1 or 2 land.
4. **Marginally suitable** – with severe limitations to the sustained application of the specified use that so reduce productivity and benefits, or increase required inputs, that this expenditure will only be marginally justified.
5. **Unsuitable** – with such severe limitations that they preclude the sustained application of the specified use.

I applied this suitability rating from 1 (highly suitable) to 5 (unsuitable) for a variety of crops and cropping systems over the entire watershed. I extracted the suitability for each crop/cropping system at each household farm location that has been recorded by GPS. The suitability maps have a resolution of 20 metres (m), so the crop suitabilities at each farm were assessed by averaging over a circle with a radius of 80 m centered on the GPS location – i.e. over an area of 2 ha, which is the mean farm size. The objective was assessing the suitability of farmers' current and preferred crop choices based on biophysical evidence. The results provided farm-based evidence about the appropriateness of farmers' choices and the relevance of advice given by extension services.

## ***Regression analysis***

I used the generalized linear model capability in SPSS to handle complex data types and analyze the effect of multiple variables, including mixtures of categorical and continuous parameters. Using this regression analysis, I investigated the factors linked to farmers' willingness and capacity to change land use. A backward stepwise process was used to eliminate insignificant factors. The results of this analysis informed the structure of my BN models.

## ***Bayesian network modelling***

BN modelling enabled me to integrate the quantitative and qualitative data on important environmental, sociocultural and economic dimensions of land use and livelihoods from different sources. Qualitative data informed the variable selection and structure of the BN models; while

the quantitative household data was used to populate the models. I used the models to demonstrate the networks of factors that influence farmers' willingness and capacity to adopt their desired land use/crops using the SLA framework, as well as quantify their strengths by using a probability distribution. I also used these models to examine the likely outcomes of different scenarios to understand the impact of various interventions on the willingness and capacity of farmers to adopt their desired land use/crops. A simple overview of the BN approach is given in Box 3.1.



### Box 3.1 An overview of Bayesian networks

#### Probabilistic graphical model

A Bayesian network is a directed acyclic graph that seeks to represent a simplification of a complex reality. However, it does not have feedback loops. It uses Netica (software created by Norsys Software Corporation) in developing a model.

Its graphical models consist of a set of interconnected nodes or variables. Each node is described through its states (e.g. Figure A), which can either be quantitative or qualitative.

| Willingness to Change     |      |
|---------------------------|------|
| Not willing               | 57.1 |
| ChangeCropSameAgriculture | 17.9 |
| AgricultureToAgroforestry | 1.35 |
| AddTreesSameAgroforestry  | 11.4 |
| AgroforestryToAgriculture | 12.3 |

Figure A- The node “willingness to change” in Netica, with 5 states

Nodes are important concepts or variables, which can either be parents (purple in Figure B) or children (green in Figure B). The direction of the relationship or causal link between nodes starts from the tail of the arrow to the head, implying that the state at the tail of the arrow influences the condition of the node at the head of the arrow (Figure B).

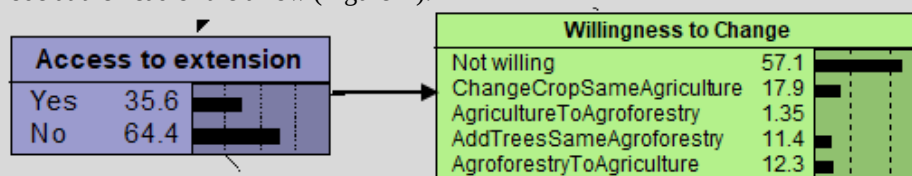


Figure B- The relationship between two nodes showing that “access to extension” (parent node) influences the state of “willingness to change” (child node)

The link between nodes through the arrow represents their probabilistic relationships or conditional dependencies. Through these relationships, inferences can be made between or among the nodes and how their interactions could achieve a particular outcome. Figure C shows a section of the probability distribution table for the variable “willingness to change”. The first line can be inferred as, “if farmers practising agriculture land use have access to extension but with low skills and soil with pH of 0 to 5, then there is a 51% probability that they would be willing to change land use, 38% probability they would change crops but maintain agriculture land use, 11% probability that they would convert agriculture to agroforestry, 0% probability that they would add trees and maintain agroforestry, and 0% probability that they would convert agroforestry to agriculture.

| Node: PreferredLU |                     |        |                |             |                           |                           | Apply                    | OK                        |
|-------------------|---------------------|--------|----------------|-------------|---------------------------|---------------------------|--------------------------|---------------------------|
| Chance            | % Probability       |        |                |             |                           |                           | Reset                    | Close                     |
| Current land-use  | Access to extension | Skills | Soil fertility | Not willing | ChangeCropSameAgricult... | AgricultureToAgroforestry | AddTreesSameAgroforestry | AgroforestryToAgriculture |
| Agriculture       | Yes                 | Low    | 0 to 5         | 50.942      | 37.914                    | 11.144                    | 1.59e-5                  | 1.59e-5                   |
| Agriculture       | Yes                 | Low    | >= 5           | 1.16e-3     | 99.996                    | 8.45e-4                   | 8.45e-4                  | 8.45e-4                   |
| Agriculture       | Yes                 | Medium | 0 to 5         | 41.176      | 52.941                    | 5.882                     | 5.88e-5                  | 5.88e-5                   |
| Agriculture       | Yes                 | Medium | >= 5           | 1.00e-3     | 99.996                    | 1.00e-3                   | 1.00e-3                  | 1.00e-3                   |

Figure C- An example section of the probability distribution table for the variable “willingness to change”

#### Further information

C. A. Pollino and C. Henderson (2010). Bayesian networks: A guide for their application in natural resource management and policy. Landscape Logic 2010

S. H. Chen and C. A. Pollino (2012). Good Practice in Bayesian Network Modelling. *Environmental Modelling & Software*, 37: 134-145.

Netica [https://www.norsys.com/tutorials/netica/secA/tut\\_A1.htm#WhatIsABayesNet](https://www.norsys.com/tutorials/netica/secA/tut_A1.htm#WhatIsABayesNet)

### 3.6 Synthesis

The research methodology used in this thesis is a comprehensive and systematic use of the IA framework using the triangulation of data from different methods (mixed-methods) and my reflective analysis of the Cabulig case. IA was selected as an approach to untangle the complex web of biophysical, environmental and socio-economic factors at farm, community and watershed levels involving farmers and external stakeholders, including policymakers and researchers. The need to understand the historical contexts of land use and livelihoods in Cabulig watershed, and how these influence the current conditions and future trends necessitated the application of a mixed-methods approach. The next chapter discusses these and demonstrates the relevance of ‘rigid’ random sampling in surveys and the triangulation method – especially for a subject such as land use and livelihood change over a period of 50 years or more.

A qualitative approach, particularly the KIIs, provided me relevant information from respondents who have first knowledge and understanding of the issues studied. They afforded insights on the major factors that affect their land use decisions and management practices at farm and watershed levels (see Chapter 5). On the other hand, quantitative methods, including the farming HH survey, enabled calculation of descriptive statistics and regression models to support the qualitative insights in Chapter 6 and the development of the BN models. I rigorously followed the stratified random sampling approach of the ACIAR Watershed Evaluation project for the geographic and social stratum in the design so as to ensure the unbiased selection of respondents. The pre-selected farmers were always surveyed, unless they refused to be interviewed, to ensure the data reflected the range of factors likely to influence land use and livelihood such as distance, accessibility and marketing of farm products. These data collection and analytical methods provided me sufficient and robust information to answer the research questions of the thesis.

The BN modelling discussed in Chapter 7 incorporates both qualitative and quantitative data in order to illustrate the relationships of factors influencing farmers’ willingness and capacity to change land use under different scenarios. The complementary strengths of the qualitative and quantitative approaches improved the credibility of the research findings. Whilst the rigor of data gathering is important, Yin (2014) has pointed out that ensuring a high-quality case study also hinges upon the researcher’s skills and expertise on the subject. In this regard, my participation in previous watershed management projects – albeit using different methods – served to enhance the validity and quality of the study.

# Chapter 4: Current land use and livelihood conditions and trends

## 4.1 Introduction

The current condition of upland watersheds in many tropical countries is determined by interweaving trends in land use change, land governance, livelihood opportunities, infrastructure development and climate change, among others (van Noordwijk et al., 2015). Meanwhile, farming households have to self-organize and respond to these complex changes, particularly the natural and socio-economic environments in which they operate (FAO, 1994), based on their livelihood resources (Chambers & Conway, 1991). This interaction forms the basis of the analyses in this Chapter which examines the changes in land use in Cabulig watershed, and variations in the livelihood strategies that the farming households employ to survive and/or prosper in response to land use changes (Table 4.1).

**Table 4.1 Overview of data sources, analyses and purposes in Sections 4.2-4.4. The main data source for each section is marked with an asterisk.**

| Data sources                                            | Analyses                                                                       | Purposes                                                                                                                      |
|---------------------------------------------------------|--------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------|
| <i>Section 4.2: Historical land use and livelihoods</i> |                                                                                |                                                                                                                               |
| Literature review*                                      | Pre-and-colonial land use and livelihood changes, and events that caused these | Understand Cabulig's historical context, and identify initial trends                                                          |
| <i>Section 4.3: Current land use and trends</i>         |                                                                                |                                                                                                                               |
| Farming household (HH) survey*                          | Current land use, production systems and dominant crops                        | Examine variations within villages                                                                                            |
| Key informant interviews (KII)                          | Changes in land use and dominant crops                                         | Explore changes and variations over the years                                                                                 |
| Focus groups                                            | Changes in land use after World War II (WWII)                                  | Summarize land use trends                                                                                                     |
| <i>Section 4.4: Current livelihoods and trends</i>      |                                                                                |                                                                                                                               |
| Farming HH survey*                                      | Current livelihood resources                                                   | Examine variations within villages                                                                                            |
| KIIs                                                    | Changes in livelihoods and strategies                                          | Explore access, claims, and control over livelihood capitals, and their influence on land use and other livelihood strategies |
| Focus groups                                            | Changes on livelihoods after WWII                                              | Summarize trends                                                                                                              |

The Chapter is structured as follows. Section 4.2 synthesizes historical land use and livelihoods of Cabulig's original dwellers. Section 4.3 examines existing land use and farmer production systems, as well as overall trends and the key rural development events underpinning them. Section 4.4 discusses the current livelihood strategies based on resource access and claims, and some important trends. In these sections, the interplay of context, scale and dynamics in understanding changing rural systems are analyzed and key findings are discussed in Section 4.5.

Section 4.6 provides the Chapter's conclusions. Direct quotes from participants in KIIs or focus groups are shown in italics throughout the Chapter.

## **4.2 Historical land use and livelihoods**

In the last century, Southeast Asia (SEA) has lost more forests and recorded the most extensive forest degradation and agricultural expansion of any region in the world (Lambin et al., 2006). Although countries like the Philippines have recently managed to increase forest cover at the national scale (FAO, 2016), the sustainability of many upland watersheds remains problematic because of the untenable rate of land use conversion resulting from population pressures and associated land degradation (Douglas, 2006). This land transformation is evident in the Cabulig watershed.

### **4.2.1 Cabulig and its mountain people (Pre-and-colonial period)**

The original dwellers of Cabulig watershed are the Higaonons<sup>23</sup>. Coming from northern Indo-China, their ancestors settled along the coast of Misamis Oriental. Following the invasions of the Majapahit Empire<sup>24</sup> (13th century) and Moros<sup>25</sup> (14th century), the tribe left the coast and retreated to the mountains (Lynch, 1955). When Spanish missionaries arrived in 1622, the Higaonons had largely established themselves as 'mountain people'. At that time, they were found across the north-central plateau of Mindanao island – from Macajalar Bay in the north down to the Pulangui River in the Municipality of Maramag, Bukidnon province. This includes the mountainous region of Misamis Oriental inland from the Municipalities of Claveria, Jasaan and Balingasag, part of which is the Cabulig watershed.

Lands, forests and rivers are the Higaonon's major means for livelihood. Their traditional farming system was mainly slash-and-burn. Activities from land clearing to harvesting were accompanied by appropriate rituals through the 'baylan' (ritualist) (Kenmore & Flinn, 1987). They planted maize extensively as their main food and source of cash and bartered maize in the villages for things that they did not have on the mountain (e.g. salt, dried fish, wine). They also planted rice but this was mostly for special occasions like weddings and rituals. Root crops, such as 'camote' (sweet potato), 'kamoteng-kahoy' (cassava), 'lutya' (taro) and 'ube' (yam) were planted as alternate food. Other crops grown around their dwellings were tobacco, betel nut trees, and coconut palms for smoking, chewing, and drinking alcohol, respectively. Animals, such as

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<sup>23</sup> The term Higaonon is a combination of the root words: 'higa' that means 'to live' or 'to lay in bed', 'gaon' meaning 'mountain', and 'onon', which means 'people'.

<sup>24</sup> Based on Java, the Majapahit Empire was one of the last major empires in Southeast Asia. Its scale of influence is still subject to many studies.

<sup>25</sup> Moros are the Muslim people from the north-central, southern and western parts of Mindanao, particularly Sulu and Zamboanga.

chickens and pigs, were raised for consumption, cash and rituals. The forest also provided alternate food like wild pigs and birds through hunting while rivers offered fish, crabs and shells. There were already small hamlets around Mt. Balatukan<sup>26</sup> under Governor-General Narciso Claveria (1844-49). In the 1880s, missionaries went to its interior areas and noticed the ‘grass plains mostly unsettled’, whereas the dwellers lived in scattered, isolated parts either in forest or rivers (Cole, 1956). While the exact period of migrants’ arrival is unknown, there were already Chinese merchants and Visayan migrants in Claveria by the 1890s. Collectively termed as ‘dumagats’<sup>27</sup>, they owned large farms where few Higaonons worked as labourers (Kenmore & Flinn, 1987). The Higaonons and migrants lived peacefully although did not deliberately mingle together. But as each wave of migrants arrived in search of lands, the Higaonons retreated to the forests in the Tabuk area<sup>28</sup> (Figure 3.1, Chapter 3).

Land ownership among Higaonons and migrants is an important factor that influenced land use transformation in Cabulig. Personal interviews with key informant (KI) farmers confirmed observations from the literature about the Higaonon’s perception of their lands’ value at that time (Kenmore & Flinn, 1987). They considered the lands where they lived and cultivated to be their property. Their slash-and-burn farming prompted them to move from one area in the forest to another. The land then was not a scarce resource. However, their traditional land use and livelihoods reduced in areal extent as migrants and the government’s interests in land for various economic and environmental purposes increased. Higaonons eventually ceased their traditional slash-and-burn practices and shifted to permanent cultivation of single plots of land.

#### **4.2.2 Land use and livelihood change (Post-colonial)**

To better understand the land use history in Cabulig, land use change is divided into three broad stages based on KI narratives and focus groups results. In addition to Rudel (2007) government-initiated (before 1970) and enterprise-driven land use changes (1970-2000), corporate-powered plantations emerged from the data collection as another stage (2000 onwards). There is some overlap between these stages but ‘enterprise-driven’, in the context of this thesis, refers to farmers changing from subsistence crops to cash crops (at least in part), perhaps with some involvement from government or corporations. This historical account describes the Cabulig watershed from the implementation of the Resettlement Policy (the 1950s) until 2016 during the data collection.

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<sup>26</sup> Cabulig was part of the fugitives’ (the ‘magahat’s) hideout. They founded the Municipality of Claveria then known as ‘Ticala’. They were still around the area up until 1950s.

<sup>27</sup> Dumagats (sea-dwellers) are migrants from nearby coastal areas and Visayas Islands.

<sup>28</sup> Claveria is divided into mainland Claveria, where the seat of the Municipality is located, and the Tabuk area, in which most of the Cabulig watershed is located.

## **Government-initiated change**

Migration: During the American period, the government promoted homesteads under the Public Land Act of 1903 (Pelzer, 1948). The aim was to relocate people from densely-populated areas in Luzon and Visayas to Mindanao, which at that time was still sparsely inhabited. The government used land ownership to entice migrants, allowing an individual to own 16 to 24 hectares (ha) of public land while a corporation could lease up to 1000 ha. Despite this, few individuals or corporations responded to the government intervention, although Kenmore and Flinn (1987) noted that there was spontaneous migration into Cabulig beginning in the 1920s. In 1954, the Resettlement Policy<sup>29</sup> was enacted, which benefitted mostly teachers and contract labourers from Luzon for infrastructure projects. Population growth over the first half of the 1900s was gradual but continuous.

One-third of the 604 farmers interviewed for this thesis and the associated ACIAR Watershed Evaluation project were more recent migrants: 43% of these migrants said that they migrated to Cabulig because their families/relatives summoned them. Other reasons migrants gave included good soil for farming livelihood (24%), religion (11%), employment on farms, logging, or plantations (7%), and opportunity to own land (5%). The majority of the farmers interviewed were non-Higaonon<sup>30</sup> (67%). Of the 20 focus group participants, only one was born in Cabulig (and he had migrant parents). The rest were dumagats; hence the Visayan dialect is widely spoken. Additional to the above literature, key informant interview (KII) and focus group participants noted that settlements and cultivations gradually replaced the grasslands and forests; also they said that other events, such as the eruption of Mt. Hibok-Hibok in Camiguin Island (1948-1953), brought some refugees to Cabulig.

Logging: In the mid-1920s, Claveria was still part of the Bukidnon Province. The Fortich family, an influential Spanish family from Bukidnon, started the logging industry in the lower region of Cabulig (Kenmore & Flinn, 1987). By securing permits from the government, other logging concessionaires began operating in the watershed; the de Lara and Poblete, Mindanao Plywood Company, and a Korean logging company were specifically mentioned by the informants and farmers during the discussions. Starting in Tamboboan, Luna and Lanise, the operations expanded to Mat-i, Aposkahoy and Malagana in the 1970s-80s. Migrants came to work for these companies. While some returned home, many stayed and became farmers. A farmer that I interviewed who was originally from Gingoog City shared the following: *“After the logging operation, we stayed and looked for lands to cultivate... we practiced slash-and-burn agriculture, and later planted*

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<sup>29</sup> Apart from lands, migrants were also provided transportation assistance.

<sup>30</sup> Actual migrants (part of the 43% who migrated to Cabulig as summoned by families or friends) and descendants of the spontaneous migrants.

*our area with permanent crops like coffee, root crops, banana and now vegetables.”* At that time, logging roads were constructed that gave others access to the lands and natural resources of Cabulig. Seeing the opportunity to earn, some locals also engaged in (illegal) logging. Some of the logging harvests supplied sawn timber for reconstructing buildings and houses in major towns and villages affected by World War Two (WWII).

Cattle-ranching: Cattle-ranching on the fringe of the lower Cabulig, particularly on the plateaus of Plaridel and Hinaplanan, expanded into the watershed from Bukidnon in the late-1920s where vast tracts of contiguous lands were converted into pasture lands by mostly absentee landowners. However, pasture lands declined during WWII when cattle were killed and consumed by both soldiers and people (Kenmore & Flinn, 1987). Unlike in Bukidnon, the industry did not flourish after the war, which was attributed to the poor road (limiting the access of cars and trucks) and the increasing presence of rebels from the 1960s onwards. Presently, there are few pasture lands left, and some of these are associated with conflicts. For example, the Higaonons have reclaimed the ‘Pastuhan’ (pastureland) in Plaridel asserting that the land was taken away from their ancestors. A farmer-leader commented: *“My forefathers lived in this area... they [the ranchers] befriended my forefathers. Then they put fences. Then there were guards in uniforms with guns. They pushed my forefathers to the ridge towards down the river... now, we are reclaiming this land for our children and their children.”* Although cattle-ranching ceased, farmers continue to raise carabaos and cows for field cultivation and horses for transportation. These work animals are also a good source of income that supports more than just the farmers’ basic needs. A farmer in Aposkahoy shared: *“My friends often ask me how I sent my children to private schools in Cagayan de Oro City (CDOC). The doctor from a private hospital in the City also asked how I paid my wife’s bill in cash during her operation... my carabaos and cows helped me through all these expenses.”*

Infrastructure projects: There was a demand for labourers to work on the government’s infrastructure projects in Mindanao after WWII, including the road construction that connected Claveria to CDOC via Jasaan. The settlements and farm cultivations of workers and their families were concentrated in contiguous patches in areas that subsequently developed into major villages downstream, such as Natubo in Jasaan, and Plaridel and Hinaplanan in Claveria (Garrity & Agustin, 1995). In the 1990s, the road to CDOC via Villanueva was constructed, which shortened the travel time. Recently, this road was connected to Gingoog City transecting the heart of Cabulig watershed. Meanwhile, the Mindanao Energy Systems Inc.’s (Minergy) mini hydroelectric power plant (HEPP)<sup>31</sup> in Plaridel began operation in 2012 to meet the energy demand of the region.

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<sup>31</sup> Meant to produce 9.21 MW of hydropower electricity for northern Mindanao.

## ***Enterprise-driven***

This phase is the transition between the government-dominated period and the current influence of corporations. Both government and corporations potentially played some role in this phase through the delivery of extension services to individual farmers.

Coffee: After WWII, the government conducted a nationwide production of various key crops as part of its rehabilitation program. In 1952, coffee was introduced in Claveria through the Settlement Farm School<sup>32</sup> (Kenmore & Flinn, 1987). Propagated seedlings were distributed to households through the students. In mid-stream, particularly in the sloping lands of Luna and Mat-i towards Cabulig, the Arabica variety became the understorey crop of forest trees. In relatively flatter areas, this was planted in wider spacing to intercrop with other annuals. A woman-farmer from Luna shared: *“As far as I can remember since we migrated here in 1962, this area was covered with coffee. I saw lots of coffee here.”* However, Excelsa and Robusta varieties replaced the Arabica because of rust disease. Although the market prices of these varieties were not as high as the Arabica, they were widely planted at that time, and old coffee stands exist on many farms today.

Coconut: Coconut was among the crops promoted by the government for the rehabilitation of the economy after WWII, which made the Philippines a major source. Coconuts replaced the downstream forests and were mostly used for copra production<sup>33</sup>. Even the steep slopes along the Cabulig River, particularly in Natubo and San Nicolas of Jasaan, were planted with coconuts. A caretaker-farmer from San Nicolas shared: *“When the coffee was so expensive, my parents transferred to Aposkahoy [to grow coffee there]. Our landlord asked if I wanted to go there. I said I will stay... So I continued planting coconuts in this five-hectare sloping land.”*

Irrigated rice: In the 1960s, the migrants from Bohol Island brought irrigated rice production to the narrow strips of lowland along Mat-i River. They developed an irrigation system manually through ‘hunglos’ or ‘pahina’, a type of collective formed to build community infrastructure. A farmer-politician from Mat-i shared: *“I was very young when the first irrigation was established here. It was in the 1960s. We volunteered, particularly those whose areas will be served by the irrigation, whether with rice fields or without. We developed it by hand.”* Rice production at that time was mainly for consumption. Some farmers started to produce a surplus when the National Irrigation Administration improved the irrigation system beginning in the 1980s. This was expanded in Aposkahoy to encourage irrigated rice production in Cabulig.

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<sup>32</sup> Now known as the University of Science and Technology in Southern Philippines-Claveria Campus (formerly MOSCAT)

<sup>33</sup> Copra is the dried meat of coconut fruits, from which coconut oil is extracted. Drying can be done by smoke or sun drying.



Tomato: The tomato industry in Claveria started in 1974 when the Philippine Packing Corporation conducted on-farm experiments. When some growers became successful ‘millionaires’<sup>34</sup>, many farmers shifted from the traditional crops into tomato. There was high motivation to change crops due to the large returns from good production and ‘jackpot’ prices at the market, especially with the regular typhoons in Luzon. Even though the production costs were high, the profit they earned was still greater than that from growing maize or rice. In the 1980s-90s, Claveria was dubbed the ‘tomato bowl’ of the country. Tomato was widely planted in the villages along the edge of mainland Claveria, including Panampawan, Luna and Mat-i, and then spread into Aposkahoy and Malagana. It was so widely planted that land renting became common and, consequently, the hiring of farm labour increased. Big farmers hired locals as well as migrants from the Visayan Islands to work on tomato farms. A migrant-farmer from Mat-i shared: *“Because of poverty I left Leyte Island to venture. I arrived here in 1979 to work on a tomato farm. I was only 20 and single. I received PhP1,000<sup>35</sup> per month, free food, and accommodation”*. While some farmers experienced jackpots, others failed because they did not use the correct technology, have the negotiating skills needed to obtain profitable prices, or possess the connections in CDOC, Manila or other big cities where the demand was. In the early 1990s, tomato leaf curl and bacterial wilt diseases wiped out most of the tomato farms. Presently, only a few big farmers engage in tomato production although they do enjoy good profits.

Cassava: In 1978, the Philippine Agro-Tech Company introduced the Java Brown cassava variety in Claveria. The company technicians provided seminars to interested growers about the new crop and its management. The variety was not meant for human consumption but industrial use, such as laundry starch and industrial paste. After harvesting, the cassava was peeled, chopped and sun-dried. The chipped cassava was then sold in nearby companies. Nowadays, many lowland farmers still prefer to plant cassava because of its relatively good income and minimal management requirements. New hybrid varieties (e.g. Ryon) are widely planted in downstream villages, particularly in Hinaplanan and Plaridel.

Yellow corn: Yellow corn became a viable crop after the tomato farms were affected by leaf curl and bacterial wilt diseases. In the 1980s, private seed companies such as Monsanto, Syngenta, Pioneer, and others started to proliferate in Cabulig. Like tomato, it requires greater financial capital than the traditional white corn and so it is mostly grown by larger farmers.

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<sup>34</sup> Some farmers did so well in tomato farming that they literally became instant millionaires that enabled them to buy trucks, build big houses, and expand farming.

<sup>35</sup> USD20 (1USD=PhP50)

## ***Corporate plantations***

Pineapple: In the early 2000s, pineapple plantations were initiated in lower Claveria. At that time, there was a high demand for fruit cocktail products that could not be met by Del Monte Philippines Inc.'s (DMPI) plantations in Bukidnon Province. Hence, the Company expanded into neighboring provinces including Misamis Oriental. Most of the plantations were (and continue to be) managed by the Company itself where they rented land from farmers for 15 to 25 years. Some plantations were (and remain) sub-contracted by farmers, with the Company providing them the inputs and technology. Their plantations were commonly located in lower-middle Cabulig, particularly in Plaridel and Hinaplanan, and around the fringes of Luna. In 2016, the Company expanded its plantation, adding 2,000 ha in Claveria, particularly in Cabulig. The company has sought to build a good standing in these villages over the years by implementing various community activities (e.g. women's training, livelihood projects).

Banana: In early 2000, there was an increase in the global market demand for upland bananas. Several multinational companies (MNCs) engaged in banana plantations expanded from Davao Province to Bukidnon. One of these, Dole-Skyland Philippines, Inc. expanded into Claveria around 2010. Its plantation station is located in Mat-i, with smaller plantations in lower mainland Claveria. By 2013, they had expanded and cultivated the grasslands on the flat hilltops and the mid-slopes towards Mt. Sumagaya. Many farmers grow bananas because of their good income and it is one of the major crops in San Nicolas.

Tobacco: In 2012, Phillip Morris Tobacco and Fortune Corp. Inc. (PMTFCI) established its first Virginia tobacco experimental farm in Anei, mainland Claveria, followed by a pre-commercialization phase in 2013 involving farmers. Since the commercialization phase started in 2014, it has rapidly expanded in Cabulig. Many farmers grow tobacco because of the production assistance the Company provides, including seedlings and fertilizers through loans. Although the profit is not as high as cassava, tomatoes and others, the farmers receive weekly payments to support their daily needs (e.g. food, education). The production risks to the farmers, which are associated with climate variability, are lessened because of the Company's policy to adjust the loan based on crop damage. Currently, many farmers favour the Company over other MNCs because of its seemingly good production arrangements and social relationships.

## ***4.3 Current land use and trends***

The historical context and dynamics in Cabulig described in the previous section provide an understanding of the upland watershed's land use and livelihoods transformation. Analyzing these local-scale changes over a long timescale helps uncover general sources of change that provide context to current land use and livelihoods, and the prediction of potential new changes. This section synthesizes the current major land uses and production systems in Cabulig watershed. It

analyzes the suitability of the dominant crops in the studied villages to soil and other biophysical characteristics like slope. It also discusses land use trends over the century and potential land uses in the coming years. The farming household (HH) survey is the main source of data for this section, substantiated by the qualitative data from KIIs and focus groups.

### 4.3.1 Land use and vegetation

The most reliable land use/land cover map available for Cabulig was produced by the Department of Environment and Natural Resources (DENR) in 2010. It defines four main types of land use: forest, agricultural land, grasslands, and ‘others’ (i.e. built-up areas, fishponds and mangroves; Figure 4.1). The KIIs and focus groups indicate that there has been forest conversion since this map was produced, even accounting for the uncertainty associated with the classification of forested landscapes.

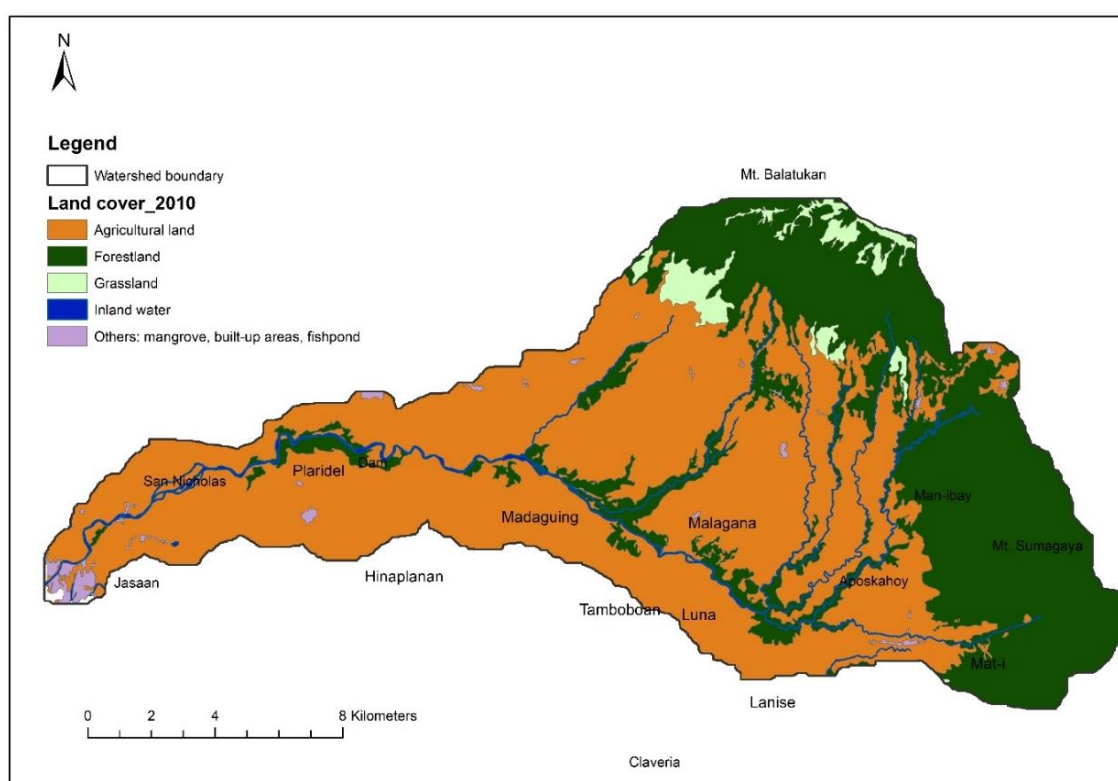


**Figure 4.1 Land uses in Cabulig watershed, Misamis Oriental (2010). (Adapted from DENR data)**

The cultivated agricultural lands now cover most of the landscape with three major types of land use: arable land, permanent crops, and others. Most arable land, which covers the relatively flatter areas of the agricultural lands, is cultivated for annual crops including maize, cassava and vegetables, that are replanted after each harvest. Land mapped as permanent tree crops or perennials is cultivated for banana, coffee, coconuts and rubber. These lands also include flowering shrubs, fruit trees and cashew nut trees, but excludes trees grown on farms for wood or timber. Other agricultural lands include pastures and barren lands.

Cultivated forestlands are often the sloping areas along the riverbanks and creeks. These areas are still forested with patches cultivated for agricultural crops (e.g. corn, root crops) and/or perennials (e.g. abaca). Conversely, uncultivated forestlands are commonly found above 1000 metres (m). These lands are dominated by species of Narra (*Pterocarpus indicus*), lauian (*Shorea sp.*), dipterocarps (*Dipterocarpus philippinensis*, *D. grandifloras*), and other premium hardwood indigenous trees. Meanwhile, the grasslands are dominated by the grass species cogon (*Imperata cylindrical*) whereas the shrublands are covered with wild sunflower (*Tithonia diversifolia*).

The remaining lands, not agricultural, forest or grasslands, are built-up areas, roads, the mangrove forest downstream and others. Note that the expansion of plantation crops (i.e. pineapple, banana, tobacco) in the watershed beginning 2010 is not reflected in the map (Figure 4.1). As of 2018, corporate plantations now cover 4,520 ha (Table 4.2) in Claveria of which about 60% are within the Cabulig watershed. To ensure agricultural crop production for food security, the Sangguniang Bayan (Municipal Legislative) Resolution No. 51-2018<sup>36</sup> through the approved Comprehensive Land Use Plan (2016-2026) was enacted to regulate each plantation's expansion up to only 1,000 ha. Nonetheless, the PMTFCI will need about 2,500 ha to achieve four million kilograms of tobacco needed to meet its facility's maximum capacity (Galvez, 2015)<sup>37</sup>. DMPI will add another 5,000 ha to the existing 23,000 ha pineapple plantation in northern Mindanao, 2,000 ha of which will be in Claveria (Icamina, 2016).

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<sup>36</sup> Strengthened by Sangguniang Panlalawigan (Provincial Legislative) Resolution No. 429-2018

<sup>37</sup> Once fully operational, the Claveria facility will add 5-8% of the country's tobacco production

**Table 4.2 Land coverage of corporate plantations in Claveria, Misamis Oriental (2018)**

| Plantation companies                     | Station                   | Covered villages in Claveria                                                                                                                                          | Area coverage (est ha) | Covered villages in Cabulig                                                                                                                                                                                                  | Area coverage within Cabulig (est ha) |
|------------------------------------------|---------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------|
| Del Monte Philippines, Inc.              | Manolo Fortich, Bukidnon* | (Out-grower)<br>Luna, Rizal, Hinaplanan, Anei, Patrocenio, Plaridel, Kalawitan, Cabacungan, Gumaod<br><br>(Corporate)<br>Lanise, Aposkahoy, Bulahan, Pelaez           | 3,350                  | (Out-grower)<br>Luna (15) <sup>#</sup> , Hinaplanan (550) <sup>#</sup> , Plaridel (60) <sup>#</sup><br><br>(Corporate)<br>Lanise (400) <sup>#</sup> , Aposkahoy (400), Bulahan (400), Pelaez (300)                           | 2,125<br>(63% of total coverage)      |
| Dole-Skyland Philippines                 | Mat-i**, Claveria         | Hinaplanan, Janopolan, Luna and Mat-i                                                                                                                                 | 130                    | Mat-i (70)                                                                                                                                                                                                                   | 70<br>(54% of total coverage)         |
| Phillip Morris and Fortune Tobacco, Inc. | Anei***, Claveria         | Anei, Aposkahoy, Bulahan, Cabacungan, Gumaod, Hinaplanan, Lanise, Madaguing, Malagana, Parmbugas, Pelaez, Panampawan, Plaridel, Poblacion, Rizal, Sta Cruz, Tamboboan | 1,040                  | Aposkahoy (200), Bulahan (20), Hinaplanan (50) <sup>#</sup> , Lanise (50) <sup>#</sup> , Madaguing (60) <sup>#</sup> , Malagana (60), Parmbugas (20), Pelaez (15), Panampawan (30) <sup>#</sup> , Plaridel (25) <sup>#</sup> | 530<br>(51% of total coverage)        |
| Total                                    |                           |                                                                                                                                                                       | 4,520                  |                                                                                                                                                                                                                              | 2,725<br>(60% of total coverage)      |

Source: Claveria Municipal Planning and Development Office; Note: \*Outside Claveria; \*\*Within Cabulig; \*\*\*Outside Cabulig; <sup>#</sup> Part of this plantation area is within Cabulig

### ***Production systems***

The survey of farming households in the six villages across Cabulig revealed six broad production systems (Figure 4.2): agroforestry (58%), mono-cropping agriculture (32%), perennials (3%), tree farms (3%), plantation crops (2%) and fallow<sup>38</sup> (0.4%) (Table 4.5). The majority of the farms visited are agroforestry with diverse crop components including timber and perennial trees.

<sup>38</sup> A piece of land that is normally used for farming but that is left with no crops on it for a cropping season or more to let it recover its fertility

Agroforestry is simply defined as the integration of trees on the farm (Prabhu et al., 2014). During the interviews, many farmers did not mention agroforestry as their land use. This infers that farmers may not be aware that what they are practising is a form of agroforestry or that they are focused on their agricultural crops. Trees are commonly integrated on-farm through parkland, block, boundary and hedgerow. The most common for the surveyed households is the parkland system where trees are scattered on the farm (often the logged-over areas). Some of these trees are dipterocarps, whose felling is prohibited by law. In other cases, fruit (e.g. jackfruit, durian, lanzones), timber trees (e.g. mahogany, falcata, eucalyptus), or woody perennials (e.g. coffee) had already been planted before the farmers decided to plant agricultural crops. Other farmers deliberately allocated particular spaces to these trees for the economic returns they get from the fruits or logs. Alternatively, some farmers whose lands are sloping adopt the hedgerow system. Along the riverbanks of Luna, Plaridel, and San Nicolas and those in the hinterlands of Mat-i and Aposkahoy, this form of agroforestry is based on indigenous forest trees where farmers plant trees or woody perennials as hedges along the contours while the alleys are grown with annual crops. The purpose of intercropping trees or woody perennials is to control soil erosion and also earn extra income from the fruits or logs, or for household use as fuelwood. It is important to note that, although these systems are based on trees, most of the income farmers report is based on the associated agricultural or perennial crops, except in the case of coconuts in Plaridel and San Nicolas.

Agricultural crops are dominant in the relatively flat land where they are usually grown as monocrops and annuals are planted on the same piece of land for two to three cropping seasons. This is most common for corn, cassava and vegetables. Some farmers in the upper villages practice relay cropping where corn is followed by vegetables, or tomato followed by corn. Others in Plaridel intercrop cassava with corn. Most of these farms have no trees and in Chapter 7, these farms are the ‘agriculture’ land use category defined in the Bayesian network model.

Perennial-based systems are mostly banana, abaca and coffee. Large plantations, particularly tobacco, are an emerging production system where farmers plant tobacco as the first crop followed by corn. This allows cropping for both corporate product and home consumption. However, it is different for banana and pineapple plantations which are managed by the companies themselves. Tree farms are mostly coconut plantations in Plaridel and San Nicolas, as well as a few being orchards in Aposkahoy. It also includes banana and sweet potato fallows in Madaguig and Aposkahoy, respectively.

The geo-references of farms allowed the various production systems to be located relative to the physiographic units and landscape positions outlined by Ringrose-Voase et al. (2019). The physiographic units are Mt Balatukan, Cabulig River Escarpment, Jasaan and Mt. Sumagaya (Table 4.3, Figure 4.2). Each of these units is divided into landscape positions: high, mid and low.

This information is important for understanding the suitability of these systems based on their location in the landscape.

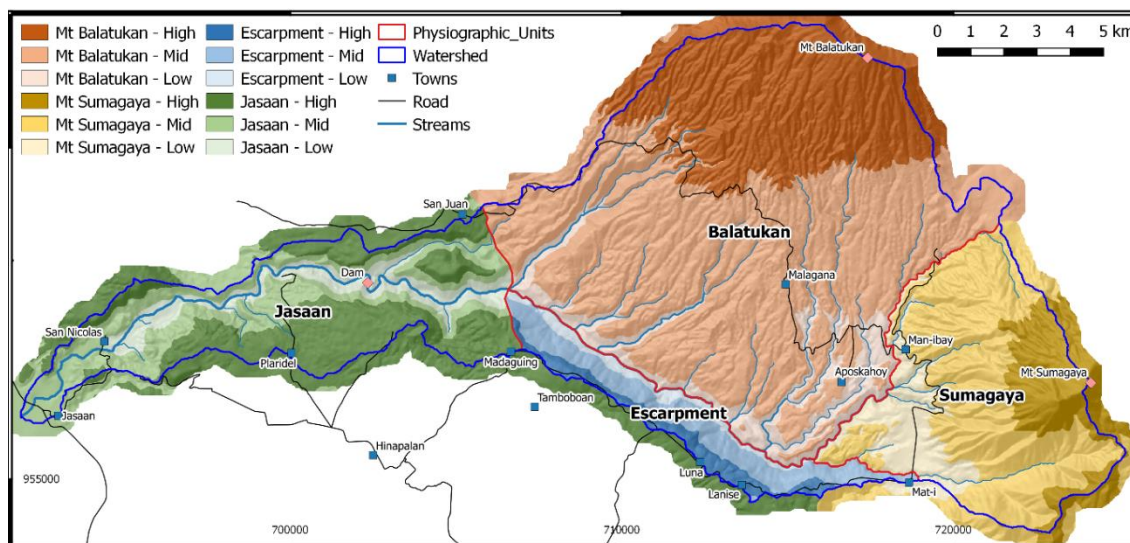


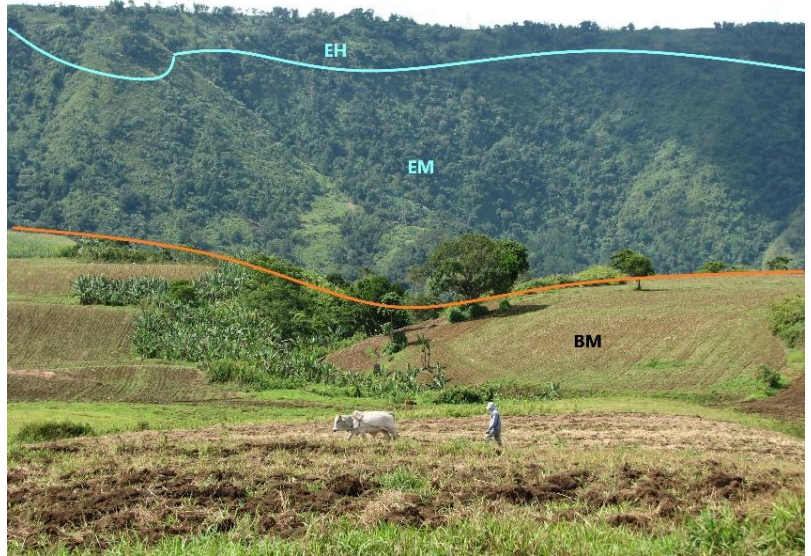
**Figure 4.2 The physiographic units and landscape positions of Cabulig watershed (2018). (Source: Digital soil map from the ACIAR Watershed Evaluation project)**

Most of the farms visited are within the Mt. Balatukan and Jasaan physiographic units (both 38%) (Table 4.4). Mt. Balatukan includes the largest area of cultivated agricultural lands of Cabulig (214 out of 562 samples), while Jasaan is located downstream in the watershed. In Mt. Balatukan, the dominant agroforestry and agriculture production systems are situated on its extensive mid-slopes (199 out of 214 samples), whereas in Jasaan these are located on its mid-slopes.

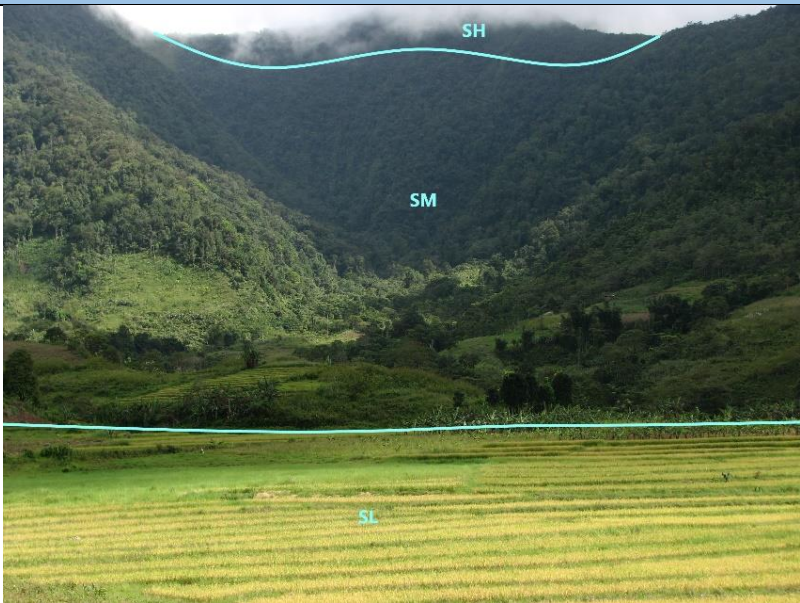
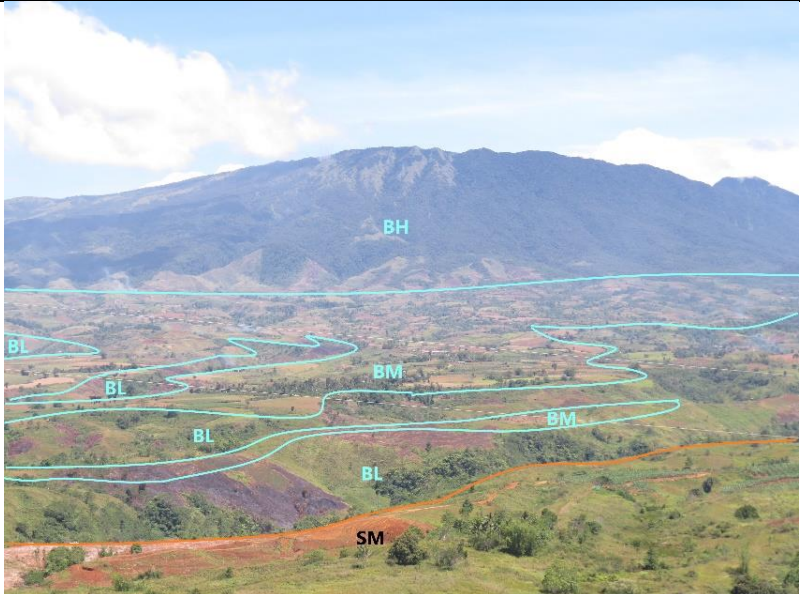
Agroforestry and agriculture production systems dominate the whole range of slope classes in Cabulig. In Mt. Sumagaya, although agroforestry and agriculture are the common production systems in its broad mid-slope, there are also patches of perennials (mostly banana) in this landscape position. The centre of Dole's banana plantation is within this unit and, while the Company is continuously expanding its plantation, non-corporate banana farms are also increasing coverage because of its good production, quality and income. Other systems include trees and fallowed farms.



**Table 4.3 Description of the physiographic units and landscape positions in Cabulig**

| Physiographic units and landscape position | Description                                                                                                  | Example of landscape                                                                |
|--------------------------------------------|--------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|
| <i>Jasaan</i>                              |                                                                                                              |   |
| High (JH)                                  | Claveria plateau: undulating                                                                                 |                                                                                     |
| Mid (JM)                                   | Steep slopes down to Cabulig River                                                                           |                                                                                     |
| Low (JL)                                   | Flatland along Cabulig River including flood plain                                                           |                                                                                     |
| <i>Escarpment</i>                          |                                                                                                              |  |
| High (EH)                                  | Upper southern slopes of Cabulig River gorge including parts of the Claveria Plateau at the top of the slope |                                                                                     |
| Mid (EM)                                   | Mid southern slopes of Cabulig River gorge                                                                   |                                                                                     |
| Low (EL)                                   | Lower slopes and flat land along Cabulig River gorge                                                         |                                                                                     |



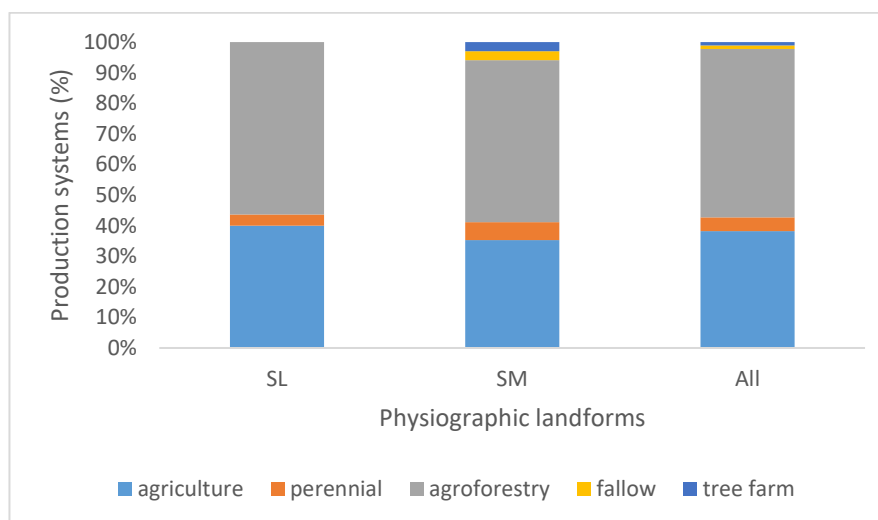
| Physiographic units and landscape position | Description                                                        | Example of landscape                                                                |
|--------------------------------------------|--------------------------------------------------------------------|-------------------------------------------------------------------------------------|
| Mt. Sumagaya                               |                                                                    |   |
| High (SH)                                  | Upper slopes of Mt Sumagaya                                        |                                                                                     |
| Mid (SM)                                   | Mid slopes of Mt Sumagaya                                          |                                                                                     |
| Low (SL)                                   | Flatter areas near Mat-i                                           |                                                                                     |
| Mt. Balatukan                              |                                                                    |  |
| High (BH)                                  | Upper slopes of Mt. Balatukan                                      |                                                                                     |
| Mid (BM)                                   | Broad undulating mid slopes of Mt. Balatukan                       |                                                                                     |
| Low (BL)                                   | Slopes of the gorges above Cabulig River and its major tributaries |                                                                                     |

Source: ACIAR-CSIRO digital soil map (2018); Photo credits: Anthony Ringrose-Voase and Gerard Grealis

**Table 4.4 Farmer production systems based on physiographic units in Cabulig (2016)**

| Physiographic units and landscape position | % Farms by production systems |             |            |           |            |           | Total      |
|--------------------------------------------|-------------------------------|-------------|------------|-----------|------------|-----------|------------|
|                                            | Agro forestry                 | Agriculture | Plantation | Perennial | Fallow     | Tree farm |            |
| Jasaan (n=212)                             |                               |             |            |           |            |           |            |
| High                                       | 57                            | 38          | 1          | 1         | _*         | 3         | 100        |
| Mid                                        | 78                            | 8           | 0          | 7         | -          | 7         | 100        |
| Low                                        | 94                            | 0           | 0          | 3         | -          | 3         | 100        |
| <b>All</b>                                 | <b>73</b>                     | <b>18</b>   | <b>0</b>   | <b>4</b>  | <b>-</b>   | <b>5</b>  | <b>100</b> |
| Escarpment (n=47)                          |                               |             |            |           |            |           |            |
| High                                       | 55                            | 27          | 5          | 9         | 5          | -         | 100        |
| Mid                                        | 50                            | 36          | 0**        | 14        | 0          | -         | 100        |
| Low                                        | 0                             | 100         | 0          | 0         | 0          | -         | 100        |
| <b>All</b>                                 | <b>49</b>                     | <b>36</b>   | <b>2</b>   | <b>11</b> | <b>2</b>   | <b>-</b>  | <b>100</b> |
| Mt. Sumagaya (n=89)                        |                               |             |            |           |            |           |            |
| Mid                                        | 53                            | 35          | -          | 6         | 0          | 3         | 100        |
| Low                                        | 56                            | 40          | -          | 4         | 0          | 0         | 100        |
| <b>All</b>                                 | <b>55</b>                     | <b>38</b>   | <b>-</b>   | <b>4</b>  | <b>1</b>   | <b>1</b>  | <b>100</b> |
| Mt. Balatukan (n=214)                      |                               |             |            |           |            |           |            |
| High                                       | 0                             | 100         | 0          | 0         | -          | -         | 100        |
| Mid                                        | 48                            | 43          | 8          | 1         | -          | -         | 100        |
| Low                                        | 46                            | 46          | 8          | 0         | -          | -         | 100        |
| <b>All</b>                                 | <b>48</b>                     | <b>44</b>   | <b>8</b>   | <b>0</b>  | <b>-</b>   | <b>-</b>  | <b>100</b> |
| <b>Grand total</b>                         | <b>58</b>                     | <b>32</b>   | <b>3</b>   | <b>3</b>  | <b>0.4</b> | <b>2</b>  | <b>100</b> |

Note: \*Not applicable; \*\*Less than 1%.

**Figure 4.3 Farmer production systems in the Sumagaya physiographic unit of Cabulig watershed (SL=flatter areas around Mat-i; SM=mid-slopes of Mt. Sumagaya) (2016)**

### ***Dominant crops***

The farming HH survey elicited the diverse crop species commonly grown under different production systems (Figure 4.4). Corn is still common over all the cultivated lands of Cabulig. History recognizes that corn was first introduced by the Spanish in the Philippines as food for livestock as part of the Columbian Exchange where plants, animals, cultures, and people were

transferred between the Americas and the Old World in the 15<sup>th</sup>-16<sup>th</sup> centuries; it later became a popular grain for human consumption as bread, roasted or boiled corns (Javellana, 2015). In the 1980s, yellow corn became popular, particularly in Plaridel, Malagana and Aposkahoy, with financing support from big farmers. Only they can afford to grow vast areas of yellow corn due to expensive financial and labour requirements. Despite this, it commands a better market price and so is very attractive to farmers. There are several reasons for corn's continued dominance in the watershed. It is the farmers' major food crop, particularly white corn. It is also a subsistent and suitable crop across different locations. It can grow anywhere and some farmers in Malagana and Aposkahoy can grow three rainfed crops on the same land in one year. Next, it is easy to grow and manage with sufficient inputs and labour. Finally, although the price often fluctuates, the market is readily available.

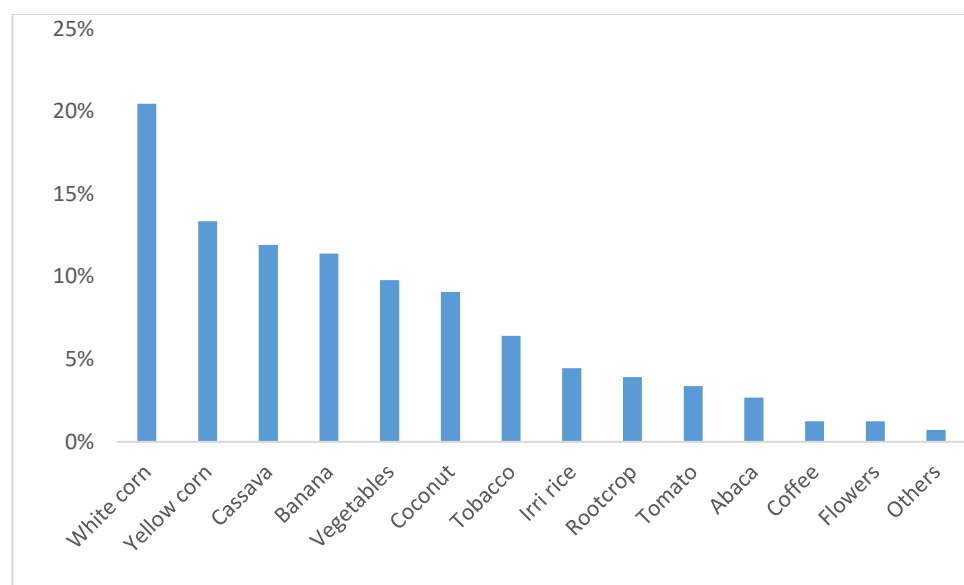


**Figure 4.4 Farmers' dominant crops in Cabulig watershed (2016)**

The geo-references of the surveyed farms were used to determine in which parts of the landscape the common crops were being grown (Appendix 4). In the Jasaan physiographic unit, cassava dominates the landscape. It is commonly planted on the relatively flat Claveria Plateau (JH). It is another traditional crop in the watershed that serves as an alternate food for Higaonons and other farmers. Presently, this root crop remains widely preferred among farmers in the Plaridel and San Nicolas because it requires minimal inputs and care. The income is also high with the adoption of high yielding varieties and better cultural management practices. On the other hand, coconut and banana are widely planted on the steep mid-slopes in addition to corn, while the lower valleys are gardened for vegetables and irrigated for rice.

The farms in the Escarpment unit have a variety of dominant crops, particularly in the upper landscape positions - on the flatter land (the Claveria Plateau) above the gorge and ridges (Figure 4.5, top). On the relatively flat land along the road, the most commonly planted are corn,

particularly yellow corn, followed by vegetables and banana. Other crops in this slope are tobacco and tomato. The ridges are grown with perennials, particularly abaca and coffee. Abaca<sup>39</sup> is also one of the traditional crops in Cabulig. Coffee, on the other hand, is grown in old stands that need rejuvenation to improve production.

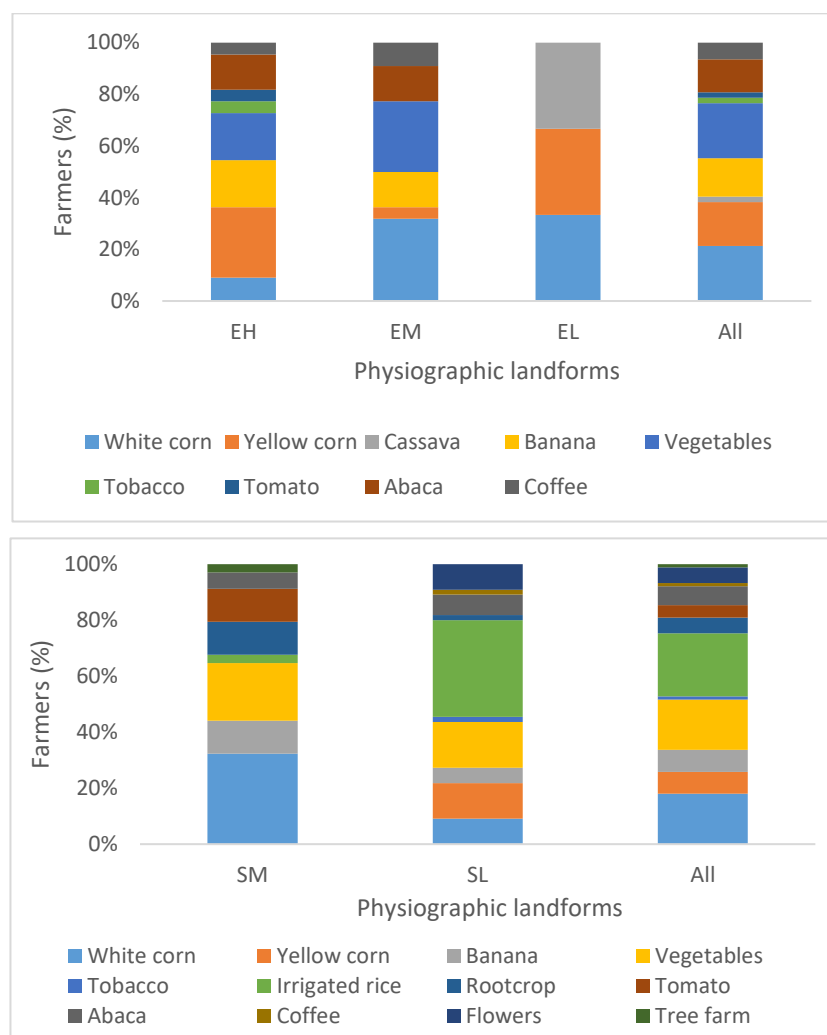


**Figure 4.5 Dominant crops in the Escarpment (top) and Sumagaya (bottom) physiographic units of Cabulig watershed (2016)**

The Mt. Sumagaya unit also has diverse dominant crops (Figure 4.5, bottom). The lower valley towards Mat-i River is dominated by irrigated rice, which is planted in terraces and is supported by an irrigation system. Corn and vegetables (e.g. eggplant, cabbage) are also widely grown. It is also in lowlands that rose gardens are grown. Rose gardening is a new activity that has flourished in the area. From one rose garden in 2008, there are now almost a dozen. While it was started by a businessman from Gumaod, many competitors are now locals who have learned the techniques

<sup>39</sup> Abaca is a perennial crop, where the stripped and dried fibers are either picked up in the villages or sold in Claveria market or in CDOC.

and ways of marketing roses in CDOC. The financial and labour requirements are high, but its demand and income generation are seasonal. A very good income can be gained in February, March, June and November<sup>40</sup>. Other crops planted in low-lying lands are coffee, banana and root crops.

### ***Suitability***

The aforementioned dominant crops were assessed against the suitability map for each crop<sup>41</sup> (Table 4.5). It revealed that the majority of the farmers across the watershed are growing crops that are moderately suitable (78%) or marginally/unsuitable (14%) for their locations. Moderately suitable means that there are considerable biophysical limitations that reduce production and/or that require major interventions to grow crops, such as the application of soil supplements (e.g. lime to correct soil acidity) and conservation measures (e.g. contouring). In the Mt. Balatukan physiographic unit, almost all of the farmers (211 out of 212) are planting moderately suitable<sup>42</sup> or marginal crops<sup>43</sup>. Corn is the dominant crop in this unit, and its suitability is limited by slope and soil acidity. Although corn is moderately suitable over most of the Mt. Balatukan unit, it is only marginal/unsuitable on the slopes of the gorge due to slope, rockiness, and shallow soil depth.

Meanwhile, in the Jasaan unit, the majority of the farmers are growing the same crops but about 21% (45 out of 211) are growing crops that are considered suitable with only minor limitations. In this unit, there are several suitable crops in different landscape positions, such as cassava on the Claveria plateau (JH), and coconut and banana on the mid-slopes (JM) (Figure 4.6). However, cassava becomes unsuitable when planted on the steeper slopes above the valley. Cassava is uprooted during harvest, which disturbs the soil and causes erosion<sup>44</sup>. Meanwhile, corn, banana and coconut are widely planted and are considered moderately suitable on these slopes with appropriate interventions.

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<sup>40</sup> Valentine's Day, graduations, weddings and All Soul's Day celebrations are associated with these months.

<sup>41</sup> One output of the ACIAR Watershed Evaluation project.

<sup>42</sup> Corn, vegetables (e.g. green onion, tomato), tobacco and cassava among others.

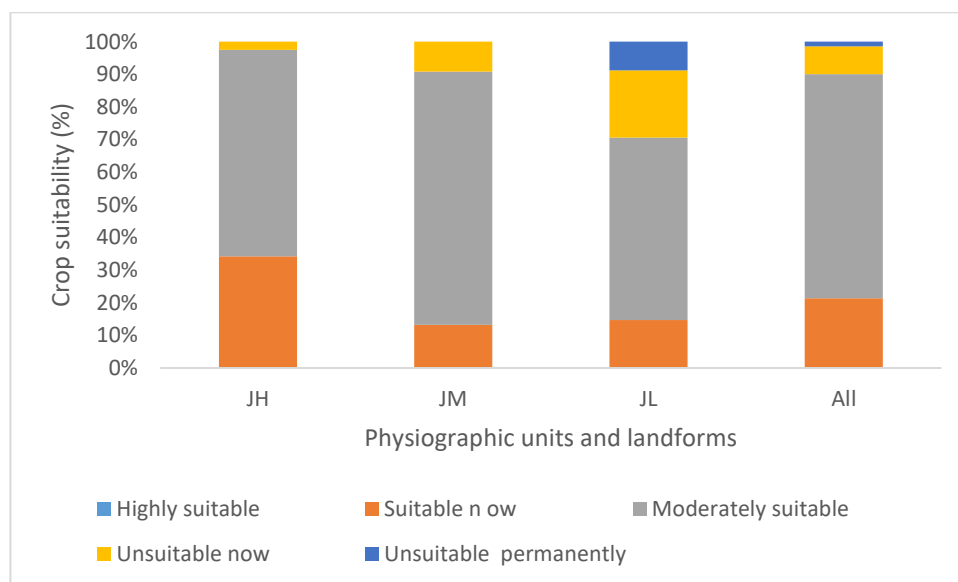
<sup>43</sup> Corn, sweet potato, carrots, cassava and coffee.

<sup>44</sup> This is similar in the case of Vietnam's northern highlands where cassava is a common rainfed cropping system cultivated on sloping lands. In Vezina et al.'s (2006) study on agricultural land use patterns and soil erosion vulnerability, cassava cultivated in sloping area showed the highest intrinsic soil erosion vulnerability, representing its watershed unit as the most prone to soil loss.

**Table 4.5 Suitability of crops for where they were grown in Cabulig (2016)**

| Physiographic units and landscape position | Soil-crop suitability (%) |            |                     |           |            |            |
|--------------------------------------------|---------------------------|------------|---------------------|-----------|------------|------------|
|                                            | Highly suitable           | Suitable   | Moderately suitable | Marginal  | Unsuitable | Total      |
| Jasaan (n=211)                             |                           |            |                     |           |            |            |
| High                                       | -                         | 34         | 63                  | 3         | -          | 100        |
| Mid                                        | -                         | 13         | 78                  | 9         | -          | 100        |
| Low                                        | -                         | 15         | 56                  | 21        | 9          | 100        |
| <b>All</b>                                 | -                         | <b>21</b>  | <b>69</b>           | <b>9</b>  | <b>1</b>   | <b>100</b> |
| Escarpment (n=47)                          |                           |            |                     |           |            |            |
| High                                       | -                         | -          | 73                  | 27        | -          | 100        |
| Mid                                        | -                         | -          | 77                  | 23        | -          | 100        |
| Low                                        | -                         | -          | 67                  | 33        | -          | 100        |
| <b>All</b>                                 | -                         | -          | <b>74</b>           | <b>26</b> | -          | <b>100</b> |
| Sumagaya (n=83)                            |                           |            |                     |           |            |            |
| Mid                                        | -                         | -          | 67                  | 33        | -          | 100        |
| Low                                        | -                         | -          | 84                  | 16        | -          | 100        |
| <b>All</b>                                 | -                         | -          | <b>77</b>           | <b>23</b> | -          | <b>100</b> |
| Balatukan (n=212)                          |                           |            |                     |           |            |            |
| High                                       | -                         | 33         | 67                  | -         | -          | 100        |
| Mid                                        | -                         | -          | 89                  | 11        | -          | 100        |
| Low                                        | -                         | -          | 69                  | 31        | -          | 100        |
| <b>All</b>                                 | -                         | <b>0.5</b> | <b>87</b>           | <b>12</b> | -          | <b>100</b> |
| <b>Grand total (n=553)</b>                 | -                         | <b>8</b>   | <b>78</b>           | <b>14</b> | <b>1</b>   | <b>100</b> |

Note: \*Some crops (e.g. fruit trees, flowers) identified are not included in the suitability map

**Figure 4.6 Suitability of commonly grown crops in the Jasaan physiographic unit of Cabulig watershed (2016)**

### ***Cropping patterns***

Cropping patterns within the watershed depend on the production system in place as well as geography. In Aposkahoy and Malagana, the most commonly adopted patterns are two crops of

corn, perhaps even three, in one year with white corn for home consumption as the last crop and yellow corn for sale as the earlier crops. Sometimes root crops (e.g. sweet potato) are grown as the third crop for home consumption. While most villages can harvest corn after four months, it takes five months in the higher areas of Mat-i and Aposkahoy because the cooler climate and higher rainfall in these areas delay the corn's maturity. Moreover, in Luna and Mat-i, yellow corn is followed by vegetables where residual fertilizer applied to the maize is used by the vegetables. Some farmers plant white corn for home consumption while the vegetables are intended to generate cash for daily needs. Similarly, some farmers plant tomato as the first crop, followed by maize, where the latter benefits from the high inputs for tomato. In Plaridel, cassava is often intercropped with maize to maximize land use and generate more income. The cassava tubers take 8-12 months to mature; maize can be grown and harvested after four months. These systems satisfy the farmers' food requirements, as well as earn income for their daily needs. They can maintain production throughout the year by carefully selecting the component crops and using farming techniques such as relay and sequential cropping. Farmers can grow different crops at different times of the year because of the area's high and well-distributed rainfall.

Multiple crops of irrigated rice are limited to Mat-i and Aposkahoy, where topography, rainfall and temperature are favourable. Most importantly, these villages have irrigation infrastructure, which ensures water supply during summer or periods of drought. However, one of the three irrigation systems was damaged by a typhoon in December 2015, which affected the production following the drought in 2016. Rice farmers usually have two crops of rice in one year. They usually keep a portion of the harvest for food consumption and seeds for the next crop, with the surplus being sold for cash.

In sloping areas, an intercropping system with annuals and trees and/or perennial woody crops is commonly adopted. This is widely observed along the riverbanks of Cabulig and its other tributary rivers. In Luna, trees (e.g. forest, fruits) and/or woody perennial crops (e.g. coffee) are intercropped with annual crops, particularly white corn, vegetables and root crops (e.g. sweet potato, cassava, taro). The tree and/or woody perennial crops provide permanent cover to control soil erosion, while their deep roots anchor the soil against landslides.

Tree farms and (woody) perennial crop systems are common in the flatlands and relatively rolling areas of Cabulig. In Plaridel and San Nicolas, coconuts are widely grown either in plantations where the understorey is utilized for banana or corn. In the upper villages of Malagana,

Aposkahoy and Mat-i, rubber, timber and fruit trees are intercropped with banana, abaca and coffee. Recently, a private company<sup>45</sup> introduced cacao as an agroforestry's understorey crop.

Although the Forestry Code<sup>46</sup> (1975) prohibits 'kaingin' (slash-and-burn) cultivation, a few farmers still practise it, particularly in the remote sloping lands along the Cabulig River gorge. The low incidence of this is due to the area of forestlands available to swidden being limited by the delineation of various land tenure instruments throughout the watershed (e.g. protected area, forestlands [ancestral domain, community-based forests] and agricultural and disposable [agrarian, privately-held] lands). Where this system is practised, it is associated with white corn and upland rice. Some farmers also integrate root crops, vegetables and legumes like mung bean. Farmers do not apply fertilizers and there is no weed control. While some farmers interviewed claimed that kaingin is good for the soil, the ecological impacts of this system on erosion, soil nutrients, watershed protection, and floral and faunal biodiversity have long been debated (Cairns, 2015; Cairns & Garrity, 1999). The impacts largely depend on the type of kaingin practice and population density. When continued deforestation is in conjunction with a kaingin system and an increasing population, Suarez and Sajise (2012) argue that kaingin is 'bad' for Philippine biodiversity in the context of conservation biology considering the current rate of habitat loss. Ultimately, very few farmers still practise fallow because land scarcity combined with the increased population affect the restoration of soil fertility and protection of biodiversity.

### 4.3.2 Future land use and vegetation

Given the patterns of change in the past decades, the KIs identified a range of land uses and vegetation covers for the next 10 years (Table 4.7). Their responses are grouped into negative, unchanged and optimistic. First, a farmer from San Nicolas was gloomy looking into the future. He commented: *"Maybe there will be no more crops because we have all been flooded here. It will all be covered by soil. All these crops will be gone... Until now, some people are still continuously cutting trees. A month will cry without me hearing someone sawing trees - coconuts, Acacia."* He attributed such a vision to people's poor farming practices. Although this farmer was the only one who shared a pessimistic forecast of the future, it is possible given flooding events in the past years.

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<sup>45</sup> Kennemer Foods International, Inc. is a Philippine agribusiness company that grows, sources and trades high-quality fermented cacao beans from smallholder farmers.

<sup>46</sup> Presidential Decree 705



**Table 4.6 Stakeholders' perceived future land use in Cabulig (2016)**

| Perception             | Farmers                                                                                                                   | Policymakers and the general public                                                                                                                                                                                                                         | Experts                                                                                                                                                                                                 |
|------------------------|---------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Negative               | <ul style="list-style-type: none"> <li>• Rocks due to continued poor farming practices and flooding*</li> </ul>           |                                                                                                                                                                                                                                                             |                                                                                                                                                                                                         |
| Unchanged (expansion)  | <ul style="list-style-type: none"> <li>• Coconut*</li> <li>• Banana*</li> <li>• Corn**</li> <li>• Vegetables**</li> </ul> | <ul style="list-style-type: none"> <li>• Corn</li> <li>• Tobacco plantation</li> <li>• Pineapple plantation</li> <li>• Banana plantation</li> <li>• Smallholder banana</li> <li>• Coffee</li> <li>• Timber and fruit trees</li> <li>• Root crops</li> </ul> | <ul style="list-style-type: none"> <li>• Corn</li> </ul>                                                                                                                                                |
| Positive for new crops | <ul style="list-style-type: none"> <li>• Cacao***</li> </ul>                                                              | <ul style="list-style-type: none"> <li>• Cacao</li> <li>• Napier</li> <li>• Agroforestry</li> </ul>                                                                                                                                                         | <ul style="list-style-type: none"> <li>• Trees with secured land tenure</li> <li>• Agroforestry in sloping areas</li> <li>• Good soil cover</li> <li>• Plantations are gone</li> <li>• Cacao</li> </ul> |

Note: \*Jasaan; \*\*Balatukan; \*\*\*Sumagaya; Source: KII

In contrast, one expert expressed a particularly positive viewpoint in saying that, *“because people will have secured tenure... they will plant trees, apply appropriate land management practices, and adopt agroforestry by planting trees and crops along the contour, [and plant] good soil cover. And then they will have better profitability... and so perhaps, plantations will dissipate.”* The expert believed that adopting appropriate land management practices is foremost to earning better income but that providing appropriate interventions is the necessary first step to motivate farmers to invest and adopt better land use. Apart from strengthening land tenure and property rights, effective delivery of extension services is also important as pointed out by a local planner who shares the same positive outlook. He shared: *“if we can convince the farmers to plant trees even just on the boundaries. If you look at Cabulig from the outside, it will be green.”* This implies not just the normal extension (show the farmers and they will adopt) but designing interventions with supporting mechanisms.

Meanwhile, most KIs (particularly the farmers) said that the same crops will be grown into the future. Corn, as their main food and cash crop, will continue to dominate in Cabulig. Banana and coconut will continue to grow in Jasaan; vegetables and root crops in Mt. Balatukan. Some farmers also mentioned new crops, such as cacao and Napier, could be grown with the current support from government and non-government organizations (NGOs) (Giller et al., 2011).

### 4.3.3 Synthesis of major land use trends

#### *Demographic trends*

Population growth in Cabulig over the last century was smaller than in the remainder of Claveria. The narratives revealed that even after WWII, the area was mostly uninhabited. It was only in the 1970s that migrants dared to venture in when Jasaan and the Claveria Plateau above the Escarpment were already populated. Much of the population growth that initially occurred in these areas was influenced by the development of logging roads (Garrity & Agustin, 1995). Migrants first came to Jasaan, which is near the northern coast and traversed by the national road. They then ventured further down the Escarpment, until they reached Cabulig. The narratives also revealed that despite the turning point of agricultural development in the mid-1970s, there was widespread depopulation in the area from 1980-1985 due to the insurgency of the New People's Army (NPA)<sup>47</sup> (Branigin, 1984). Claveria was then a stronghold of the NPA and was often attacked by the government military affecting the lives and livelihoods of the civilians. After democracy was declared in 1986, migrants rapidly increased until the 1990s. During this period, the land ownership regime changed with land selling and renting/pawning becoming the norm. Presently, population growth in Cabulig, particularly Mat-i and Malagana is increasing, with government facilities (e.g. schools) also improving.

Note that while new migrants continue to come in search of lands to cultivate, there is also out-migration. The disparity in livelihood assets between the local farmers and migrants is evident in the scale of production such that some family members of local farmers move to cities or abroad to provide better income for their households. However, with poor education, most of them work in menial jobs with low wages, sometimes even below the standard minimum wage. Conversely, children of some big farmers also go to cities for better education. Most of them are taking courses that are meant for working in cities or abroad such as marine technology, information technology, and medical courses like nursing and midwifery (the motivations behind this push for improved education are discussed in Chapter 6.2). Both cases imply the discontinuity of household farming, especially with the opportunity of renting land to new migrants and MNCs.

#### *Land use and vegetation cover change*

Despite the absence of reliable maps, farmers' narratives revealed a range of land use and vegetation cover change patterns over time (Figure 4.7), with two broad trends. First, there were differences in the change between physiographic units. While Jasaan and the Claveria Plateau

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<sup>47</sup> The military wing of the Communist Party of the Philippines and its political front, the National Democratic Front. Their mission is to overthrow the Philippine government.

above the Escarpment showed a rapid change in the beginning, Mt. Sumagaya and Mt. Balatukan exhibited slower change. It was only in the late 2000s that land use and land cover within these units changed. Although this can be related to their remoteness and other biophysical attributes, factors such as politics, transportation, community acceptance, and peace and order among others were also important. The second broad trend has been demographic changes that were generally slow but constant since the migrations of the 1920s and after WWII. The changes soared in 1975 with the conversion of logged areas and grasslands into tomato farms, but then dropped dramatically with the insurgency until 1985. Most of the changes in Mt. Sumagaya and Mt. Balatukan occurred recently beginning around 2010 with grasslands becoming banana plantations and cornfields being converted to tobacco. Overall, areas within Jasaan and the Claveria Plateau are experiencing unidirectional transformation, such as urbanization because of their proximity to the main cities and towns. Conversely, Mt. Sumagaya and Mt. Balatukan are generally experiencing changes in rural land uses in terms of reforestation and agriculture.

### ***Agriculture trends***

Throughout the Cabulig watershed as a whole, the area of forestland and grassland has decreased since the migration of 1920. Patches of cultivation and settlement first occurred along the roads, and then expanded towards the relatively flat and sloping lands on adjacent sides (Garrity & Agustin, 1995). The narratives revealed that pressures for food and settlement have replaced forest and tree-based farming systems with non-tree-based agricultural crops. After WWII, cultivated lands were dominated by enterprise crops (e.g. coffee, cassava, tomato, yellow corn). These crops introduced the use of commercial inputs, and farmers have since relied on these inputs to ensure good production. The impact of monocropping was evident with the eradication of tomato farms because of diseases that prompted farmers to change crops. This reflects the need to consider land health through farmers' land use and management practices. Presently, the presence of MNCs' plantation crops (e.g. pineapple, banana, tobacco) has two effects – it competes with the land that could be used for food production while it also enables grasslands and other barren lands to become productive. Over time, the expansion of cultivated lands occurred for consumption but ultimately to capture the benefits of commercial agriculture.

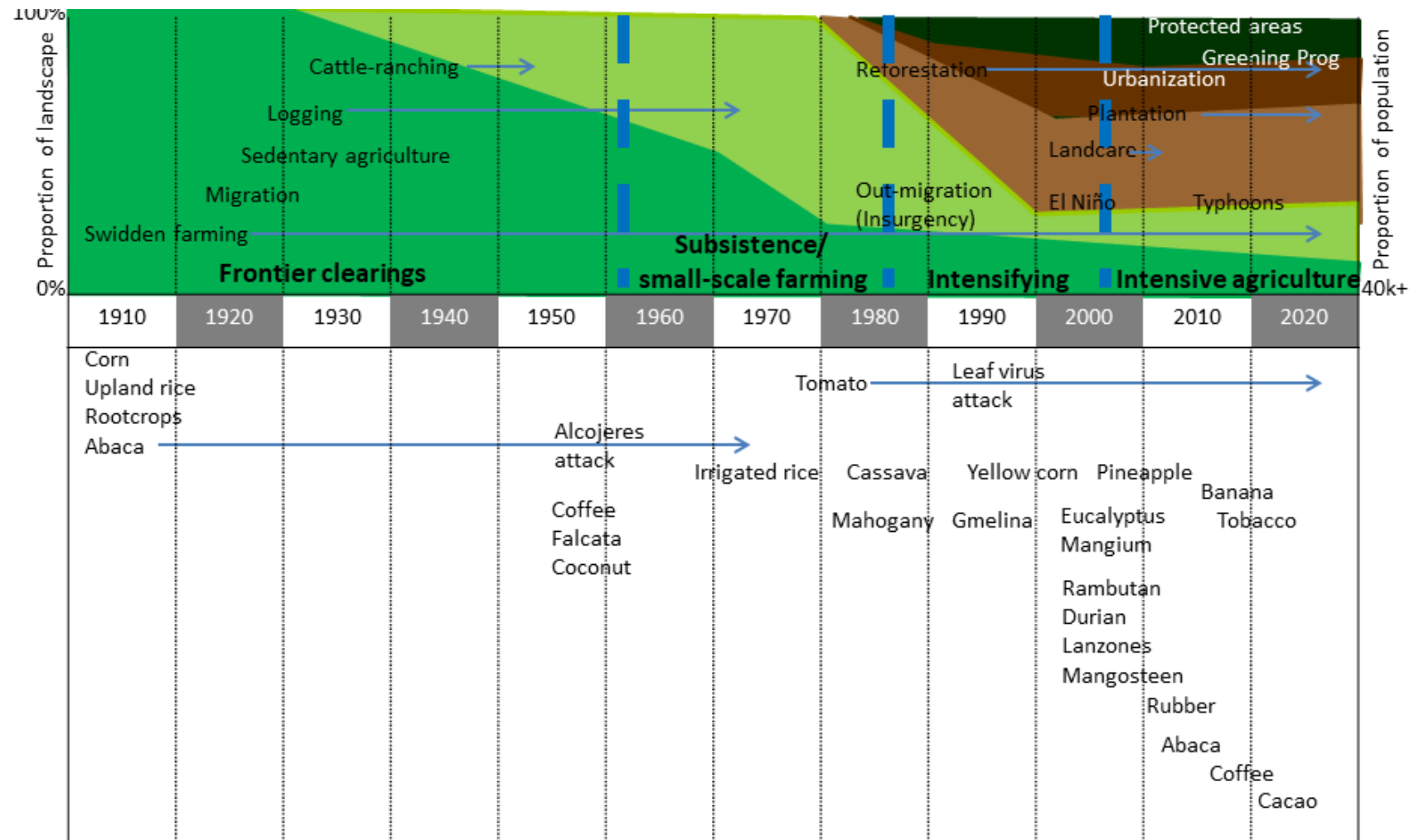


Figure 4.7 Land use change and trends in Cabulig watershed (1950-2016). This figure is pictorial and not based on quantitative data. Based on KIIs and focus groupss, this figure represents the scales of change from largely forest + swidden (green) to subsistence (lighter green) to intensive agriculture (light brown), urbanization (brown) and conservation (dark green).

## 4.4 Current livelihood conditions and trends

This section documents the current livelihood conditions of farmers in the Cabulig watershed, and important trends over the last century. The five capitals, namely natural, physical, financial, human and social, are used to understand the farmers' livelihood portfolios (Chambers & Conway, 1991). Different capabilities, access and claims to these capitals are analyzed to assess their situation, which is measured in terms of quantities (e.g. number of agricultural tools) from the survey. The analyses emphasize the extent to which there are consistencies among important trends, as well as differences between social groups (i.e. ethnicity, gender, age<sup>48</sup>). Note that capital endowments are constantly changing as influenced by their vulnerability context (e.g. willingness and capacity to adapt to change) and the intensity of external forces. The data collected in this thesis represents the 2016 time period and should be used to analyze the livelihood condition within that period only.

### 4.4.1 Current livelihood portfolios

#### *Natural capital*

Land and water are among the basic resources needed for farming. The average landholding size in the sample villages indicates that farmers in Plaridel (3.1 ha) own bigger areas than the other villages, particularly San Nicolas (1.66 ha) (Table 4.7). Cultivated areas are often smaller than landholdings and farmers from Malagana (1.51 ha) cultivate the greatest areas, mostly planted with mono-crop corn, while Luna (1.01 ha) and Aposkahoy (1.09 ha) recorded the smallest cultivated areas. In Aposkahoy, average farm sizes are relatively small because of the vegetable plots provided to the members of the Doal Nara Restoration Society<sup>49</sup>. Each member household of the latter is usually assigned a 30 m<sup>2</sup> plot to cultivate and develop. It is important to note that cultivation is also affected by the area's natural characteristics like slope, rockiness, soil type (i.e. shallow, deep), soil acidity, soil fertility, and others.

Landholding also varies by ethnicity and age. The average land area of older Higaonons is relatively large (3 ha) compared with non-Higaonons (2 ha) and younger Higaonon farmers (1.7 ha). However, the actual areas being cultivated are similar for both the Higaonons (1.3 ha) and non-Higaonons (1.4 ha). Younger farmers (1 ha) tend to cultivate less land than older farmers (1.5

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<sup>48</sup> Based on age distribution in the HH survey, farmers are categorized into younger (20-35 years old); mid (36-50); and older (51-83).

<sup>49</sup> Doal Nara is a Community-Based Forest Management Agreement holder, which is a tenure provided by the DENR for 25 years.

ha). The lands cultivated by these younger farming households are often their inheritance from their farmer parents, whose lands are often equally divided among children (so smaller in size). Overall 70% of farmers own their land, but this varies between villages. While most lands (81%) are owned in Malagana, 45% of the lands cultivated in Plaridel are not owned. In Plaridel, land renting (8% of areas not owned) is common for cassava and corn. There is also an on-going land conflict over pastureland (27% of areas not owned) between the Higaonons and a claimant based in CDOC<sup>50</sup>. Absentee land ownership in this village is likewise common where some farmers are only tenants (7%). Across social groups, most of the lands cultivated are owned.

**Table 4.7 Farmers' land ownership, land areas and cultivated areas in Cabulig (2016)**

|                      | Villages (% of farms) |          |      |          |       |           |        |      |
|----------------------|-----------------------|----------|------|----------|-------|-----------|--------|------|
|                      | San Nicolas           | Plaridel | Luna | Malagana | Mat-i | Aposkahoy | Others | All  |
| Land ownership       |                       |          |      |          |       |           |        |      |
| Owned                | 78                    | 25       | 89   | 81       | 75    | 61        | 46     | 70   |
| Not-owned            | 22                    | 75       | 11   | 19       | 25    | 39        | 54     | 30   |
| Land area (ha)       |                       |          |      |          |       |           |        |      |
| <1                   | 28                    | 12       | 28   | 12       | 27    | 30        | 7      | 21   |
| 1-3                  | 52                    | 49       | 47   | 60       | 53    | 50        | 36     | 51   |
| 3-5                  | 17                    | 22       | 15   | 15       | 13    | 11        | 21     | 16   |
| 5-10                 | 3                     | 13       | 8    | 9        | 6     | 8         | 25     | 9    |
| >10                  | 0                     | 4        | 3    | 4        | 1     | 2         | 11     | 3    |
| Average (ha)         | 1.66                  | 3.10     | 2.21 | 2.62     | 2.03  | 1.91      | 4.45   | 2.22 |
| Median (ha)          | 1.00                  | 2.00     | 1.00 | 2.00     | 1.50  | 1.00      | 3.00   | 1.50 |
| Cultivated area (ha) |                       |          |      |          |       |           |        |      |
| <1                   | 39                    | 28       | 44   | 28       | 55    | 43        | 18     | 38   |
| 1-3                  | 51                    | 61       | 51   | 60       | 37    | 50        | 32     | 51   |
| 3-5                  | 11                    | 10       | 4    | 8        | 7     | 5         | 32     | 9    |
| 5-10                 | 0                     | 2        | 1    | 4        | 0     | 2         | 11     | 2    |
| >10                  | 0                     | 0        | 0    | 0        | 1     | 0         | 7      | 0    |
| Average              | 1.22                  | 1.46     | 1.01 | 1.51     | 1.18  | 1.09      | 3.16   | 1.24 |
| Median               | 1.00                  | 1.00     | 1.00 | 1.00     | 0.75  | 1.00      | 2.75   | 1.00 |

Source: Farming HH survey (n=604)

Crops in Cabulig are generally rainfed although they may be supplemented with irrigation water. Downstream villages rely mostly on the Cabulig River and springs for irrigation/domestic use, whilst the upper villages also have an irrigation system for rice paddies. Hence, some farmers in Aposkahoy and Mat-i claimed to have more than enough water. About 32% of the farmers interviewed in Mat-i benefit from the irrigation system. Conversely, many farmers (32%) in San

<sup>50</sup> Also called Zone, this vast flatland along the gorge was a pastureland since the 1970s. When the concession ended, the children or relatives of the original inhabitants who are from the Higaonon tribe came back and claimed ownership. During the fieldwork in 2016, the negotiation was on-going at the regional trial court in CDOC. In the village, the farmers continued developing their lands, planting these with durable trees like coconuts and fruit trees. Since then, I learned from a local contact that the farmers lost the case and were forceably evicted in 2017.

Nicolas depend on the Cabulig River as an alternate water source. They stated that they have inadequate water volumes, especially during dry seasons and when there is drought. During the rainy season, the river water becomes muddy and unusable for bathing, or washing dishes and clothes. This is similar in Plaridel which has limited or lack of a water system for domestic use. Springs are an important water source in this village for both domestic and farm use<sup>51</sup> (24%).

### ***Financial capital***

Most farmers in Cabulig are small landholders but there is variation in their capacity to earn money from their farming and to secure their livelihoods (Figure 4.8). Plaridel (PhP106, 448) has a higher average annual income compared to the other villages. In this village, many farmers (32%) do not depend entirely on farming for income but also have off- and non-farm activities<sup>52</sup>. For off-farm, working as hired labour and integrating livestock in their farming system increases their income from farming alone. For non-farm, the monthly subsidies of indigents from 4Ps<sup>53</sup> augment their household income. Remittances from family members working abroad and cities are also particularly high. Many also engage in small-scale businesses like food vending and sari-sari stores. Other sources of income are driving, working in various government and private companies (e.g. DMPI, Minergy), the monthly honorarium farmers receive as government volunteers<sup>54</sup> and others. Nevertheless, the majority of the farmers (42%) in Plaridel said that farming remains the main source of their income.

Conversely, the average annual income in Luna is considerably lower (PhP26,178). While farmers depended on combined on- and off-farm activities (32% of farmers) and on- and non-farm livelihoods (31% of farmers) for income (Figure 4.8), 35% of the farmers shared that off-farm employment, particularly farm labour, provides the highest share of their household income.

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<sup>51</sup> In Kiao spring, located along the road to Minergy HEPP, people collecting water, taking a bath or washing dishes/laundry together with trucks pumping water for farms are common sights every day.

<sup>52</sup> Off-farm activities are those part-time works that are meant to provide extra income for the household; non-farm covers activities from waged or self-employment that are not agricultural but which generate income for the household including income in-kind.

<sup>53</sup> Pantawid Pamilyang Pilipino Program (Bridging Program for the Filipino Family); this is meant to support to their children's nutritional and educational needs.

<sup>54</sup> Barangay Health Worker, Barangay Tanod and Barangay Nutrition Specialist

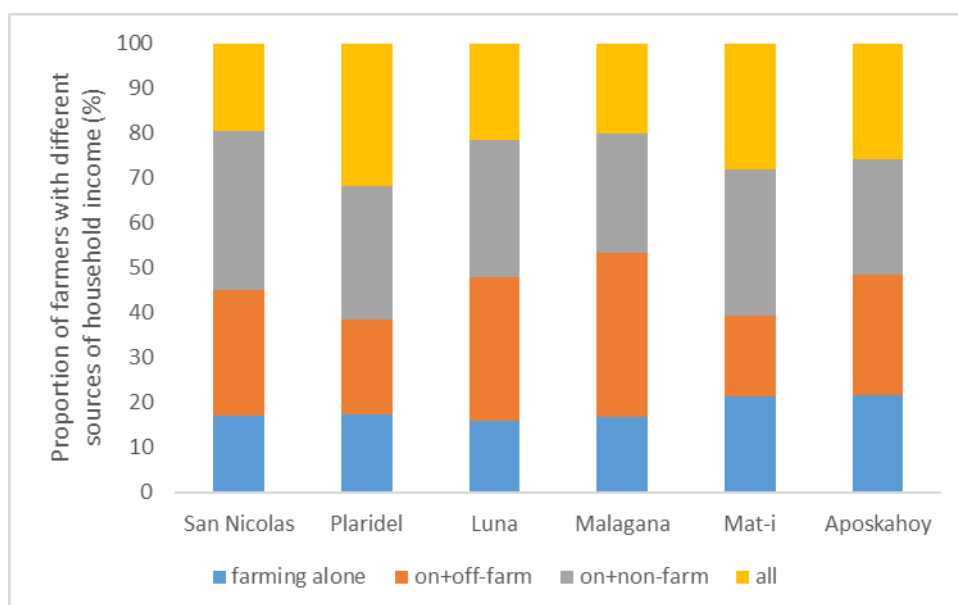


**Figure 4.8 Proportion of farmers with different sources of household income in Cabulig watershed (2016)**

Financial assets vary between social groups. Apart from farming (‘on-farm’), the Higaonons rely on farm labour for additional income (‘off-farm’) and the non-Higaonons on small-scale business or employment (‘non-farm’). Nonetheless, both groups identified farming as their main source of family income. The annual farm and total HH incomes of the non-Higaonons are relatively higher (PhP35,337; PhP79,803) compared to the Higaonons (PhP27,630; PhP61,050). While male farmers have higher annual farm income (PhP34,253) as opposed to female farmers (PhP23,810), the latter have higher annual total HH income (PhP82,539) than the former (PhP69,212). This is consistent across social groups analyzed and can be attributed to women’s engagement on both off- and non-farm livelihood activities, particularly managing sari-sari stores, food vending, remittances as domestic helpers and others. While male farmers rely mainly on farming for income, women farmers depend on both farming and non-farm income sources.

Savings are another important capital to help farmers in times of shocks and extreme events. However, saving is not commonly practised by farmers in Cabulig (92%) other than in Aposkahoy where several farmers have savings (18%). Most of these farmers are from the Doal Nara Restoration Society, who are cultivating small vegetable plots that they do not own. This shows that savings are not dependent on land ownership, big farm size, or income. Similarly, farm credits are also not commonly utilized among farmers across the watershed (90%). Overall, across all social groups, savings and credits are not commonly practised.



## **Physical capital**

Livestock, agricultural tools and irrigation assets are used as indicators of physical capital in this research, with vehicles and mobile phones of lesser but increasing importance. Across the six villages, many farmers have integrated livestock into their farming livelihood (72%). Malagana, in particular, has many farmers with livestock (85%), while there are fewer in Aposkahoy (62%). Livestock is grouped into big animals (e.g. water buffalo, cow, horse) and small animals (e.g. pig, goat, chicken). There are more big animals in Malagana (75%), which can be attributed to the large area of cornfields that require draught animals like cows for plowing. Conversely, there are fewer big animals in Luna (75%), where most of the farmers are cultivating on slopes adjacent to the river and where most farm activities are done manually (e.g. land preparation). With regards to small animals, this is again most common in Malagana (60%) and least common in Aposkahoy (33%). Raising native chickens is the most popular: mainly for consumption, but also as a calamity-coping strategy where farmers sell them when there is a typhoon or drought. Pigs are commonly raised in San Nicolas and Plaridel, which are near to Jasaan where pigs are often sold for meat in the market.

More than half of the farmers (63%) in Cabulig own farm tools. Many farmers in Malagana (61%) and Mat-i (56%) plant corn on larger fields that need to be tilled using ploughs (the commonly owned farm tool). Irrigation is only common in Mat-i and Aposkahoy where irrigated rice is produced. There are currently three irrigation systems in Mat-i, which are locally managed by irrigators associations. As mentioned, these were damaged by a typhoon in December 2015. The lack of irrigation reduced farmers' production in the 2016 drought. At the time of the interviews, the irrigation remained unrepaired and non-functional. Farm tool ownership is uncommon in San Nicolas (90%). In this village, coconut and banana are common crops that do not require any farm tools.

Although vehicles are a basic need in farming livelihood, particularly for transporting outputs and inputs from and to the farm, ownership is not common in Cabulig (80%). Some farmers in Malagana (27%), particularly the big farmers, own vehicles because of the remoteness of their village from CDOC, which is the main market for their agricultural products. Motorcycles or 'habal-habal' are commonly owned vehicles. Aside from their ability to get into farms accessible only by tracks, motorcycles are also used to transport passengers within and between villages and are a source of additional household income. Farmers who do not have vehicles hire trucks and jeepneys to transport their products. A woman-farmer from Aposkahoy commented: *"The road has improved a lot. Before, we always got stranded because of the poor road conditions. Our tomatoes [had] already ripened because it would take days or weeks to fix the road and/or the truck. When this happens, we [would] get a cheaper price for our tomatoes... The trucking cost*

*remains the same*". Transportation costs remain expensive despite the on-going road improvement.

Meanwhile, although more than half of the farmers interviewed did not have mobile phones (57%), it is an asset that is becoming important, particularly in marketing farm products. Mobile ownership was higher in Mat-i (67%) and Plaridel (61%). In Mat-i many farmers planted vegetables and so required mobile phones to interact with outside buyers. In Plaridel, ownership results more from farming households' higher income. Conversely, fewer farmers used mobile phones in San Nicolas (70%) because of its location in the river valley where the mobile signal is poor.

There is no difference in physical assets when the data are examined by social groups. Most of the Higaonons and non-Higaonons have integrated livestock in their farming systems. However, the majority of farmers do not have farm tools, vehicles or mobile phones. This is the case regardless of farmers ethnicity, gender or age.

### ***Human capital***

The available labour force is the main human capital of farming households in Cabulig. In the six villages studied, the proportion of the working population (52%) is high relative to the proportion of dependents (48%) (Table 4.8). One or two earners in a household are common: usually, the husband and wife are considered the main providers in the household. The wives help on the farm (including selling the product) and also engage in other off-farm (e.g. farm labour, livestock) and/or non-farm (e.g. food vending, managing the sari-sari store, house helper) livelihood activities. In Aposkahoy, the number of dependents (39%) is relatively small compared to that reported by farmers in the other villages. This can be attributed to the farmers from Doal Nara Restoration Society, of whom many (11%) do not have children or have only 1-2 dependents.

In Cabulig, having a large number of children, especially males, is considered a good human capital. Farming livelihoods still dominate the remote sitios (sub-villages), and this is where most of the labour supply is concentrated and needed. Farming practices consist mainly of traditional labour-intensive techniques with simple farm tools. The sloping landscape, which constitutes many of the cultivated lands, makes it impossible to use tractors or draught animals with physically demanding tasks such as land preparation. There are also sitios where transportation of crops from farm to village centers for marketing occurs mainly by foot. In Luna, sacks of root crops and vegetables, often up to 50 kilos, are carried by men, women and/or children from their farms down in Cabulig River up to the village – a vertical climb of 560 m. Similarly, in San Nicolas, sacks of banana are manually transported from the riverbanks down to the village. This heavy task is undertaken on foot as this is the only way possible. Some can hire extra labour, which becomes an additional income for others.

**Table 4.8 Age-wise distribution of farming household members in (2016)**

| Village     | Ave household members | <18 years |    | 18-65 years |    | >65 years |   | Tot n (%)  |
|-------------|-----------------------|-----------|----|-------------|----|-----------|---|------------|
|             |                       | n         | %  | n           | %  | n         | % |            |
| San Nicolas | 4.5                   | 173       | 41 | 239         | 57 | 11        | 3 | 423 (100)  |
| Plaridel    | 4.9                   | 243       | 48 | 243         | 49 | 21        | 4 | 511 (100)  |
| Luna        | 5.1                   | 169       | 44 | 205         | 53 | 12        | 3 | 384 (100)  |
| Malagana    | 5.0                   | 255       | 45 | 288         | 51 | 21        | 1 | 565 (100)  |
| Mat-i       | 4.8                   | 186       | 43 | 228         | 53 | 14        | 3 | 428 (100)  |
| Aposkahoy   | 4.3                   | 169       | 39 | 256         | 59 | 10        | 2 | 437 (100)  |
| Others      | 5.1                   | 72        | 66 | 34          | 31 | 2         | 6 | 109 (100)  |
| All         | 4.8                   | 1267      | 44 | 1493        | 52 | 91        | 3 | 2851 (100) |

Source: Farming HH survey (n=604)

Demand for labour for farming in Cabulig is high, and acquiring sufficient labour during the harvest season can be challenging. Farmers with limited financial capital only utilize household labour during land preparation, planting and maintenance. Sowing corn is one task that can easily be done by a 10-year old child. Others who have larger farms, regular employment, or whose children attend school struggle to find adequate labour. A local government employee who is an aspiring farmer commented: *“Even if I already roasted a whole pig to encourage farmers to help us harvest our corn, no one came. It’s challenging if you do not maintain some people to work on the farm. Especially now with the presence of MNCs, labour competition will be more intense”*. Big farmers, who are also often the financiers of smallholder farmers, are in a better position because they have the commitment of those smallholders during harvest season. There are different ways of farming based on labour availability: full-time farmers and part-time farmers whose main work is as daily paid labour, or is in government/private company or their own business, and for whom farming is only a secondary livelihood activity. These part-time farmers cultivate their land themselves and/or hire labour. In Plaridel, some women whose husbands work abroad rely largely on hired labour for all production activities.

Health is an important component of human capital in such intensive work as farming. Across the villages, most interviewees perceived their current health status to be satisfactory (68%). In answering this question, farmers often related their health status to their age or compared it with members who are sick or disabled. For example, older farmers from Mat-i, which had the greatest number of farmers with bad health across all age groups (13%), complained that their strength had waned and that they were suffering from muscle pain, arthritis and poor vision. This has implications for their current farming practices and aspirations. One farmer from Mat-i explained: *“I want my children to have a good education. Farming is only good for uneducated people like me, who does not know anything but this. It is such hard labour. It’s very tiring.”* The use and handling of pesticides and other agrochemicals is another aspect of farming that may impact farmers’ health status. During the fieldwork, farmers were observed mixing fertilizers with bare hands or spraying chemicals without protective masks or other kinds of body protection. They

often took little notice of the precautions recommended on chemical containers. Proper waste management was also not commonly practised. Despite local policy, wastes are typically thrown out around the farm. However, the behaviour around pesticide/chemical use and waste management has changed for some farmers who plant tobacco. PMFTC strictly enforces the use of protective gear by farm labourers. As this entails a cost, investment in protective gear is part of the input capital that the Company loans the farmers. The Company's technicians are quite strict in monitoring compliance, and farmworkers have to use the gear to avoid demerit points and risk not receiving incentives that others get. This is impressive for a Company but quite ironic considering its product is a health hazard.

Access to education is another component of human capital. Literacy is relatively low in Cabulig where many farmers have only reached elementary school (63%); only 25% achieved high school levels of education. In Plaridel, 97% of farmers received some form of education. As discussed earlier, this village has a higher household income that perhaps enables education support; also its proximity to Jasaan for high school/vocational courses and CDOC for vocational/college education may contribute to higher education levels. An indigenous woman-farmer in Plaridel shared: *“At that time, Lambogohon’s school offered only up to primary grade, so I had to walk farther to finish intermediate. I start walking from home at four in the morning to arrive at school at seven. After school, I start walking at five in the afternoon and arrive at home at seven in the evening... I remembered that only the moon and stars light our way during summer, and the fireflies and thunder during the rainy season. Going to school was a hard ordeal but I completed up until high school in Jasaan”*. This is contrary to farmers in Luna, particularly those living down by the Cabulig River. A widow-farmer from this village who finished Grade III recounted: *“When I go to school, I walk up to the village every morning, and down again in the afternoon. It was a long and tiring walk... My parents were not interested to send me to school. They wanted me to miss school so I can look after my siblings. Who would be interested to go to school with that?”* In Luna, many farmers reached an elementary level (75%) while a few had never gone to school (4%).

Children start to help their parents with some farm activities at 10-12 years of age, such as sowing corn, weeding and harvesting. Only in the past decade has it become common to send children to school, at least up to high school. Due to the limited livelihood options in the villages, especially for those who have not finished school, education has become a priority for many parents. There are also many beneficiaries of the government's 4Ps Program that provides monetary support to poor households to ensure their children go to school every day. Hence, it is expected that the level of education of the younger generation in Cabulig will improve, noting the challenges of travel to school faced by many families.

Many farmers interviewed come from farming households and acquired their knowledge and skills from their parents, and their parents from their grandparents for some. Across the villages, farming is the only skill they possess (82%). This implies the importance of resource-based livelihoods, particularly land, water and forest, for the residents in this watershed, and the need to develop and broaden this skill. Only a few had two or more skills (18%). Additional skills included driving, construction and carpentry for men-farmers, and (food/snack) cooking and vending for women-farmers.

There are few differences when considering these human assets by social groups. The household size is similar, with an average of five members, as is their perceived satisfactory health condition. While the majority of interviewees have achieved elementary education, some non-Higaonons, together with males and younger farmers, have attained relatively higher levels. Apart from farming, the non-Higaonons, males, and mid- and older-farmers also have other skills that provide them additional income.

### **Social capital**

The majority (70%) of the farmers interviewed in Cabulig are not affiliated with any farmer organization (FO) (Figure 4.9). A critical constraining factor was the ease of access for the farmers to the village centers where most collective actions occur. In Luna about 90% of farmers are not members of any social group, possibly because many of them live by the Cabulig River at the bottom of the gorge. Extension services from both government and NGOs have difficulty accessing such communities because the tracks are very steep and can only be reached on foot. Across the catchment, those farmers who are members of a group are usually affiliated with a single FO (28%). Most FOs have a specific objective to achieve better productivity and more secure farming livelihoods. An exception to this exists in Plaridel, where about 40% of the farmers were part of FOs, half of which are members of the New Indigenous of Barangay Plaridel Farmers' in Pastuhan. The group's goal is to reclaim ownership of their ancestral lands.

Most farmers claimed they had no political connections (86%). Some farmers (23%) interviewed in Plaridel were related to politicians, but mostly only at the village level – the village captain or a councilor. On the other hand, many of the farmers have social support from the presence of relatives (80%) and friends (100%) in all villages, which may increase resilience against shocks and extreme events. F11 from Malagana shared: *“In the last typhoon, it was just okay because of our planted banana, they became healthy instead. But with this drought, the bananas are so affected... Then the soil is very warm. They break... We're not able to harvest anything from the corn because of this drought. The water has dried up in the springs... But we'll get by. So for us here, we will still plant corn and integrate banana. The sloping areas, we will plant more trees.”* Relatives and friends in the village help them survive the drought by providing alternate sources of income, particularly recommending big farms that need daily labour.

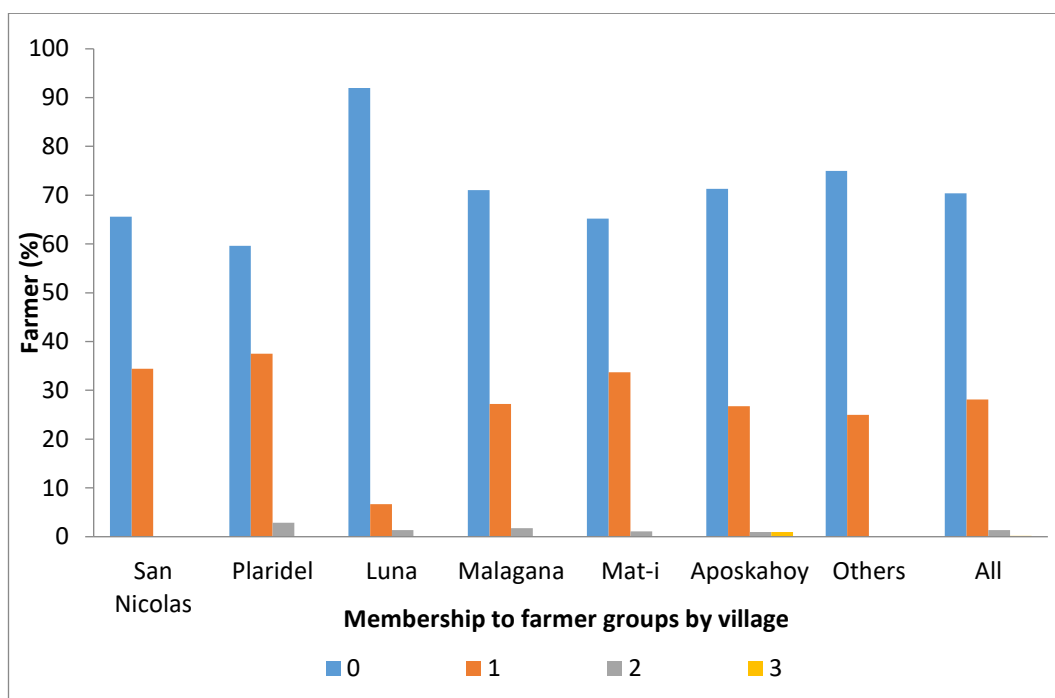


**Figure 4.9 Farmers' membership by the number of farmer organizations in Cabulig watershed (2016)**

Some farmers from Malagana (25%) and Aposkahoy (21%) said they have no relatives nearby. In Malagana, most of the farmers are migrants, apart from Sitio Linandang which is still inhabited mainly by Higaonons. Migrants first arrived in this village during the logging operations and second during the conversion of grasslands and logged areas to hybrid corn when large farmers or financiers hired labourers from the coast to work on their farms. The situation in Aposkahoy is similar. The residents of the Doal Nara Restoration Society, in particular, are all migrants, coming from all over the country, as well as Korea and countries in SEA. Their main motivation is spiritual through environmental restoration.

There is not much variation in social capital by ethnicity, gender and age, except for nearby relatives where most of the non-Higaonons said that they have no relatives where they live (50%). In summary, the current livelihood assets of farmers in Cabulig generally reflect the typical conditions of smallholders of upland watersheds in developing countries. They own small areas of two hectares where only half is tilled due to lack of financial capital. They are located in remote and inaccessible areas, which limit them from accessing the market, affiliating with FOs, and participating in political activities. They have available family labour and have integrated livestock in their farming system, but their relatively low educational attainment, lack of vehicles to transport products and limited use of mobile phones for communication affect their access to extension services, credits, and networks for agro-enterprise activities, and other assistance that may help develop their farms and diversify their livelihoods. Although these conditions vary by village and social group, the smallholder farmers in Cabulig are mostly deficient in all aspects of

livelihood assets, but most specifically for the Higaonon, women and younger farmers. Any intervention has to be targeted to enable these marginalized smallholder farmers to contribute to sustainable development.

#### 4.4.2 Important livelihood trends

##### ***Land acquisition and the decreasing farm size***

As the original inhabitants of Cabulig, the Higaonons were first to claim the lands as their property. During the migration periods, the dumagats acquired these lands in two ways: homesteads and barter/purchase. As noted in Section 4.2.2, it was the teachers from Luzon and contracted labourers that benefitted the most from the government's Homestead Program after WWII. Large tracts of land in mainland Claveria were given to them as an incentive for serving in the area. Meanwhile, individual migrants bought land from the Higaonons for very low prices or bartered with goods. A farmer from Luna shared; *"Our great-grandparents before bartered a hectare of land for a few bottles of alcoholic drinks, packs of Chinese miguey (noodles) and tin cans of sardines... These goods were consumed in a week or so while our lands are gone forever."* This suggests that the Higaonon's were not aware of the real economic value of their lands or the implications of selling the land on their future use and access. Beginning in the 1980s, land renting and/or pawning emerged as the new form of land acquisition.

In the survey, many of the farmers claimed ownership of the lands they were cultivating (70%). Referred to as 'owner-like possession', some lands are inherited but with land titles still under their grandparents' or parents' names. Titling procedures are not only costly but also tedious, requiring many documents. Legally, this means that current occupiers cannot sell these lands without the consent of other household members. The lack of formal title also limits them from accessing formal credits. This also has major implications for the overall land use in the watershed because farmers are unable to sell their land and get out of farming, which may be the best option for some. Conversely, forest communities are given access, withdrawal, management and exclusion rights but not the alienation right that is the right to sell or rent/pawn out these lands. However, with minimum government monitoring, there were cases of selling land rights. A farmer from Aposkahoy shared: *"That should have been mine because I was the only member of the CBFM in the family. But that became the source of conflict in the family. So I just left and chose to become a caretaker of this land. There, they have already sold our land. Yes, the rights... There are many people interested to buy lands here even if it's just rights."* The market price of lands in Cabulig has increased with the road development and increasing demand from MNCs and individual buyers from nearby towns and cities who want to either venture into farming for better income or simply enjoy the cooler weather, simple lifestyle and clean environment in the uplands.

With increasing population and no change in the area of arable lands, decreasing farm size is inevitable. One farmer from Luna was emotional sharing that at one point in the village's history, they owned the largest land. But now, *"We only have three ha to divide among the six siblings of my mother, which is 0.5 ha. As my parents have three children, we will further divide the 0.5 ha into three parcels, which is practically nothing. When this is divided, it will just become residential and not be farmed anymore."* By upland standards in SEA, farm size in the Cabulig watershed is small with an average of 2.39 ha. The modal farm size class of  $\leq 3$  hectares includes 81% of farms while 92% of all farms are smaller than five ha.

### ***The transition from farming livelihood to income diversification***

Livelihood diversification is evident in Cabulig with off-farm and non-farm rural economies rapidly growing in the six villages surveyed. Results show that off-farm and non-farm earnings account for more than 60% of farming households' total income. The reliance on off-farm income sources started in the 1960s with the promotion of coconuts and cassava downstream, and tomato farms upstream in the 1970s (Figure 4.10). Farm labourers were hired locally, as well as from nearby towns and islands. While working as farm labour is presently an important source of income for most farmers, it is a physically difficult job. A widow-farmer in Luna who was forced by financial hardship to work as a daily paid labourer said: *"I work from 7 am. I stop at 12 noon. I start again from 1 pm until 4 pm. Rain or shine. It's not an easy job... Two of my six children also work as daily paid... I can only hope that they [the other children] will not become farmers like me."* Some big farmers provide free meals to their labourers but with a lower rate of pay. Nonetheless, their daily income provides cash that helps satisfy the household's basic needs (e.g. food, school fees) while maintaining their farms.

Most of the income from non-farm activities is wages of household members who are either public servants or are working for various government and private companies. Those who have better education (i.e. high school) work for the village government as staff, nutritionists and health workers. Others who serve as 'tanod' (deputized police in the village) also receive a monthly honorarium. Remittances from household members who work in cities or abroad are also an important part of their total income. Monthly remittances are usually used for their siblings' or children's school fees or elderly parents' subsidies. A farmer-carpenter from Luna shared: *"We invested in tomato farming years ago but failed... My wife is now in Lebanon working as a domestic helper to support our children's education... I just became a grandfather. It's hard to rear teenagers. As much as we want them to get a good education, if they do not aspire for the same future, nothing will happen. We'll all end up farming."* This is one example of a livelihood strategy that has negatively affected intra-household relationships in the villages; worse examples encountered in this research were broken families because of the infidelity of a spouse while working away from home.



|       | Major events                                            | Lower villages<br>(San Nicolas and Plaridel)                                                                                                                                      | Middle villages<br>(Luna and Malagana)                                                                                                                   | Uppervillages<br>(Mat-I and Aposkahoy)                                                                                                |
|-------|---------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------|
| 1950s | End of World War II                                     | -Slash-and-burn farming<br>-Hunting<br>-Collecting shells in river/fishing<br>-Mat weaving                                                                                        | -Slash-and-burn farming<br>-Hunting<br>-Collecting shells in river/fishing                                                                               | -Slash-and-burn farming<br>-Hunting<br>-Collecting shells in river/fishing                                                            |
| 1960s | Logging operations<br>Promotion of coconut and coffee   | -Working as tenants and/or farm laborer in big coconut farms                                                                                                                      | -Laborers in logging companies<br>-Farm laborers in coffee farms                                                                                         | -Laborers in logging companies<br>-Farm laborers in coffee farms                                                                      |
| 1970s | Promotion of cassava                                    | -Farm laborers in cassava farms                                                                                                                                                   | -Farm laborers in tomato farms                                                                                                                           | -Farm laborers in tomato farms                                                                                                        |
| 1980s |                                                         |                                                                                                                                                                                   | -Farm laborers in vegetable and corn farms                                                                                                               | -Farm laborers in vegetable and corn farms                                                                                            |
| 1990s | -Establishment of economic zones                        | -Factory workers in Villanueva and Jasaan Economic Zones<br>-Driving (motorcycles)                                                                                                | -Small-scale business (stores)<br>-Driving (jeepneys, trucks)                                                                                            | -Small-scale business (e.g. stores) (market stalls)<br>-Driving (jeepneys, trucks)                                                    |
| 2000s | -Plantation operations<br>-Construction of Minergy HEPP | -Employment in pineapple plantation<br>-Construction workers<br>-Remittances from household members working in cities or abroad<br>-Working in sugarcane farms in other provinces | -Driving (motorcycles)<br>-Government employment (teaching, local government)                                                                            | -Driving (motorcycles)<br>-Government employment (teaching, local government)                                                         |
| 2010s | -Expansion of plantation operations<br>-Rural banks     | -Small-scale business (stores, food vending)                                                                                                                                      | -Remittances from household members working in cities or abroad<br>-Small-scale business (stores, food vending)<br>-Skills-based casual jobs (carpentry) | -Employment in banana plantation<br>-Small-scale business (stores)<br>-Remittances from household members working in cities or abroad |

**Figure 4.10 Historical events that have influenced livelihood change in Cabulig watershed (2016). (Source: KIIs [2015; 2016]; Focus groups [2016])**

### ***Declining collective actions and limited extension services***

In the early 2000s, there were several NGOs (e.g. Balay Mindanao, ICRAF) advancing various aspects of rural development, in addition to the government's land distribution and reforestation programs. Presently, their number and presence vary across the landscape, as well as the diversity of their projects (Figure 4.11).

With Cabulig's remote communities and difficult terrain, extension delivery and facilitation are challenging. When coupled with institutional weaknesses and limitations (e.g. lack of manpower, funds, priorities), there are deficiencies in the provision of extension across the villages surveyed. Farmers respond to this differently. A farmer-leader from Aposkahoy who has the connections and the means can go to government offices and seek what he and his community needs (i.e. water system, agrarian map). Those farmers with limited assets have to rely on their resources and do things by themselves. A farmer in San Nicolas commented about the lack of extension services: *"None that I know... But when there is an election, ah they directly come here – election campaign and this population census... But those agricultural projects, no. We initiate things on our own here."*

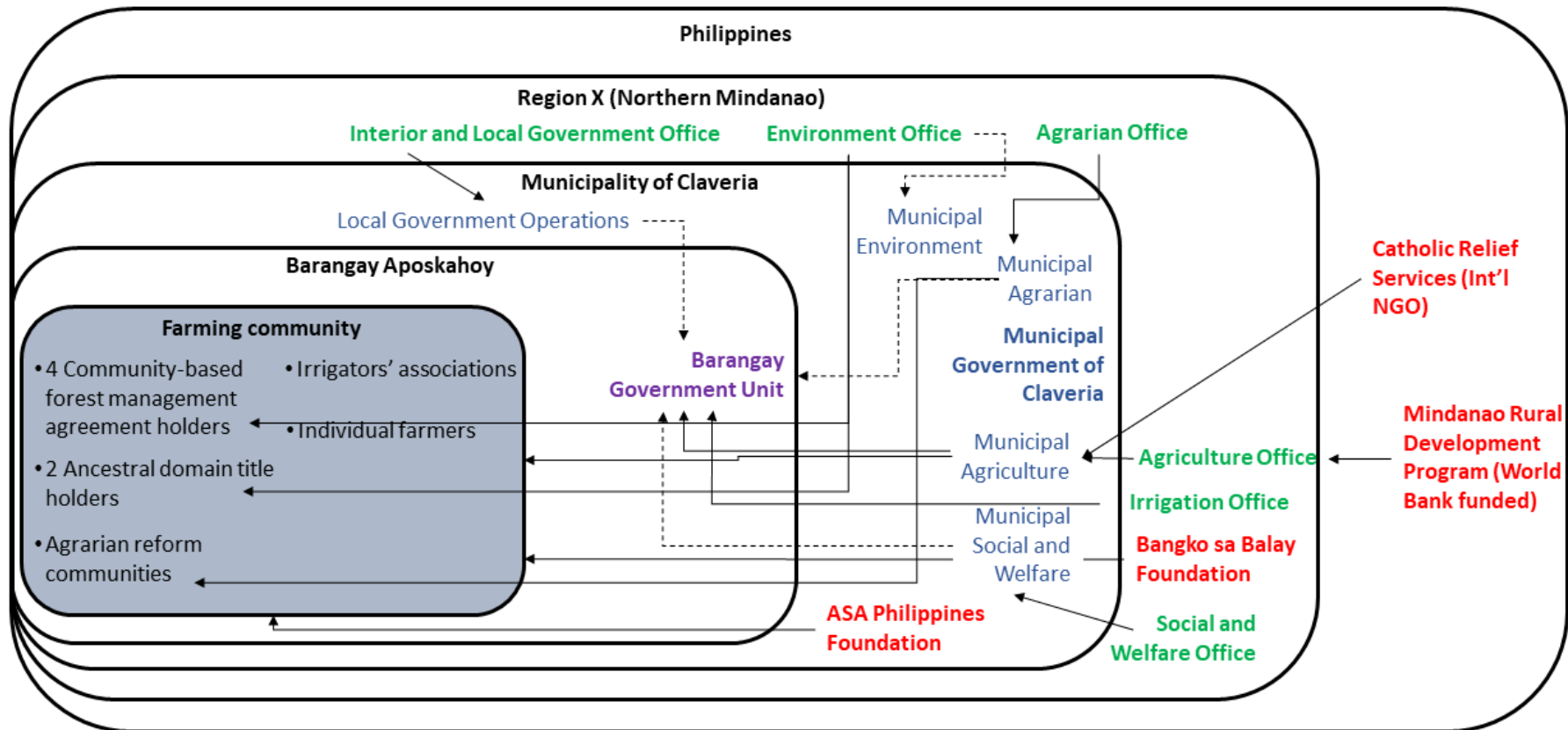


Figure 4.11 Institutions that support the farming livelihood in Aposkahoy, Cabulig watershed (2016). An institution in purple is the village government; blue is municipal government offices; green is national-regional offices; and red is private companies, international non-government organizations, and funding agencies. Direct arrows mean they directly facilitate farmer organizations while broken arrow lines mean they go through the village government to facilitate their projects.

Focus group results show that more institutions are working with farmers in upper villages, which can be attributed to important forest ecosystems and the presence of indigenous communities. Most farmers identified the Department of Agriculture<sup>55</sup> (DA) as the most important institution. The way farmers and these institutions connect and behave vary depending on their activities, locations, funding, and rules and norms. Some institutions like the tobacco company work directly with farmers, while others such as DA have to carry out their activities through the local government units (municipal, village). Some projects come regularly to the farmers such as those from the governments, while others are project-based and have a specific duration, which is mostly from the NGOs. Nonetheless, the farmers value relationships that are based on voluntary participation, and transparent two-way communication and learning.

Based on interviews, there are several farmer scenarios with regards to FOs: (1) unsustained FOs, since disbanded or inactive; (2) struggling FOs without facilitation; (3) functioning FOs with facilitation; (4) uninterested farmers due to bad experience/s in past organizations; and (5) interested farmers who do not have opportunities. The last condition is more prevalent in remote areas, where farmers claimed to have good social support in times of adverse shocks but only from relatives and friends. In other areas, many farmers seem uninterested in joining collectives due to not-so-good experiences in the past. One of the problems raised was the transparency of transactions, where only the leaders make decisions for the whole group. The benefits, particularly financial gains, were sometimes concentrated with certain members but the whole group bore the burden when there were problems. This developed distrust among members. Some FOs whose stakes were high, like those aiming to address land ownership issues, made the effort to reform and address internal issues. However, current FOs are mostly reactive and driven by short-term economic goals. F06 recalled: *“At that time, I was the president for three terms. Just to get budget and finish the trees’ strip brushing activities, tree planting will continue in areas designated by the DENR, I sold my cow for PhP15,000 to finance tree planting... I was able to bill the Asian Development Bank of about PhP200,000. I worked on those areas again and billed an amount of PhP500,000 but was refused by the new president... They were encouraged to become president because money was already available... When the fund arrived, there was a bit of a commotion... Our policy was changed regarding re-election of leaders. She knows that there is still money. What did she do? She membered even those newly weds so she can have many votes.”* That farmers preferred individual loans to group loans also reflects declining interest in collective action. Nonetheless, there is a perceived need mainly from external stakeholders to revive the value of social capital among farmers in Cabulig. The Municipal Agriculture’s Office of Claveria,

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<sup>55</sup> During the survey and interview, farmers often refer DA as MAO, which shows that they are not aware of the Local Government Code’s devolution.

in particular, has taken several steps to address this. For example, they allocated funds to organize the Municipal Agriculture and Fishery Council and revive farmer cooperatives.

## **4.5 Discussion**

Rural development aims to improve a farming community's economic and social well-being (Ellis & Biggs, 2001), reflecting new or improved livelihood activities and increased capacities and means of living, including food, income and assets (Chambers & Conway, 1991). However, achieving such improvements is a challenge in Cabulig, as in other watersheds in developing countries where land conversions often compromise farming livelihoods (Lambin et al., 2003; Rola, 2011). This chapter uncovered an intergenerational land use transition that has influenced (and been influenced) by farmers' different livelihood capitals and capacities, highlighting the complex and dynamic nature of landscape and livelihood transformation.

### **4.5.1 Landscape transformation and emerging multi-functionality**

Historical records show that many upland watersheds in the Philippines and SEA are transforming from rural systems to urban areas (Douglas, 2006; Rola, 2011). Cabulig has seen distinct periods of change since the spontaneous migration of the 1920s and the government-sponsored migration of the 1950s. The migrants' permanent agricultural plots replaced Higaonon's traditional farming systems (Vliet et al., 2012). This was followed by the government's enterprise-driven programs, and most recently a rapid shift into corporate-driven plantation crops. This transition has fragmented and disintegrated the forestal landscape with agricultural mono-crops (e.g. corn, cassava) and plantation crops (e.g. pineapple, banana, tobacco) dominating the flatlands and undulating slopes across the watershed. Even steep areas, which are highly vulnerable to soil erosion, are now cultivated due to the limited availability of arable land, such that 'real' forests only remain in inaccessible areas at high elevation.

Although cultivated lands are integrated with trees, this is mostly incidental and the majority of production systems are agriculture-based with almost all farmers growing crops that are only moderately suitable or marginal/unsuitable in their locations. This has implications not just for farmers' current and future land health, but also Cabulig's continued provision of watershed services and other environmental functions (van Noordwijk et al., 2015). Conservation measures are needed to sustain farming in such fragile environments (Cramb, 2005). However, as shown above, farmers' circumstances vary, as reflected by their current production systems and livelihood strategies, and this has implications for their capacity to invest in conservation measures.

In areas where the expansion of corporate plantations is on-going, there are concerns about their sustainability (food security, soil fertility) similar to rubber in Lao (Thongmanivong et al., 2009)

and oil palm in Indonesia (Rist et al., 2010). In Plaridel, one farmer shared that lands that used to be pineapple plantations take several years before corn can grow again. For this reason, she will not renew their rental contract with the company after the 15-year lease ends. But there was no doubt that this strategy solved their loan problem with a bank at the time of taking the lease, and ensured income security through family members who worked as labourers in the plantation. In Mat-i, banana plantations have shown the capacity to make poor acidic soil more productive, but have ultimately displaced some farmers from these lands.

In understanding the multi-functional agriculture that is emerging in many upland watersheds in SEA (Renting et al., 2008; van Noordwijk et al., 2015) – as in Cabulig – food production remains central mainly because the majority of farmers have limited livelihood capitals. However, declining farm incomes have caused some better-off farmers to diversify farm activities, as well as expand their sources of income to include off- and non-farm occupations. Moreover, some farmers' agroforestry practices are a sign that cultivated lands are increasingly valued not just for food production but also for their aesthetic and environmental qualities. Some new migrants from cities are motivated to adopt agroforestry to enjoy 'biodiversity and laidback lifestyles' in the uplands. This shows that long-term farmers and new landholders have different values and knowledge that affects their land use and management (Curtis et al., 2001; Douglas, 2006). Nonetheless, the multi-functionality of upland watersheds must be balanced and managed to meet the different priorities and aspirations of the different farmers, including the needs of the downstream communities, without affecting Cabulig and its viability for agricultural and forestry production. This involves improving the provision of ecosystem services – in particular hydrological services (flood mitigation) and landslide prevention.

#### **4.5.2 Diversification of livelihoods**

The identity of upland dwellers in Cabulig as 'farmers' has also changed (Renting et al., 2008). Farming alone is no longer a viable livelihood option for many farmers such that economic activities have become diverse. As in Indonesia (Mahdi et al., 2009), farmers with diverse livelihood activities typically have a relatively better and more secure income. There are differences in the extent of off-farm employment and the variety of non-farm activities across the watershed. In villages where large areas are owned by a few big farmers, the opportunity to earn as daily paid labourers is high, so that farmers who have surplus household labour rely on working as farm labour. The proximity of villages to towns and CDOC enables those farmers with relevant skills and education to find regular employment in the government, factories or plantations while maintaining their farms either themselves at weekends or by hiring farm labour. This shows that farmers' locations and access to livelihood capitals influence their capacity to take advantage of available livelihood opportunities.

The diversity of farmers' livelihood activities is linked to their livelihood capitals and the viable activity choices they face (Chambers & Conway, 1991). Sufficient financial capital enables farmers to develop their production system, change to a more profitable crop, or diversify their livelihood activities. Meanwhile, those who have little land but surplus household labour usually apply that labour to their farm and hire out labour for an off-farm wage to other, bigger farms for additional income. In contrast, those who have large areas of land may sell or rent out a portion of this natural asset and invest in a non-farm activity like a small-scale business. This is common in villages where plantations operate. The rent paid for the land was invested in businesses such as sari-sari stores, food restaurants and vulcanizing shops<sup>56</sup>, following the increasing number of vehicles in the area. While managing these, some continue to devote their time to farming; others simply hire labour to work for them on the farm.

Farmers' have various reasons for diversifying their livelihoods beyond farming alone. The need emerges naturally from limited farm size, time-varying returns from tree crops, or impacts of fluctuating market demand/prices and extreme events. In the last case, livelihood diversification may be a kind of self-insurance where farmers forego some expected earnings for reduced income variability in the future. They do this by deciding and investing in alternative livelihoods that have a low impact on the household's total income. A combination of farm earnings with seasonal off-farm labour, regular employment, and/or business can reduce household income variability.

In Cabulig, lack of financial capital is an important productivity issue for many farmers, preventing them from investing in crop inputs (quality seed, fertilizer), soil amelioration products (lime) and soil conservation. While accessing credit is a crucial strategy for the farmer to overcome this constraint, the majority of the farmers are unable to access such financial support due to the limited presence of financial institutions<sup>57</sup>. Even when credit is available, farmers' access is limited by the absence of necessary documents to show land ownership. However, financial capital alone cannot solve the land use and livelihood problems in upland watersheds, because farmers may not be able or willing to put their financial resources to good use due to a lack of knowledge of the alternatives, or due to constraints imposed by policies, institutions or processes.

### **4.5.3 Aligning programs to farmers' land use priorities and livelihood capitals**

The land use and livelihoods of many of the farmers interviewed reflect that effective institutional, financial, technological and informational support are generally incomplete in Cabulig. Farmers

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<sup>56</sup> Local shops where broken tires are fixed and/or changed

<sup>57</sup> Individual financing is the most common and accessible form of financial assistance

have to find their own ways to continue farming, for most as a matter of survival, but for a few as a path to prosperity. In the neighboring Manupali watershed, large farmers get most of the government's incentives on agroforestry and tree farming (free seedlings, training) because of their institutional connections and access to information (Catacutan & Duque-Piñon, 2009). There are differences in farmers' livelihood status in Cabulig, with some benefitting from major land use changes, while others lose out. Big farmers benefit more than smallholders because they have financial reserves to finance the production of in-demand, high-value crops, as well as links to government and other organizations, which in turn provide them better access to information, technologies and markets. In contrast, smallholders' minimal livelihood assets limit their activities mainly to production for consumption. They are trapped in sustaining their existing farming and off-farm livelihoods. While facing constraints in accessing external support, such as technical and financial assistance, smallholders are placed in more vulnerable situations because of their limited capital. Degrading land resources resulting in declining productivity and profitability (Chapters 2.2.2 and 4.3.1), coupled with limited alternatives for livelihoods, add more hardships to their conditions. They are then compelled to either sell/rent out their lands<sup>58</sup> or leave farming to move to the cities or abroad. Government interventions such as technical and financial assistance through effective extension services should be established to build farmers' livelihood capitals and enable them to adopt better land uses and diversify their livelihood activities (Mahdi et al., 2009).

## 4.6 Conclusions

This chapter has addressed the importance of understanding the current conditions and long-term trends in land use and livelihoods in a watershed: how the transformation evolved and may continue evolving in the future. Using a triangulation approach with multiple data sources, the historical sequence of key events that influenced land use change patterns has been identified and the development of associated diverse livelihoods in Cabulig described. It argues that the cumulative effects of long-term land use trends frame both the current conditions of the watershed and farmers' livelihood strategies.

Current land use and livelihood activities are heterogeneously distributed across different locations in the watershed. However, the identities of upland watersheds and their dwellers are changing. Declining farm size, lack of financial capital and ineffective extension services among other factors are affecting smallholder farmers' land use and livelihoods and have resulted in out-migration – to seek employment for income or acquire better education (not related to agriculture/forestry) for higher income. This has implications for the future of farming. This

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<sup>58</sup> Some are are constrained by the lack of formal titling

chapter claims that under these conditions and trends sustainable land use and farming livelihood have become more vulnerable. Smallholder farmers, in particular, will continue to have limited capacity to respond to the expected impacts of market shocks, climate change, and long-term degradation of their land resource through erosion and declining soil fertility. Understanding the complexity and dynamics of this transformation should prompt the government to adjust its policies and programs to assist farmers to develop their land use and livelihood strategies to adapt to the emerging conditions.

The transformation of Cabulig's land use was influenced by both internal and external factors. Understanding drivers of change are integral to understanding land use and livelihood transformation. Although drivers of change have received increasing recognition in the literature, understanding how this occurs over substantial periods, and affects livelihoods in the context of upland watersheds in developing countries, remains limited. The next chapter will examine to what extent the drivers of change have influenced farming household decision making over their lands and livelihoods.



# Chapter 5: Drivers of land use and livelihoods and influences on farmer decisions and strategies

## 5.1 Introduction

Land use and livelihood transitions have been studied in the domains of forestlands (Rudel et al., 2005) and watersheds (Thongmanivong et al., 2009), and in the context of rural development (Ellis & Biggs, 2001) and climate change (van Noordwijk et al., 2013). While transition effects differ based on geographic location within a watershed with drivers connecting and interacting at different levels, space and time (McLennan & Garvin, 2012), they occur at the farm and landscape levels, and are often outcomes of many farmers deciding to change their land use and livelihoods. These decisions are influenced by various economic, sociocultural, political and institutional determinants operating at the farm level that interact with biophysical conditions and a climate variability that has recently become more pronounced (Hettig et al., 2016; Lasco et al., 2016). Farmers' knowledge, values and aspirations also inform these interactions (Curtis et al., 2001). The land use and livelihood changes made by farmers in the process are often diverse and complex (Douglas, 2006), which consequently leads to varied outcomes for the well-being of farming households, their village and the watershed.

This chapter identifies and analyses the key drivers of both land use and livelihood change, and how these influence farmers' decisions and strategies (Research question 3 in Chapter 1, Table 5.1). Using thematic analysis, the Sustainable Livelihoods Framework is used as a conceptual tool for the study. The five capitals represented in the framework (Chambers & Conway, 1991) guide identification and comparison of the patterns (commonalities and differences between villages) across data sets that are associated with the drivers of land use and livelihood change identified in Tables 5.2 and Table 5.3. These drivers are determinants of farmer decisions and strategies. Following the recommendations of Scoones (2009), the connections and interactions of these drivers and determinants over knowledge, space, dynamics and politics at the farm, village and watershed scales are considered and discussed.

Section 5.1 introduces the rationale and objective of this chapter. Sections 5.2 and 5.3 explore the forces that shape the land use and livelihood conditions and trends, respectively, at both village and watershed levels. Section 5.4 then analyzes how farmers make their land use decisions and livelihood strategies. The connections and interactions of drivers and determinants of land use and livelihoods are discussed in Section 5.5 through case studies, with the chapter synthesis in Section 5.6. Excerpts from the key informant interviews (KIIs) used to inform this chapter are tabled in Appendices 5 and 6.

**Table 5.1 Overview of data sources, analyses and purposes by Chapter 5 subsections**

| Data sources                                                                       | Analyses                                                                                                          | Purposes                                                                                                                           |
|------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------|
| Section 5.2: Drivers of land use condition and trends                              |                                                                                                                   |                                                                                                                                    |
| Key informant interviews (KIIs)*                                                   | Drivers of land use condition and trends                                                                          | Examine major drivers of land use condition and trends in Cabulig                                                                  |
| Focus groups                                                                       | Major drivers of land use change                                                                                  |                                                                                                                                    |
| Section 5.3: Drivers of trends and current livelihoods                             |                                                                                                                   |                                                                                                                                    |
| KIIs*                                                                              | Drivers of current livelihoods and trends                                                                         | Explore major drivers of current livelihoods and trends in Cabulig                                                                 |
| Focus groups                                                                       | Major drivers of livelihood change                                                                                |                                                                                                                                    |
| Section 5.4: Determinants of farmers' land use decisions and livelihood strategies |                                                                                                                   |                                                                                                                                    |
| KIIs*                                                                              | Factors (livelihood capitals) that influence farmer land use decisions and determines their livelihood strategies | Identify and compare the determinants of farmer land use decisions and determinants of livelihood strategies across villages       |
| Section 5.5: Connection and interaction of drivers and determinants                |                                                                                                                   |                                                                                                                                    |
| KIIs*                                                                              | Case studies on governance (land use) and globalization through plantations (livelihood change)                   | Analyze the connection and interaction of land use and livelihood change as influenced by knowledge, space, dynamics, and politics |
| Focus groups                                                                       | Major drivers and determinants of land use and livelihood change in Cabulig                                       |                                                                                                                                    |

\*Section's main data source

## **5.2 Drivers of the current land use condition and its trends**

Six major interrelated and overlapping drivers of land use change in Cabulig watershed over the past century were identified by the key informants (KI) involving farmers, policymakers and experts in Cabulig (Table 5.2). For the land uses over time identified in Chapter 4, the KIs were asked, *'What drove this change? Who initiated the change? How did the change occur? Who benefitted and did not benefit? Why do you think so?'* The information was thematically organized in the NVIVO package and analyzed based on the current condition and trends described in Chapter 4. The results were supported by findings from the focus groups and secondary data such as policies, plans and reports.

### **5.2.1 Natural environment**

The KIIs identified that 'natural environment' drivers have shaped current land conditions (e.g. declining soil fertility, land scarcity issues and intensification) (Table 5.2).

Although a large portion of Cabulig is remote and inaccessible due to difficult terrain, its forests, elevated location and high rainfall contribute to the relatively cool climate that is conducive for farming, particularly for temperate vegetables. This natural environment is an inherent characteristic that drove in-migration and intensification after World War Two (WWII).

**Table 5.2 Relationships between current conditions/trends and drivers of land use change in Cabulig (2016)**

| Current land use conditions/ trends                    | Drivers             |                             |                               |               |                             |                |
|--------------------------------------------------------|---------------------|-----------------------------|-------------------------------|---------------|-----------------------------|----------------|
|                                                        | Natural environment | Demographic characteristics | Government policies & actions | Globalization | Non-government institutions | Climate change |
| Land conditions, declining soil fertility, terrain     | X                   | X                           | X                             |               |                             |                |
| Land scarcity, intensification                         | X                   | X                           | X                             | X             |                             |                |
| Land adjustment, intensification                       |                     | X                           | X                             | X             | X                           | X              |
| Global integration, expansion of cultivated lands      |                     |                             | X                             | X             |                             | X              |
| Market access, preference to the non-tree-based system |                     |                             | X                             | X             |                             | X              |
| Land ownership                                         |                     |                             | X                             | X             | X                           | X              |
| Diffusion of conservation ideas and technologies       |                     | X                           |                               | X             | X                           | X              |

Source: Key informant interviews (2015; 2016)

**Table 5.3 Relationships between current conditions/trends and drivers of livelihood change in Cabulig (2016)**

| Current livelihood conditions/ trends                                 | Drivers           |                                 |                                                               |                                    |                                  |                |
|-----------------------------------------------------------------------|-------------------|---------------------------------|---------------------------------------------------------------|------------------------------------|----------------------------------|----------------|
|                                                                       | Population growth | Changes in agricultural systems | Infrastructure development, market access and public services | Urbanization and industrialization | Government policies and programs | Climate change |
| Land intensification                                                  | X                 | X                               |                                                               |                                    | X                                | X              |
| Economic resources, farm size, capital                                | X                 | X                               | X                                                             | X                                  | X                                | X              |
| Education, experience and aspirations                                 | X                 | X                               | X                                                             | X                                  | X                                |                |
| Remote, poor road system                                              |                   | X                               | X                                                             |                                    | X                                |                |
| Collective actions, reliance on relatives and friends                 | X                 | X                               | X                                                             |                                    | X                                |                |
| Government policies, extension services, restrictions, and incentives | X                 | X                               | X                                                             | X                                  | X                                |                |

Source: Key informant interviews (2015; 2016)

The informants often associated the pressure of farming households on land and its soil condition with (inappropriate) fertilizer application. In Malagana, F10 shared: *“It’s different now because before, we didn’t use any fertilizer but still the harvest was very okay. Until we had to use chicken dung. Then we started using fertilizer... The soil is already used to these inputs. Without these, the corn will not grow well.”* Since F10 started farming, agricultural expansion and intensification coupled with inappropriate land use and practices on Cabulig’s inherently fragile lands have increased erosion on steep slopes and depleted soil fertility to the extent that fertiliser additions are now needed to grow crops. The digital soil mapping by Ringrose-Voase et al. (2019) shows that the topsoil of most cultivated lands in the watershed is acidic, except on the riverbanks and steep gorges of the River. Natural acidity of topsoil and steep terrain, made worse by inappropriate land use and management, has led to a decline in soil fertility on farmers’ lands.

### 5.2.2 Demographic drivers

Cabulig’s demographic drivers include the population changes caused by migration into and out of the watershed, peace and security issues, and other economic and sociocultural changes. These drivers have influenced land scarcity, land adjustment, intensification and the diffusion of conservation ideas and technologies (Table 5.2). Land adjustment here refers to deliberate alteration of land to improve it and make it arable for cultivation such as applying soil and water conservation, fertilization and contouring. Lands are ‘adjusted’ due to land scarcity, particularly lack of arable areas.

As discussed in Chapter 4, the Higaonon’s practice of swidden farming did not alter the forest ecosystem much since there was a small population at that time. The later arrival of migrants led to forest clearance for settlements and cultivation. For example, the Bohol Islanders converted the foot slopes of Mt. Sumagaya to rice paddies in the 1960s. P06 recalled: *“The first generation of Bol-anons who came here were knowledgeable about rice production. They formed the rice paddies. We, their children, saw how they did it. We also developed our own over the years”*. In the 1980s, the government’s Farm Systems Development Corporation improved the canals and lined them with concrete, which enabled the expansion of rice production in the village. The steady but continuous in-migration since the 1920s has changed Cabulig’s natural environment and land use over the years.

While the main initiator of forest clearing in Cabulig was the logging operations of several private concessionaires since the 1920s (see Chapter 4.2.2 and footnote 60), there are other actors with differing effects. They are led by the Higaonons who practised slash-and-burn agriculture. They allowed the migrants to stay who later practised semi-sedentary farming. F10 shared: *“My father was the first teacher here in Malagana ... As a gift, the natives gave us the land, which we planted with coffee”*. The families of the migrants’ children shifted to the fallow system. The subsequent

younger families then applied diversified production systems where smallholders integrated crops with livestock. Bigger farmers opted to maintain coffee farms.

On the issue that the migrants ‘mischievously’ accumulated land from the Higaonons, F10 countered: *“They were not cheated (‘lokoha’). They negotiated that, ‘is it possible that I will exchange our land with some food [salmon]’ ... That point-system (‘tudlo’), just point. It’s not being measured... Or when we throw the bolo (‘sundang’), ‘that area where the bolo fell, that will be my exchange – here to there’.”* So, if you throw it slow, you also have smaller land. It was just a very casual negotiation. In the process, the Higaonons were displaced from relatively flatlands and rolling areas and had no option but to move onto sloping areas or into the remaining forest. The dynamics between indigenous and migrant populations explain the village and farm-level forces that have driven forest cover, farm location and land quality changes over the years.

Population growth and changes in farmers’ socio-economic status affected household structures. Extended families broke down into several smaller families. This meant increased clearing of forests to provide land for settlement and wood to build houses and use as fuel. The higher number of smaller households, the higher the risks of forest and land degradation, whereas a smaller population allowed greater forest cover and soil rejuvenation. This was evident during the peak of insurgency (1980-1984) when farmers from Mat-i, Aposkahoy and Malagana fled from the area. Some of the women stayed and farmed smaller plots just to provide food for their husbands and adult male children who evacuated to Poblacion or neighboring towns, cities and provinces. Cultivated lands were left fallow, enabling natural restoration of the tilled soil and disturbed forest. But when they came back, beginning in 1985, tomato cultivation expanded with the integration of Cabulig into regional and national agricultural markets. Cagayan de Oro City (CDOC) was set up as the market for their harvests. This link between Cagayan market and Cabulig instigated the financing schemes offered by the financiers to smallholder farmers who did not have the financial capital but did have the land and labour resources. F10 shared: *“With tomatoes before, I had to seek [local] financing because the capital was so expensive. Then I met another financier from Cagayan. Until I was able to save some capital and... finance my farm.”*

The market value of land increased alongside agricultural expansion, which resulted in land selling, pawning and/or renting. Absentee landowners are now common in Cabulig as some retirees from cities own the prime lands in the watershed or those along the roads. F08 said: *“There are many people interested to buy lands here even if it’s just rights. The area is gradually improving... Our landlord is from Cagayan. He only bought the rights to this land.”* This Cagayan-Cabulig linkage also increased the growth of urban aspirations, which led to rural-urban migration such that, while the growth of urban areas created new markets for timber, livestock and agricultural products, it also increased the household’s total income because of the remittances from family members working in the cities.

### 5.2.3 Government policies and actions

Several major policies have influenced land use change in Cabulig since the 1920s, and contributed to most of the conditions and trends listed in Table 5.2. Among these was the government's strategy from the 1960s to 1970s to exploit forest resources to generate revenue. A focus group participant shared, “...forest canopy covered the sky as I walked from Aposkahoy to Mat-i. It was always dark in the village even in daytime... The logging trucks can only carry one log because the old trees were so huge that three people had to hold hands to gather around the base...” Two major logging companies were operating in Cabulig at that time<sup>59</sup>, and a few smaller ones remained until the early 1980s. As in other upland areas in the country, the unprecedented deforestation caused by logging led to the enactment of the Presidential Decree (PD) 705 on Forestry Code (1975). This was followed by the implementation of several tenurial instruments believing that better land arrangements would progress to responsible land use and stewardship. The Republic Act (RA) 7586 on National Integrated Protected Areas System (NIPAS) (1992) was also enacted to protect ‘remarkable and biologically-important public areas’ and sustain the life-support system and development. While it had a worthy goal, the policy affected farmers’ land use when the Mt. Balatukan Range Natural Park (MBRNP) was declared a protected area in 2007. Meanwhile, the Local Government Code of 1991 paved the way for decentralization, which was operationalized through the devolution of major basic services including agricultural and environmental protection, to the local government unit (LGU) in each municipality (Section 3.2.4). While the Municipal Agriculture Office’s (MAO) function remained despite institutional challenges, most LGUs opted not to create a Municipal Environment and Natural Resources Office (MENRO). Moreover, the LGUs’ power to generate revenues to fund local development enables them to decide the operations of multinational companies (MNCs) within their jurisdictions.

Currently, there are five existing major resource management regimes in Cabulig, which are implemented by six different institutions: (1) the Department of Environment and Natural Resources (DENR) for the whole watershed, particularly the forestlands (PD 705), (2) the Protected Area Management Board<sup>60</sup> for MBRNP (still under the DENR), (3) the National Commission on Indigenous Peoples (NCIP) for ancestral lands (RA 8371 of 1997), (4) the Department of Agriculture (DA) for alienable and disposable lands, (5) the Department of Agrarian Reform for those lands with Agrarian Reform Communities (RA 6657, Comprehensive

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<sup>59</sup> In 1957, the de Lara and Poblete logging company was granted a timber concession to log in about 300 hectares in Claveria, Misamis Oriental allowing them to cut annually about 600 m<sup>3</sup> of timber. In 1961, P&B Enterprises Co., Inc. was given a forest concession of approximately 25,000 hectares, also in Claveria.

<sup>60</sup> A multi-sectoral board that decides for and manages the MBRNP.

Agrarian Reform Law of 1988), and (6) the LGUs that share the responsibilities with the DENR in developing and protecting all natural resources (RA 7160). Although there are current convergence projects between forestry, agricultural and agrarian sectors around Mt. Balatukan, the land use condition at the farm level is still characterized more by segregation than integration. Also, in the early 2000s, following the Philippines' Strategy for Improved Watershed Management (1998), DENR's initial efforts resulted in drafting the characterization report of Cabulig, and its watershed management and development plan, as well as the creation of its Council. These documents were not ever finalized because the Council is not functional. To date, there is still no institution that oversees and integrates all the activities in Cabulig. In effect, individuals and agencies alike adopt land use and management practices in their areas without an overarching strategic or operational guidance. For example, agricultural cultivation is prevalent in areas above 1000 masl and along the riverbanks, which are prohibited in the PD 705. These fragile areas are meant for protection because of their fragile ecosystems. This shows that the government's failure to enforce zoning ordinance or the absence of robust comprehensive land use plans or both is an important policy driver that influence land use change.

## 5.2.4 Globalization

Globalization facilitates open trade, reduces government interventions, and increases the interdependency between countries. MNCs are key players in accelerating economic development and promoting technological advancement, and so have recently influenced most of the conditions and trends listed in Table 5.2. The signing of the Philippine government to the World Trade Organization in 1995 facilitated the liberalization, deregulation and contractualization of numerous sectors including the agro-industrial sector<sup>61</sup>. Cabulig became part of this when a pineapple plantation commenced operation on Plaridel's plateau near the edge of the watershed in the early 2000s. Pla1037 shared, *"Our nine-hectare land has been rented by the Del Monte Philippines, Inc. from 2010 to 2021 where one hectare is PHP 10,000/year... A family member was also given the opportunity to work as field labor, my cousin."* Now, three MNCs are operating in the watershed, and they are continuously expanding. Many prime lands have become a wide expanse of plantations where traditional food crops have been replaced by pineapple, banana and tobacco meant for export (Table 4.2, Chapter 4). Some landowners have become casual workers in these companies, while continuously cultivating their sloping plots along the edges of the plantations. Considering their impacts on the community and environment, these companies are also striving to achieve a social license by applying better green certification of their operations

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<sup>61</sup> Prior to WTO, the Philippines was also a signatory to the General Agreement on Tariffs and Trade (GATT) in 27 December 1979

according to international standards. For example, Phillip Morris upholds the Good Agricultural Practices guidelines and assessment to ensure standard farming techniques and productive farm practices<sup>62</sup>.

### 5.2.5 Non-government institutions

Several non-government organizations (NGOs) and institutions interact with farmers, and in the process influence their land use decisions and actions, namely through land adjustments in response to intensification, land ownership and diffusion of ideas and technologies (Table 5.2).

Since the Earth Summit in 1992 that promoted the concept of participatory watershed management, there have been several private research institutions and NGOs that conducted research, development, and extension (RDE) activities in various villages. Their activities were funded by international and/or national funding agencies. For example, the Australian and Spanish governments funded the Landcare Program implemented by the World Agroforestry in Claveria including Cabulig (1998-2004). By organizing farmers from the sub-village, to the village and municipal levels, the program rapidly disseminated options for soil and water conservation technologies, including contouring sloping lands and agroforestry development (Mercado et al., 2001), which adjusted the lands for better use and productivity. One of its strengths in addressing land degradation was its extension services. The facilitators provided farmers and farmer groups timely assistance on how to best manage risks and respond to various changes happening around them, including markets and climate variability. Local policies were enacted to support and sustain Landcare activities. Whereas the program influenced farmers' land use and production systems, one impediment was its dependence on outside, time-limited funding. Despite the capacity-building program, the MAO was not able to sustain the extension activities due to various institutional and political challenges, particularly leadership change. In the villages, some Landcare farmer-leaders have continued their sustainable farming practices and voluntarily shared their knowledge skills to fellow interested farmers. A popular Landcare advocate, P05 shared: *"...I'm happy that at least I can share, I can influence them for the benefit of God's creation. We can help the people... and the environment in general... In my opinion, God will be happy because I did not ignore His creation..."*.

On another hand, some NGOs are backing up the Higaonon community in Plaridel to reclaim ownership of their ancestral land. P08 shared, *"... the Misamis Oriental Farmers' Association helped us lobby and dialogue with DENR and DAR and during rallies... They support us how to process documents... We couldn't have pursued this without their support."*

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<sup>62</sup> Interview with a local manager from Phillip Morris (2015)



### 5.2.6 Impacts of climate variability

Unpredictable climatic fluctuations and frequent occurrence of extreme events in Cabulig, particularly drought, typhoons and flooding, increases the vulnerability of the watershed and its inhabitants (Table 5.2). Farmers' geographic locations in the landscape and their land use systems determine the severity of the impacts they face. The farmers' discussion (Focus group) held in Mat-i revealed that the impacts of the typhoon, flooding and landslides are more severe in Mat-i than in Malagana because the Cabulig River traverses the former's main village area which is highly populated and largely cultivated. While flash flooding has negligible impacts in Plaridel, it has big impacts on the floodplains of San Nicolas. Typhoon Senyang in December 2014, for example, damaged about 30 houses in the village along with their farms due to flashflood and flooding.

Although location is important, the controllable element of climatic impacts is the land use system present in the watershed. Many monocropping systems are severely damaged by extreme events. Most farmers affirmed that droughts have caused severe impacts to their land resource and farming livelihood. They recounted that the 1998 El Niño, which was the longest dry spell, affected them so much it almost caused the Cabulig River to dry up. It induced extensive destruction of the already degraded watershed and grasslands because of forest fires. More recently, the 2015-2016 droughts were particularly hard for those cultivating rain-fed monocropped corn.

## 5.3 Drivers of current livelihoods and its trends

As with land use change, the different livelihood strategies of farmers in Cabulig that have transformed the traditional slash-and-burn agriculture of the Higaonons' subsistence lifestyle emanate from the interplay of multi-level drivers. In Chapter 4, the review of major historical events over the last century through KIIs enabled the identification of six major drivers of current livelihoods and livelihood trends in the watershed (Table 5.3).

### 5.3.1 Population growth

Population growth has resulted in smaller farmlands through the inter-generational division of lands (Table 5.3). Lun1001 shared: *"with about 150 ha of lands, my grandfather was among those who own vast lands here [Luna] before. Now, we only have three hectares to divide among my mother's six siblings, which is 0.5 ha. My mother will divide this among us three children, which is practically nothing. When I divide my 1,700 sqm share among my three sons, it will just be for their houses and not be farmed anymore. They have to finish their studies to get employment because we don't have lands to cultivate anymore"*. Smallholder farmers who have limited knowledge and skills continuously cultivate these small farms as they are the only source of livelihood they know and have. With no capacity to fallow, soil fertility is declining, which in

turn affects farm productivity and income. This has already happened as narrated by F10 in Section 5.2.1. This reinforces a lack of capacity to implement conservation or change their farming activities.

As lands become smaller farmers must find alternative sources of income. The most common alternative is from daily paid agricultural labour on bigger farms, but the competition is high. There are many smaller farmers seeking work, so obtaining work requires good connections and able performance in the field. The government's lack of financial support moved others to avail loans from rural banks or micro-financing for small-scale businesses. P06 shared: *"As much as I discouraged my people to avail these loans because of the incredibly high interests, they take the risks because as they say, 'we want to improve our lives'. Some use the loan to finance their farm; others use it to start sari-sari stores. Look at this street, every house has a small store. Who will buy their goods? How can they pay their loans?"* While the goal to help farmers improve their livelihood is noble, institutions lack guidance on how to invest effectively, and not drown the farmers with further economic stress.

### 5.3.2 Changes in agricultural systems

Agricultural change has been largely shaped by government-motivated perennial crops, then commercialization by private seed companies, followed by the plantation economy with globalization (Table 5.3, Chapter 4.2.2). Big landowners employed coastal people as tenants to plant coconuts and coffee, which the government promoted after WWII. F02 shared; *"My parents moved to this village in 1969 as tenants. They planted these coconuts. After three years, they transferred to Aposkahoy to plant and venture on coffee as it was so expensive. I became the new tenant and filled the rest of this five-hectare land with coconuts"*<sup>63</sup>.

The destruction of tomato farms caused by the wilt virus in the late 1980s was an opportunity for private seed companies to promote yellow corn. This crop was planted on many former tomato farms in Malagana and Aposkahoy and continued to expand from the 1990s to 2010s with available financing from big farmers/financiers. This crop is planted in large areas and requires much farm labour. This provides an opportunity for smallholders to work as daily paid farm labour. Since planting and harvesting works are seasonal, they can still plant and manage their small farms at other times. Their daily pay, which ranges from Philippine Peso (PhP) 100-150<sup>64</sup>, is used for everyday expenses such as food and children's allowance for school. The harvests from their farms are for consumption and any surplus income is for big expenditures like clothes and household equipment.

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<sup>63</sup> As tenants, farmers give 65% of the profit to the landowners

<sup>64</sup> 3-4AUD at 1PhP=35AUD

Over the same period that broad-scale corn production was expanding, MNCs arrived in mainland Claveria. Beginning in the 2000s with the operation of pineapple plantations, banana commenced in 2012 followed by tobacco in 2014. The rapid expansion of plantations in Cabulig replaced many of the grasslands, corn and cassava farms. Those farmers who rented out their lands to the pineapple and banana plantations were allowed to work as company labourers. Being contractual labourers, they received higher daily pay plus additional benefits compared with other labourers. F04 whose son works for the banana company shared: *“My son works six-days a week, and receives PhP 291 a day. But this [P291] is still deducted for Social Security System (SSS) and PhilHealth,”* which leaves the son about PhP270. These benefits are useful for health and retirement pension. Meanwhile, the tobacco company requires that its farmers pay the labourers based on the government’s regional minimum agricultural fee which is PhP180-200 a day (slightly higher than the usual pay). The labourers are also required to use personal protective equipment, such as face mask, to protect them from green tobacco sickness. This transition suggests a general improvement in the total household income, as well as benefits and well-being for many labourers in Cabulig. However, there are still many smallholders who remain farming their marginal lands and who have not benefitted from these drivers of changes to agricultural systems.

### 5.3.3 Infrastructure development, market access, and public services

Government programs have aimed to better connect the rural areas with the major cities in the region and, in doing so, deliver better public services (Table 5.3). They have invested in the completion of the alternate Gingoog-Claveria-Villanueva route between CDOC and Gingoog City, as well as Butuan City. This expanded road network has mixed impacts on farmers’ livelihoods. It has negatively affected some small-scale businesses in the villages. Mat01 shared: *“Our main customers were the jeepney drivers and their passengers. The road was bad and muddy before, and the travel was long. So, they have to stop and get refreshments here [Mat-i]. But this has changed with the road improved. The jeepneys can now leave early to Cagayan and straight back to their villages. This reduced my store’s income.”* Conversely, the road has improved the market access to farmers’ products. While it has improved product quality, the improved road has not reduced transportation costs (e.g. Imp1041). Moreover, in the early 2000s when the number of jeepneys was still few, some farmers rented out or sold parts of their farms to mortgage motorcycles for transportation hire. It provided a good additional income because some better-off people who have formal work or business in Poblacion were willing to pay more to avoid waiting for and squeezing into jeepneys loaded with farm products. However, for some who did not manage their transportation business well, it cost them their lands. Road development has helped expand public services, such as education and health, and access to electricity and

communication – all of which increased the opportunities to integrate the remote parts of Cabulig into mainland Claveria.

### 5.3.4 Urbanization and industrialization

Road development has contributed to urbanization and industrialization in Cabulig (Table 5.3). The new road has linked the watershed, not just to mainland Claveria, but also to CDOC, Gingoog and Butuan Cities. Exposure of farmers, and especially their children, to urbanization and industrialization in these cities, has affected various aspects of their life, particularly their life decisions and aspirations. Some farmers have diversified their income to support their children's education. Mat01 shared: *"We used most of the payment we received from renting our land to the banana company for our children's education. Three of them graduated college - BS Hotel and Restaurant Management at Misamis Oriental State College and Agricultural Technology, BS Information Technology in Cagayan de Oro College, and BS Communication Technology in Mindanao University of Science and Technology. Only one did not finish school. Our farming livelihood, my husband's work in the banana company, my salary as a public servant, together with my sari-sari and eatery store, have supported their education."* For farmers able to afford school fees, it is common for their children to take courses that will give them employment in cities or abroad. Their remittances enabled parents to renovate their houses, buy vehicles and appliances that improve their status in the village. Hence, children's education is given more value and is perceived as a way out of poverty.

Agricultural changes, urbanization and industrialization over the years have been driven by government economic policies and development strategies, which in turn are influenced by international events. Technology transfer in developing countries has facilitated adoption through information and communication technology-based extension programs using mobile phones (Aker, 2011) as well by computers, televisions and radios. As MNCs and farmers respond to these happenings, local livelihoods are also altered in Cabulig. The return of original dwellers and the influx of new settlers after the end of the insurgency in 1985, and the subsequent 1986 People's Power Revolution in Manila, dramatically changed farming livelihoods. As mentioned above (Section 5.2), many had left their farms and, on their return, found starting a new life hard. New settlers with capital bought and rented out prime lands. They cultivated big farms and planted commercial crops like tomato, yellow corn and vegetables. As some were not farmers, they hired local farmers who better understood how to best farm in the area. Off-farm employment as daily paid labourers on big farms became the major source of livelihood, which is still true today. While some farmers work 2-3 days a week on bigger farms for extra cash while waiting for their harvest, others spent up to six days labouring.

### 5.3.5 Government policies and programs

Meanwhile, the participation of the Philippines in GATT-WTO since 1995 has changed the agricultural activities of many rural areas (Table 5.3). With the lowlands already at capacity with settlement expansion, factories and agro-industrial companies moved to the uplands where there were still lands for expansion and people were keen for development. Their entry was facilitated by the decentralization of 1992 after which the Mayors could strategize their development pathways. Specifically, the granting of powers to Mayors grant or approve the conversion of agricultural lands to urban areas within their jurisdiction facilitated the encroachment of urban activities into natural lands. Nonetheless, the operations of corporate plantations have changed the landscape, resulting in the mushrooming of small-scale businesses in village centers, such as small stores, vulcanizing shops<sup>65</sup> and others. Non-farm activities such as employment by the companies and income from small-scale businesses have become the major livelihoods for people who have spare parcels to rent out. These farmers still cultivate small areas but mainly for consumption. Smallholders find it hard to rent lands out as these are their only source of income. Besides, their lands are too small and are often located in remote and inaccessible locations.

### 5.3.6 Climate change

Unpredictable climatic fluctuations and frequent occurrence of extreme events in Cabulig, particularly drought, typhoons, and flooding, also affect farming livelihoods in some villages (Table 5.3). In a focus group, the participants were asked to identify hazards that influence their livelihoods. Participants from Mat-i and Malagana are prevented from planting valuable crops because of strong winds from December to March, so they rely on off-farm and non-farm livelihoods. The recent 2015-2016 drought affected many of the farmers interviewed. F03 shared: *"Most of my banana died while the coconuts wilted because of the drought. That's why my wife now works in Cagayan. She just sends us money. My children give us some money sometimes as well... Life this time is difficult."* Farmers must adapt to these periodic events that make their farming livelihood vulnerable.

## 5.4 Farmers' decisions on land use and livelihood actions

The determinants of decision making listed in the left-hand column of Table 5.4 (land use decisions) and Table 5.5 (livelihood decisions) were identified from the dataset of KII with farmers. The results, which are presented by village, are aggregated to indicate those that are relevant to most of the informants (H), those that have some relevance (S), and no relevance to

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<sup>65</sup> Small shops that treat flat (rubber) vehicle wheels or those holes, which commonly happens in rough roads

them (N). In this section, the major determinants identified across all villages are discussed first, followed by consideration of those which are conditional on geographic location.

### 5.4.1 Determinants of both land use and livelihoods

The major determinants that farmers consider when making land use decisions and livelihood strategies across all the study villages are:

- *natural characteristics*: soil fertility, soil type, the presence of rocks and slope that determine the crops farmers' plant and their management strategies;
- *land, financial and human resources*: land ownership, land area (the size and number of plots), existing financial capital and available household labour; and
- *farmers' values, knowledge and aspirations*: farmers' identity and succession.

#### **Natural characteristics of farmers' land**

The natural characteristics of a farmer's land can either constrain land use and management or support livelihood diversification. Farmers cultivating along the Cabulig riverbanks in San Nicolas claimed that soil is still fertile enabling them to diversify their crops, whereas the declining soil fertility in Mat-i and Aposkahoy limits crop choice to corn and sweet potato. Soil type also limits farmers' crop choice. F01 shared: *"If sandy and away from the river, you can raise livestock, right? You can also plant it with coconuts because it can thrive in this sandy soil... The rocky areas here [San Nicolas] are commonly for timber trees, coconuts, banana, root crops."* Similarly, rocky areas in Mat-i and Aposkahoy are usually planted with timber trees such as falcata and mahogany.

#### **Land tenure**

The farmers concurred on the benefits of cultivating owned lands as they can plant any crops they wish and manage them in the way they prefer. They value the freedom that ownership provides for their daily farm activities. There are cases when despite non-ownership of land, farmer land use is still productive and sustainable. This is the case for two farmers in San Nicolas who do not currently own the land they cultivate. F01 shared: *"Farming is not permanent for me... I will work abroad... In the meantime, I thank my parents for giving me the freedom to plant additional crops on the farm..."* This farmer's cropping system is complex and diverse, including agricultural (short-term income) and tree (long-term income) crops as well as livestock (medium-term income). F02 commented: *"When my landlord comes and checks around asking, 'What kind of job is this? Can't you see the grasses around? ... You develop this farm.' They can be scary."* While F01 is confident that he will inherit the farm in the future as the eldest son, F02 is hopeful that he will soon be given a part of the land he has devoted his life to so that he can leave it to his children. The challenge for the latter is that the original landowner is already dead, and he is now

dealing with the professional children who have no affinity for the land. He will be devastated if this land is sold leaving him with nowhere to live and farm.

### ***Land, finances and labour availability***

The number of parcels and land area determine the informants' options for allocating areas to different uses or management. F06 shared: *"I planted it with falcata to preserve my sloping areas from landslides... I contoured it with Napier grasses for my livestock... I also have a small area planted with corn for consumption followed by vegetables for income... I also rent lands for grazing cattle."* In contrast, farmers with smaller farms restricted to one plot must prioritize agricultural production for both consumption and income. For many, farming is their only source of income and practising fallow is not possible. In many cases, an intensified production system does not mean more diversified crops. Some intensify their production system to meet the current required income for basic needs while also considering their children's future. F03 said: *"Aside from corn, cassava, banana... I leave them [ipil-ipil] to grow because its leaves are nutrients for the soil... My Gmelina trees, which are as almost as big as my coconuts, are for my children. They can just cut these to build their houses..."*

Lack of financial capital limits many farmers from planting the more profitable vegetable crops to which they aspire (e.g tomato), and also applying fertilizer and other inputs to improve both the soil's fertility and production. Smallholders with a plot less than one hectare cannot be flexible in making decisions and must cultivate their single, small plot all-year-round for consumption and income, regardless of the natural condition of the land. Even farmers who have two or more plots can lack enough financial capital to make their lands productive. In many cases, farmers kept mentioning that the lack of financial capital is their major farm issue. F10 said, *"Finance is the limiting factor that disables us from achieving productive farming... That is why labouring becomes feasible if farmers have no other option to solve their financial problems."*

A related issue is a lack of household labour that limits smallholders from diversifying their production systems simply for consumption and income. It is common for wives and young children to help with easier farm tasks such as sowing and harvesting. For children who have non-farm occupations, the farmers expressed willingness to cultivate the farms on their own so the children can continue working as drivers, labourers in companies and other ways. The remittances provided by children are used for employing labour. Not all households have such resources to draw on, with some experiencing loss of labour productivity due to illness, old age, or death of a husband or wife. F05 admitted: *"The death of my husband is a nightmare for me... I still have students to support so even if my body is tired, I continue to work [daily paid]. We have no one to lean on."* It is difficult for households that have limited or no cash to replace the shortfall of labour.

**Table 5.4 Determinants of farmers' land use decisions and management in Cabulig (2016)**

| Determinants of current land use conditions/trends                                | Relevance to farmers' decisions and actions |          |      |       |          |           |
|-----------------------------------------------------------------------------------|---------------------------------------------|----------|------|-------|----------|-----------|
|                                                                                   | San Nicolas                                 | Plaridel | Luna | Mat-i | Malagana | Aposkahoy |
| 1. Land conditions (e.g. soil fertility, soil type, the presence of rocks, slope) | H                                           | H        | H    | H     | H        | H         |
| 2. Access to water                                                                | S                                           | S        | -    | -     | -        | -         |
| 3. Remoteness (e.g. poor road system, extension)                                  | S                                           | H        | H    | -     | S        | -         |
| 4. Land ownership                                                                 | H                                           | H        | H    | H     | H        | H         |
| 5. Farm size and number of parcels                                                | H                                           | H        | H    | H     | H        | H         |
| 6. Land selling/renting                                                           | -                                           | S        | -    | S     | -        | -         |
| 7. Sharing arrangement                                                            | S                                           | -        | -    | -     | -        | -         |
| 8. Available financial capital                                                    | H                                           | H        | H    | H     | H        | H         |
| 9. Access to loans/financing                                                      | S                                           | -        | -    | S     | -        | H         |
| 10. Available household labour                                                    | H                                           | H        | H    | H     | H        | H         |
| 11. Reliance on off-farm employment                                               | -                                           | S        | H    | -     | S        | S         |
| 12. A diverse source of income                                                    | H                                           | H        | -    | -     | H        | H         |
| 13. Access to market                                                              | H                                           | S        | -    | S     | S        | S         |
| 14. Low-cost, simple and adaptable technologies                                   | S                                           | -        | -    | -     | -        | -         |
| 15. Land use motivation                                                           | H                                           | H        | H    | H     | H        | H         |
| 16. Personal aspiration                                                           | H                                           | H        | H    | H     | H        | H         |
| 17. Soil knowledge and farming experience                                         | H                                           | H        | H    | H     | H        | H         |
| 18. Crop preference (e.g. income, consumption)                                    | H                                           | H        | H    | H     | H        | H         |
| 19. Perception of trees                                                           | H                                           | H        | H    | H     | H        | H         |
| 20. Children's education                                                          | H                                           | H        | H    | H     | H        | H         |
| 21. Farmers' identity                                                             | H                                           | H        | H    | H     | H        | H         |
| 22. Environmental awareness                                                       | S                                           | S        | -    | S     | S        | H         |
| 23. Advanced household life cycle                                                 | H                                           | -        | -    | H     | S        | -         |
| 24. Retirement                                                                    | S                                           | -        | -    | -     | -        | H         |
| 25. Extension services                                                            | S                                           | S        | N    | N     | H        | H         |
| 26. Collective action                                                             | S                                           | S        | N    | S     | S        | H         |
| 27. Available source/s on farming information                                     | H                                           | S        | -    | N     | S        | H         |
| 28. Government incentives/subsidies                                               | S                                           | S        | -    | -     | S        | S         |
| 29. Government policies and programs                                              | -                                           | H        | -    | -     | H        | H         |
| 30. Climate variability and extreme events                                        | H                                           | H        | S    | H     | H        | H         |

Legend: H- Highly relevant; S- Some relevance; N- no relevance; - means not mentioned by the key informants from the village



**Table 5.5 Determinants of farmers' livelihood strategies in Cabulig (2016)**

| Determinants of current livelihoods condition/trends     | Relevance to farmers' decisions and actions |          |      |       |          |           |
|----------------------------------------------------------|---------------------------------------------|----------|------|-------|----------|-----------|
|                                                          | San Nicolas                                 | Plaridel | Luna | Mat-i | Malagana | Aposkahoy |
| 1. Soil fertility                                        | S                                           | S        | N    | H     | S        | H         |
| 2. Rocky Soil                                            | H                                           | H        | H    | -     | -        | -         |
| 3. Steepness of land                                     | S                                           | H        | H    | -     | S        | H         |
| 4. Terrain/remoteness/road system                        | S                                           | H        | H    | H     | S        | N         |
| 5. Access to water                                       | S                                           | S        | -    | -     | -        | -         |
| 6. More secure land tenure                               | H                                           | H        | H    | H     | H        | H         |
| 7. Diversified/intensified production systems            | H                                           | H        | H    | H     | H        | H         |
| 8. Farm size and number of parcels                       | H                                           | H        | H    | H     | H        | H         |
| 9. Sharing arrangements                                  | S                                           | -        | -    | -     | -        | S         |
| 10. Available household labour                           | H                                           | H        | H    | H     | H        | H         |
| 11. Available financial capital                          | H                                           | H        | H    | H     | H        | H         |
| 12. Access to loans                                      | S                                           | -        | -    | S     | H        | S         |
| 13. Land selling/renting                                 | -                                           | S        | -    | H     | -        | -         |
| 14. Diversification of income sources (e.g. remittance)  | S                                           | S        | H    | S     | S        | S         |
| 15. Reliance on off-farm employment                      | -                                           | S        | H    | -     | H        | -         |
| 16. Education (but restricts family labour)              | H                                           | S        | -    | H     | H        | H         |
| 17. Presence of multinational companies                  | S                                           | S        | -    | H     | S        | H         |
| 18. Experience and knowledge conditions                  | H                                           | H        | H    | H     | H        | H         |
| 19. Farmers' identity                                    | H                                           | H        | H    | H     | H        | H         |
| 20. Motivations (economic vs conservation)               | H                                           | H        | H    | H     | H        | H         |
| 21. Land acquisition                                     | S                                           | S        | -    | S     | S        | S         |
| 22. Youth preferences for off-farm/urban work/lifestyles | H                                           | S        | -    | H     | H        | S         |
| 23. Retirement                                           | S                                           | -        | -    | -     | -        | S         |
| 24. Advanced household life cycles                       | S                                           | H        | -    | H     | H        | -         |
| 25. Extension services                                   | S                                           | S        | S    | N     | H        | S         |
| 26. Collective actions                                   | S                                           | S        | N    | S     | H        | H         |
| 27. Social network – reliance on relatives and friends   | S                                           | S        | -    | -     | S        | -         |
| 28. Government conservation policies                     | -                                           | S        | -    | -     | -        | H         |
| 29. End of project support/facilitation                  | -                                           | -        | -    | S     | -        | S         |
| 30. Increasing environmental awareness                   | H                                           | H        | H    | H     | H        | H         |
| 31. Climate variability and frequency of extreme events  | H                                           | H        | -    | H     | H        | H         |

Legend: H- Highly relevant; S- Some relevance; N- no relevance; - means not mentioned by the key informants from the village

## **Farmers' values, knowledge, and aspirations**

Intrinsic values, knowledge and aspirations also shape the informants' land use decisions and livelihood decisions. Many became farmers because of limited education and opportunities and, like their parents and grandparents, they support their families from farming. The key motivation for some is simply to produce food for the household and generate income for other basic needs. F07 said: *"As long as we can produce food for the family, that's all that matters."* Others have identified themselves as farmers, such that land selling is not an option unless it is a matter of life and death (e.g. F04 said *"I will die as a farmer"*). They want their children to inherit their lands and continue farming. F07 said: *"I want him [only son] to farm because we have no one else to work on it. He has to continue farming."*

Along with land succession is the passing on of farming knowledge and values. Having lived in rural landscapes with a farming livelihood that is closely connected with the land and natural resources, they have a good understanding of their environment and the measures needed to protect these. They understand the impact of their activities downstream and beyond the watershed. However, for some growing up in a farming household does not always equate to enough farming knowledge and skills because of gender roles. F05 shared: *"I grew up with them [parents] farming. But I was never used to farming... My parents wanted me to miss school so I can look after my siblings... When I got married, I just stayed at home looking after our children... When he [husband] died, it was like learning how to live again, learn to plant corn by myself, and undertake labour in others' farms to survive."*

The farmers recognize that trees play important roles in their production systems and the watershed. The sustainability of their farms is important for their children's future although their land use decisions (current and aspirational) are driven by economic factors. However, economic needs override any intent they may have to prioritize environmental protection. Specifically, they are minimizing short-term risk by lessening inputs and investment (e.g. in soil conservation measures) but in doing so they are increasing the long-term risk to both their productivity and the provision of ecosystem services by allowing land degradation. Their crop preferences reflect their limited financial capital and are mostly for products that command better market prices such as coconuts, hybrid corn and vegetables. Smallholder farmers are still in dire poverty and must work hard just to survive. This affects their aspirations, which are to support their children's education and their basic livelihood assets such as land and capital. F01 hopes to get a job abroad so he can support the education of his young children and buy his land to cultivate. Similarly, F02 hopes to own a part of the huge coconut farm he has cared for all his working life for his children to succeed. While big farmers in Aposkahoy and Malagana can send their children to private universities in CDOC, other farmers struggle to send their children even to a local college. F05

is unsure how to support her children's education at least up to high school. F04 is content that his son is working on a banana plantation with land to leave as an inheritance. Most farmers are confident that they will leave their lands, which some inherited from their parents and grandparents, to their children to continue the legacy of farming. Paradoxically farmers work hard for their children's education so they will not become farmers like them, which in the process diminishes the children's affinity to land and farming.

#### 5.4.2 Determinants of land use decisions by location

The determinants of land use decisions vary from one village to another but include access to water for farming (e.g. rainfall, irrigation), the remoteness of the farm coupled with poor road systems, the extent of land selling, pawning and/or renting, access to financing, retirement planning, access to extension services, agricultural or environmental knowledge and extreme events.

Farming in the watershed is generally rain-fed but villages with irrigation system, such as in Mati and Aposkahoy, are still able to plant lowland rice during dry months. For downstream villages, such as San Nicolas and Plaridel, they use the Cabulig River to provide supplemental irrigation during the dry season, particularly in drought years. F01 from San Nicolas also shared: *"Even if we are near the river, we still water our crops when there is no rain. Especially with this kind of drought, I water our crops manually every 15 days."* For other farmers in Plaridel without a water source, they plant crops that are resistant to droughts like coconuts and cassava.

Most of the smallholders' farms can only be accessed by foot, horse or motorcycle, thereby constraining farmers' access to the market. In effect, farmers plant crops with accessible markets or those that can easily be transported from the farm. In San Nicolas, bananas are mostly planted along the steep riverbanks, and so farmers transport sack loads on their shoulders by foot, sliding down the slope and zigzagging the boulders to the village. They sell them to middlemen in the village who earn more than the farmers themselves. Similarly, farmers prefer to plant bananas, coffee, vegetables and root crops for 'easy' manual transport up the steep gorge – a climb of over 500 m – to the village of Luna for the market. Farm remoteness also affects farmers' access and awareness of extension services. They generally have no access to extension services and must rely on their own farming experience, skills and learning. F01 shared: *"It depends on the farmers' curiosity and hard work. If you plant a crop and it doesn't grow well, don't grow it again. Find another crop that is suitable in the area... Before we planted [cantong] banana but they withered. We tried maize but they didn't grow well... My father said, 'Let's replace these with coconuts and fruit trees.' The coconuts are now our main source of income... We are enjoying the fruits and income from our Lanzones, and Rambutan soon."*

Land selling, pawning and/or renting occurred across the landscape at different times in parallel with migration into the watershed. In the downstream to the mid-stream villages it commenced

in the 1980s and, after the insurgency ended, reached the upper villages in the late 1990s. In the following decade with the emergence of MNCs, land selling, pawning and/or renting continued across the watershed. In some cases farmers have engaged in these activities to fund short-term needs or priorities but wish to regain their land in the future. For example, F04 has sold, pawned and rented out some of his lands in Mat-i to support the college education of his children. His aspiration to get back this land motivates him to manage his remaining land well for better production and profit. For tenant farmers in San Nicolas, their motivations and behaviour shape the sharing arrangements between tenants and landlords in San Nicolas. As discussed earlier, F02 developed the farm as his own because he is holding on to the landlord's promise that he will help him in the future by giving him some of that land.

Limited financial capital has prompted some farmers to access loans and financing. Because San Nicolas is closer to coastal towns, farmers from this village have access to rural banks and micro-financing NGOs. This enabled some to start up banana farms, where loans were used to buy suckers and pay for labour. In Aposkahoy and Malagana, financial sources are mostly individual financiers who are often big farmers in the neighborhood. F07 (Aposkahoy) and F10 (Malagana) only access financing when they plant crops like hybrid corn and tomato that require expensive inputs. Other smallholders are not keen on loans/financing and may instead rely on off-farm employment for income. As such, their farming system is also just focused on white corn, sweet potato and other root crops for consumption, as in the case of some smallholders in Luna and Aposkahoy.

Retirement is not an issue for many farmers because they intend to farm as long as they can. However, planning for retirement has influenced some farmers' current land use. F02 shared: *"A portion of our income from copra is used to pay for my parent's monthly SSS dues. It is a good investment because they will receive a monthly pension when they turn 65. I told them, 'land is a permanent resource but we are not permanent, our health diminishes'."* Similarly, F06 allocated parcels of his lands for tree farming and another for grazing livestock. He showed his notebook with a calculation of his annual earnings from these land uses and the amount he needed to save for his retirement. These farmers are not big landholders, but they are more relaxed financially as they have diverse sources of income. They enjoy farming more than others but welcome the idea of retiring soon.

As mentioned above, many farmers interviewed grew up farming, and this has influenced their understanding of how their farming livelihood relates to the environment. Farmers upstream exhibit more complex and diverse information about their natural resources and forest ecosystem. From soil knowledge to the importance of trees on rivers, creeks and springs, they have greater environmental awareness and their production systems reflect this. But this mindset has many contributing factors that vary with location and time. It is important to note that Mat-i,

Aposkahoy, Malagana, and other villages with forest cover, have been part of several tenurial programs accompanied by reforestation projects. In the early 1980s, the Integrated Social Forestry Program (ISFP) provided farmers individual tenure to improve forest land use and management. Mahogany, Gmelina and other exotic tree species were promoted in the succeeding reforestation projects. In the late 1990s, they entered into Community-Based Forest Management Program (CBFMP) agreements with DENR. Along with financial assistance to implement a community plan, DENR also provided extension services. After the project and financing ended, the extension services also waned. While the farmers gained knowledge from these projects, they preferred continuous extension services. A farmer from Aposkahoy said: “... *we need the government’s continuous guidance to understand the changes happening in our village and cope effectively.*”

Farmers in Mat-i and Luna recognize the potential benefits of extension services but say that their absence has no effect on their land use and management (noted as N in Table 5.4). Such views may be influenced by the lack of extension services in their areas, meaning they learnt how to use and manage their lands from their parents and grandparents. Some farmers from remote areas in San Nicolas claimed they have never received any extension services. They relied on agricultural shows from television and/or radio broadcasts for information. F01 goes to internet-shops and searches online for solutions on specific farm issues. Some farmers from the village have joined the recent livelihood project on organic farming and participated in various training courses and seminars. It may be a coincidence but the participating farmers either have positions in farmer organizations or have relatives in the Village Council. Some farmers did not adopt the composting technology that was promoted by the project because it was too labourious and smelly. While they recognized the importance of the goal of the project, they needed farming technologies that were low-cost, simple and easy to adopt (noted as S in Table 5.4). This demonstrates that available extension services might have an important role in providing farmers with options for sustainable land use and land management practices. But an extension program can only be effective if it reaches out to farmers (even in remote areas) and influences their land use and management decisions by providing financial, time-saving or other benefits.

Farmers across the landscape experience the effects of climate variability and frequent occurrence of extreme events such as drought, typhoons and flooding, but the severity varies according to their location. Despite potentially higher income from vegetables, farmers in San Nicolas opted to plant coconuts as they can withstand drought and flooding; and in Plaridel cassava is preferred as it can resist drought. Some farmers cultivating along riverbanks, particularly in Mat-i and Aposkahoy, are affected by landslides when there are typhoons and intense or long-duration rains even though they leave forest trees and/or plant more trees. However, this is not so relevant for F05 in Luna because she does not rely entirely on her farm on the riverbank of the Cabulig River for livelihood but on her labouring work.

### 5.4.3 Determinants of livelihood strategies by location

While the previous section focused on the factors influencing farmers' land use decisions at the farm-level, this section emphasizes the determinants that impel them (or not) and/or their household members to engage in other off-farm and non-farm livelihoods. While full-time farmers think of land use and farming as the same livelihood (Section 5.4.1), others have diverse sources of income that are distinct from the land use on their farm and dependent on their farm location in the Cabulig watershed. The localized determinants that emerged from the KIIs are farms' poor/vulnerable biophysical condition, sharing arrangements for tenants, access to credit, land selling and/or renting, diversification of livelihood sources, conservation policies and programs, and climate change.

The poor/vulnerable biophysical condition of many smallholder farms made it difficult for farmers to diversify their livelihoods. This stems from the steepness of slopes, rugged terrain, and remoteness causing inferior roads. While the riverbanks in Luna are fertile, lack of household labour and financial capital constrains farmers from planting vegetables that would have earned them a better income. F05 said: *"We planted banana in a small area... small corn... It's okay. My biggest income is the one I get from working as a daily paid worker."* In this case, what makes the remoteness and difficult terrain important is the farmer's gender (female) and status (a widow with young children). Working as daily-paid labour on bigger farms has become more desirable for some smallholders than relying solely on their small farms, which are often located along the steep river gorges. They work on their farms on Sundays as they work as daily-paid labour six days a week. However, this off-farm employment is vulnerable to extreme weather, such as drought and typhoons. In contrast, the remoteness and vulnerability of some farms located in the flood plains of San Nicolas did not deter farmers from diversifying their income sources. SN1034 shared: *"My husband is looking after our farm. Twice a week, I cross Cabulig River to go to the village and vend our harvested string beans. Sometimes I earn PhP200 per vending... I also have sari-sari store for extra income, the only store here."* Here, the farmers used their vulnerability to adjust their crop choices and isolation as an opportunity to vary their livelihoods.

The proximity of some villages to towns and cities provides opportunities for farmers to access other livelihoods, particularly non-farm types. This is particularly the case in San Nicolas and Plaridel, where family members work in CDOC. They also have the option to work in various industrial companies in the coastal municipalities of Jasaan and Villanueva. SN1033 shared: *"After Senyang flooded our farm and ravaged our house, I planted banana again. It's good that our coconuts and other fruits have not been damaged... I also work at the Philippine Sinter*

(PVEC), in 'soya'<sup>66</sup>... *It's hard work and the pay varies. Sometimes they pay us PhP80/day. Sometimes PhP150. It changes. But at least we have an option.*" With limited education and skills, they are limited to unskilled work such as house helpers and labouring.

The presence of MNCs in some villages, such as in Plaridel, Mat-i and Aposkahoy, also offers livelihood options for farmers. As mentioned earlier, a privilege for some farmers who have rented out their lands to plantations is to work in the plantations. The remittances from family members are an important part of farming households' total income.

The government's environmental policies have affected the livelihoods of some farmers located upstream. Since Mt. Balatukan was declared a protected area, farmers who used to cultivate there had to find new areas outside the Park. Imp01 and Imp02 are still farming in the buffer zones but the non-farm employments of their wives in daycare and as Barangay Health Workers provide regular income for the households. With the land rights given to farmers in Mat-i and Aposkahoy comes greater stewardship responsibilities. They live and cultivate in a fragile forest ecosystem, so they must integrate trees in their farming systems. When there are reforestation projects, they get income from planting trees in the forests. F08 recalled: *"DENR paid us in planting these trees. We worked planting these trees per day, 'pakyaw-pakyaw' [booked-up] system... That was a long time ago, maybe 20 years ago. As you can see, these trees are already big."* The same livelihood scheme is implemented with the current National Greening Program (NGP) under the DENR in which farmers are paid for growing the seedlings and planting these in the forests and on farms. It is important to note that this is seasonal. While it provides farmers with short-term income (up to three years for maintenance), previous undertakings like these are challenged by sustainability issues such as tree cutting and fire in subsequent years (Catacutan et al., 2001).

Looking at these determinants, farmers shared numerous constraints but few enabling factors that influence their land use decisions and livelihood strategies. Poor biophysical and vulnerable ecological conditions reduced access to the natural resources required for intensive production systems and/or diverse livelihood activities. Insufficient economic resources including lack of financial capital relative to increasing farm expenses, and insecure land tenure also affect them. Illness, advancing age and their children's preferences for non-farm employment and lifestyles limit labour available for farming. Smallholders' non-integration in farm groups limits them to go beyond their farms and mobilize other forms of economic and social resources at the village and/or municipal levels. In contrast, some of the enabling factors, including land tenure, have improved production systems and protect the forest. Plantations have driven up the price of land, and big landholders have rented some out to the companies. Absentee owners found land renting

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<sup>66</sup> It involves soya that is turned to chicken feeds. It is a booked-up system ('pakyawan'). The group that bids the lowest usually get the contract.

to be a beneficial opportunity<sup>67</sup>. Idle land and grasslands have been brought back into production. For smallholders who depend on farming alone, poverty is still evident alongside land degradation.

## **5.5 Connection and interactions of drivers and determinants**

Tables 5.2 and 5.3 showed that governance and globalization are the major drivers of land use and livelihood change, respectively, which were discussed in Section 5.4. The two case studies in this subsection show that land governance (or lack of it) is a driving force behind land use change in Cabulig (Section 5.5.1) and probes how the plantation economy through globalization affected farming livelihoods (Section 5.5.2). Both case studies relied on the information collected from KIIs and focus groups.

### **5.5.1 Case study 1: Decentralization and land use governance in Cabulig**

The structures and processes that have been implemented in the past decades to regulate land use and manage forestland watersheds have changed from centralization to decentralization (Figure 5.2). This transformation is most evident in the areas of resource use, land ownership and management. This case study will examine how changes to land tenure, and decentralization of natural resources management and agriculture have not always had the intended outcomes for either smallholders or the environment.

The current state of forests in the Philippines is living evidence of irresponsible resource use for purely economic gains (Pulhin et al., 2006). This can be traced back to the Spanish Royal Decree, which declared that all public lands belonged to the State. Although the succeeding Forest Act (1904) and Kaingin Law (1939) emphasized forest protection, exploitation of forest resources through logging operations continued to intensify. While this strategy increased the contribution of the forest industry to the country's income in the 1960s-70s (Kummer, 1992), the effects of imprudent logging (e.g. deforestation, in-migration, displacement) were most felt at the local level, as also narrated by KIs in this thesis (Section 5.2). For example, one focus group participant commented: *“Forest canopy covered the sky as I walked from Aposkahoy to Mat-i. It was always dark in the village even in the daytime... The logging trucks can only carry one log because the old trees were so huge that three people had to hold hands to gather around the base... Now, the landscape is so different.”* Along with the Master Plan for Forest Development in 1990, several

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<sup>67</sup> These landowners were among those who left the village during the insurgency but did not come back. They had tenants but the latter failed to give their share based on agreed arrangements.



regulations have been formulated over the last three decades that aim to protect forest resources and address environmental degradation. There was a total logging ban in 1992, and in the same year the RA 7586 was enacted to preserve biodiversity. In Cabulig, the MBRNP<sup>68</sup> was designated a protected area in 2007. Since then, farmers' livelihood activities have (in theory at least) been limited to designated production areas.

### **Land tenure**

Regarding land tenure, various instruments have been designed to protect the forest and improve farmers' livelihood conditions. In 1982 the ISFP consolidated all previous tenure instruments provided to forest inhabitants into Certificates of Stewardship Contract for households (CSC) and Certificates of Community Forestry Stewardship for people organizations (POs)<sup>69</sup>. In Cabulig, many of the farmers have the CSCs, particularly those cultivating along the slopes. For some, this has translated to positive land use outcomes. Lun1001 shared: *"The government gave that sloping land to my grandmother [mother side]. When I got married in 1996 after high school, they allowed me to cultivate it... It had many native trees like Balite and wild sunflowers too. We planted corn, tomato, beans, banana and fruit trees... In 1997, we also planted Mahogany and Bagras even if we don't own the land... I believe that the 'durable' trees will strengthen our claim of that land..."* However, not all tenurial interventions have had good outcomes. Some families were divided because of conflict. F08 disclosed: *"That was supposed to be my area because I was the member of that [ISFP]... But my uncles [not members of ISFP] claimed it as ancestral land... It became a source of family conflict. Ah, I'll just take care of this land that is not mine because life is stress-free... If I had to fight my uncles over a small area [1.6 hectares], it is better not to."* The perception of migrants towards the tribe was also affected. F10 shared on reproaching a tribal leader in the village saying: *"'...you break your laws.' He laughed. He said it's his right. 'Which right? Pawning your lands when it is in your law that you cannot pawn lands...' He (tribal chief) just laughed and said. 'I will give you lands.' I said, 'Then you will tell me, I cheated you?'"* Land selling and/or pawning of land rights was still rampant in the 1980s-90s with migrants wanting to venture into tomato, vegetable and corn farming.

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<sup>68</sup> Mt. Balatukan Natural Range Park

<sup>69</sup> These tenures have 25-year terms, and renewable for another 25 years. Beneficiaries are not meant to sell or rent the land within the period of tenure.

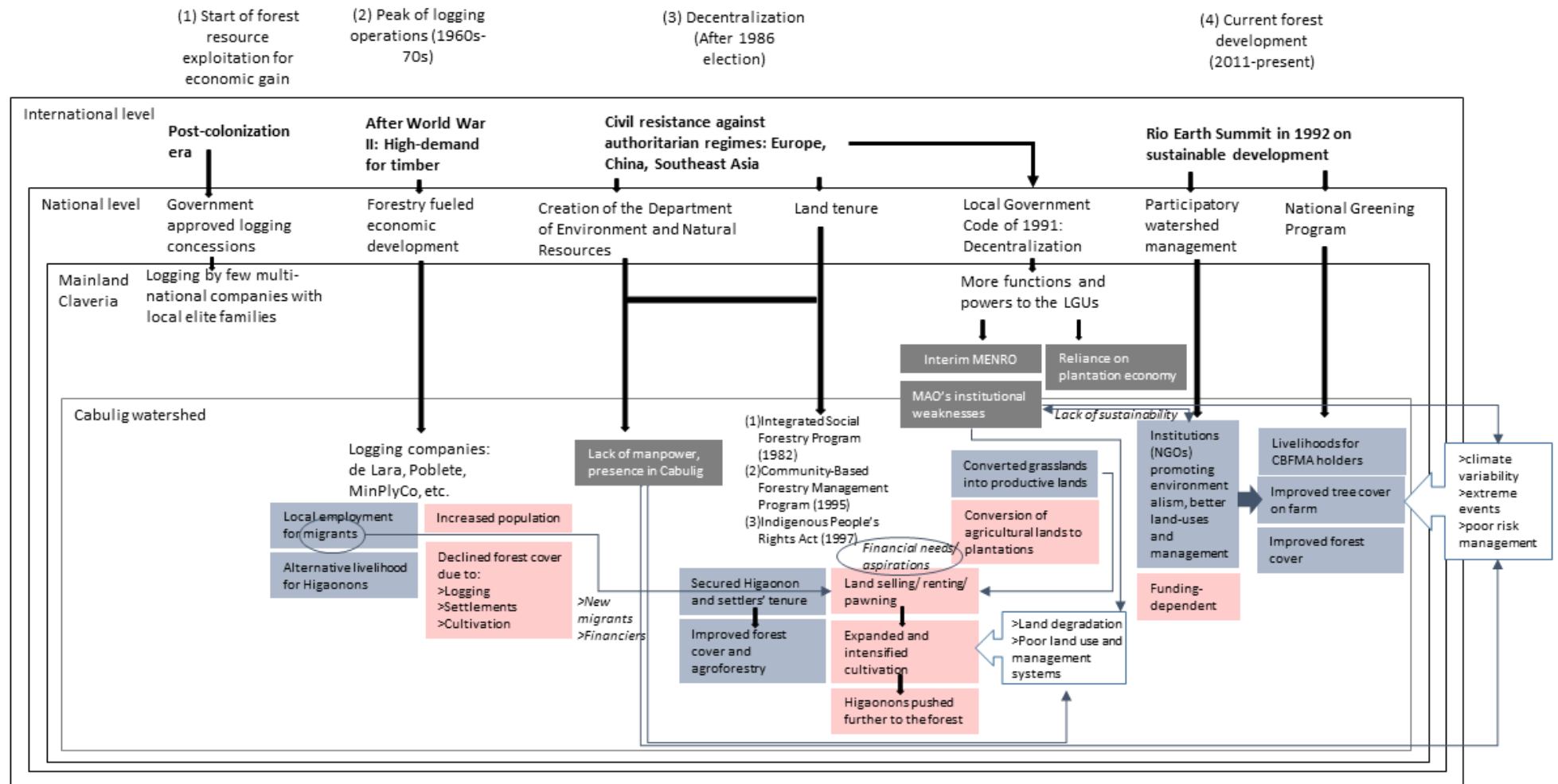


**Figure 5.1** The connection of different governance factors interacting over space and time in Cabulig watershed (2018). The logging operations after WWII transformed the landscape, which moved the government to provide tenure to forest communities. The local government shares the responsibility of environmental protection with the DENR.

Then in 1995, the CBFMP integrated all previous tenure arrangements into CSC for households, CBFM agreements (CBFMA) for POs, and Certificate of Ancestral Domain Claim/Title (CADC/T) for indigenous peoples. One feature of the CBFMAs and CADC/Ts is that the property rights to a forest are shared by the members of the POs. However, this communal forestry effort is hardly visible to tenure holders in Cabulig, except when there are projects with monetary returns. Recently, the POs with CBFMAs and CADC/Ts participated in the DENR's NGP which started in 2011<sup>70</sup>. The farmers are paid for their labour in planting and maintaining the trees for up to three years. The native trees are planted in protected areas where no one can cut them, while the exotic or cash crop trees are grown in production areas or farmers' fields. However, some farmers did not continue in the project because they misunderstood the conditions involved. F06 said: *"We plant trees so that after 10 or 25 years, we can cut these for income. We can reuse again our lands. But tree cutting is no longer permitted with that NGP now... they asked us to plant trees in our remaining cultivated lands as most of our lands have already been planted with trees. What will become of our farming livelihood? What will we eat?"* The program has been extended until 2028, and now seeks the participation and investment of the private sector.

### ***Decentralization of natural resources management***

One key feature of the Local Government Code (1991) is the decentralization of natural resources management (NRM). However, effective NRM remains constrained by the complexity in the governance structures and processes involved. In Cabulig, the main 'players' are DENR, DA, NCIP, and the LGUs. The DENR is tasked with administering forestlands and watersheds. Whilst 60% of the watershed is classified as forestland, only one forester, based in CDOC, is assigned to Cabulig. R03 claimed: *"There's only me – the focal person, the staff, the technical person... If the LGU calls because they need my technical assistance, that's when I go, as I also have other things to attend here [in CDOC]."* Other staff from the Department occasionally come to the field for their respective projects (e.g. CBFMP, NGP). Unlike the DENR, the DA and NCIP have no assigned staff for Cabulig and only a few proactive farmers are prepared to travel to the regional office in the City to get the information and assistance they want. As land is important capital for farmers, F06 shared: *"... Anywhere in this [Aposkahoy] village, I know, I'm familiar as long as it is A&D... I got these [maps and documents] from the region. I requested this personally."* Most farmers do not do this because, being poor and with limited education, they are generally timid, and they lack the time and finances to do so. Therefore, extension services are fundamental for upland development and watershed protection.

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<sup>70</sup> A countrywide rehabilitation project that aimed to plant 1.4 billion trees in 1.5 million hectares by 2016.

These national agencies have limited manpower and technical capacities, which is meant to be augmented by the LGUs' creation of MENROs and MAOs<sup>71</sup>. The Code devolved major functions to the LGUs, including the provision of basic agricultural services and environmental protection. These services are intended to promote greater involvement of the people and other local organizations in planning, decision making, and management of natural resources. However, the Code made the creation of MENROs only optional, and to this point in time (2018) the three LGUs covering Cabulig have not created this Office. P03 said: *"It is very ironic because Claveria has the biggest forest cover in Cabulig, and yet it does not have a MENRO. Several NGOs have already lobbied for this for some time. P02 also said: "We have advocated the creation of MENRO for a long time now. Even if they don't give the budget yet, as long as there is the staff. But we always lost."* There is recognition of its importance at the municipal level, but no clear action has been taken yet because the creation of this Office takes political will. This is supported by R03: *"...The watershed initiatives in the early 2000s by the previous focal person here [Cabulig] were not pursued because the LGU [was] not focused on the environment. He was [focused] on infrastructure... even if they have a joint memorandum circular that requires the LGU and the DENR to divide the responsibility. Although 7160 [the Code] also stipulates their responsibility on the environment, the LGU does not consider that. It does not show concern [for the environment]..."* This shows a difference in how these resources should be used and managed as influenced by their land use values, priorities or institutional mandates.

### ***Decentralization of agriculture***

The MAOs also struggled with various institutional challenges: lack of manpower, mobility, performance incentives, post-harvest facilities and field-level agricultural projects, as well as time-consuming processes and paperwork. The office in Claveria remains particularly constrained by a lack of manpower and mobility. With a current population of almost 50,000 scattered across 24 villages within the 580 km<sup>2</sup> land area, there is a big gap with only seven regular Agricultural Technicians (ATs). Although the use of personal vehicles is subsidized (e.g. petrol cost), mobility is further constrained by distant villages that cover large spatial areas, the poor road system and difficult terrain. The extension works of ATs are also affected by many 'mission documents' that they regularly have to collect from the field (e.g. volume of production, area), complete the forms, and submit to the different Offices at the provincial and regional levels. P01 commented: *"When there are missions on documents, they [DA] don't go through the province anymore. They go directly to the municipality. They follow the documentary requirements themselves... Sometimes they [DA and Provincial Agriculture's Office] come to the municipality together."* This issue has

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<sup>71</sup> Some LGUs have also created their Municipal Tribal Office

been recognized by the MAO whose actions to address these issues include hiring an additional 14 casual AT designates, acquiring motorcycles from project funds, and implementing incremental promotion for staff as an incentive<sup>72</sup>. The DA, on the other hand, is currently undertaking rationalization, which includes improving extension services by creating the Provincial Operation Center.

### **5.5.2 Case study 2: Farmers' livelihoods in a rapidly expanding plantation economy**

Large-scale plantations have been part of the agricultural landscape in Mindanao for many decades. As early as 1926, the Philippine Packing Corporation started its pineapple plantation in Bukidnon, northern Mindanao, while the banana plantations in Davao, southern Mindanao began in the late 1960s. As mentioned in Section 5.2, corporate plantations increased and rapidly expanded even in upland watersheds beginning in the 2000s. This case study demonstrates the trends and current livelihood conditions as influenced by the expanding plantation economy in Cabulig watershed (Figure 5.3).

With limited opportunities, there is a strong desire for rural development from both LGUs and farmers. P06 affirmed this: *“We compete with others [villages] to have investors. The village government is happy that we have Dole [banana plantation] at least because we are no longer that behind compared with others. People have another livelihood option. Also, we agreed that they will improve and maintain the roads they will use.”* Corporate plantations guarantee new income and employment opportunities and so are used as a major vehicle for economic development.

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<sup>72</sup> Instead of just having two levels: MAO and technicians, there are now several levels to enable promotion such as Senior Agriculturist I, Junior Agriculturist I, and so on.

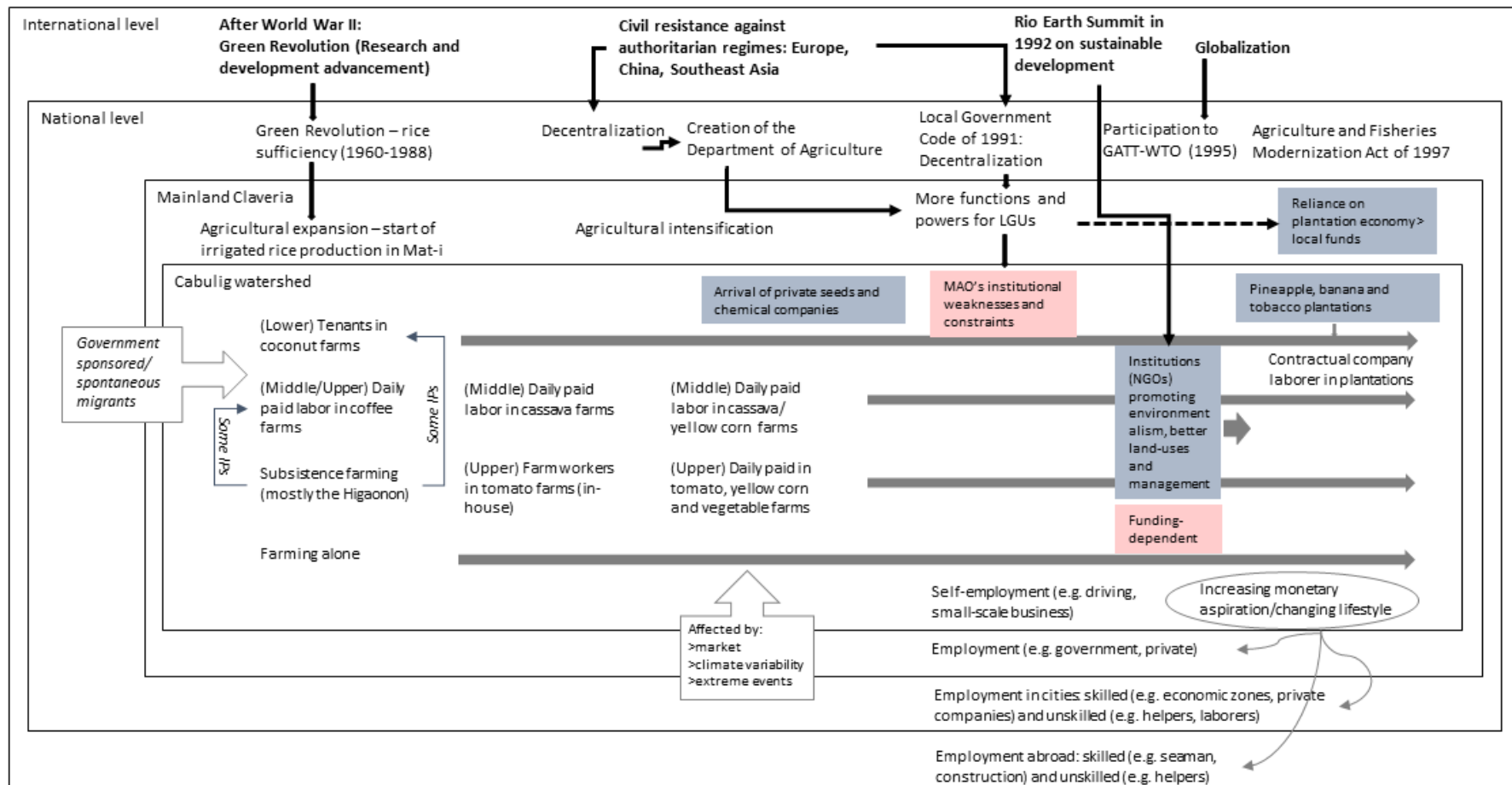


**Figure 5.2 The connection of different factors on the plantation economy interacting at different space and time scales in Cabulig watershed (2018).** Enterprise crops changed Cabulig after WWII where coconut, coffee and other crops are widely planted. Plantation crops, such as banana, pineapple and tobacco, transformed the landscape, beginning in the 2000s.

Farmers have become more exposed to urbanization and industrialization through radio, television and mobile phones, as well as the linkage of Cabulig to the region's major cities because of the market, road networks and other enablers. This has resulted in a growing monetary aspiration among farmers as they compare themselves to new settlers who seemed to be better educated and wealthier. Declining farm productivity and profitability have led them to seek a regular source of income to secure their daily food, to better educate their children, and to purchase motorbikes or electronic gadgets to be 'in' the trend. But for Pla1045, renting out their nine ha to the pineapple plantation was more than a financial need but also an affinity to their land. She shared: *"My father just had a stroke then, and we no longer know where to get the money to pay for the ballooning loan interest in the bank. The Company's offer was a good option to solve the problems... at least we will own the farm again after the contract."* They are now cultivating the sloping one-ha land just beside the plantation, while her nephew works as company labourer.

The plantations have been a source of significant livelihood improvement for landowners who have family members working in the company. Except for tobacco that uses contract growing, the pineapple and banana plantations hire labourers. They offer greater returns for labour than working on big farms. Mat1014 shared: *"My husband works at the banana plantation. He works there six days a week, with a net pay of about PhP2,500. I also cook 'binignit' and other snack food from the root crops we planted on our farm. We go to our farm on Sundays."* They also provide health and retirement benefits. But such employment is not open to everyone. It is a privilege for those who have rented out their land to the plantations. This creates a livelihood gap between big landowners and those farmers who have no land to spare. However, employment opportunities in the plantations are concentrated on labouring, while extension or supervisory positions are sourced from outside the watershed. This is an opportunity for farmers' children to consider agriculture or environment-related courses in college and use them to apply for such positions in the big companies operating in Cabulig.

Aside from landowners, bigger farmers who have trucks and vehicles have also benefited from the plantation economy. The tobacco company hires local trucks and vehicles to collect and transport fresh tobacco leaves from the farms to their main facility in mainland Claveria. As a result, having multi-cabs has become a lucrative livelihood as, out of the tobacco harvesting season, the operators can also transport vegetable products. This is an option for farmers who have a certain level of financial or other substitutable capital.

While aspirations are growing, farmers' livelihoods are also changing to meet them. Farming provides for subsistence, but it is no longer a trusted regular source of income given market fluctuations, climate variability and declining yields due to land degradation. Farmers who have engaged with corporate plantations recognize the need to diversify livelihoods. Pla1024 shared:

*“We planted 0.5 ha of our land with tobacco. The company provided us with inputs, including the seedlings, and buys the harvested fresh tobacco. Even if the profit is not that high, the income comes every week during harvesting. They pay us regularly and that is good while waiting for the harvest of our cassava. We need cash, aside from that of our store, because we have a student.”*

An example of the attitude of the tobacco corporation was evident during the fieldwork for this thesis. In response to the 2015-2016 droughts which damaged some of the tobacco farms, the company gave the planters food baskets and a half-sack of rice. Moreover, the owners of the tobacco farms that were damaged were no longer required to pay off their debt (PhP13,000 for 0.5 ha). The stable and regular income and relatively fair socio-economic arrangements with the company (initially at least) encouraged farmers to plant tobacco together with other crops. They rotate tobacco with a second crop, such as corn. Sometimes a third tobacco crop is still possible. A technician from the Company commented: *“We maintain the trees that already exist on the farm and do not destroy contours on sloping lands. We encourage this because tobacco requires a certain amount of shade.”* It is for the same reason that intercropping is also practiced in Indonesia where orange or woody perennials like coffee serve as permanent intercrop or pure stand on existing tobacco farms (Keyser & Juita, 2005). However, the company has recently changed the harvesting protocol from greenish to yellowish affecting the leaves’ weight. F10 shared: *“It was still okay in the beginning. But they changed the harvesting method now... Maybe this is just for this drought. But if the price remains the same after this cropping, maybe I will not plant anymore. We are at loss. Then, they want to increase the salary of the workers. With their current price, what do you call that? Isn’t that maltreating us?”*

Although the corporations have invested in health missions, tree growing activities, livelihood training and others, these have failed to curb persistent poverty or improve the general well-being of ‘all’ farmers. They have indeed improved and diversified farmers’ livelihoods but only those who have land and other physical assets. Most smallholder farmers have remained spectators to the economic transformation in their villages. It is therefore argued that the growth of the corporate plantations in Cabulig has had inequitable impacts on farmers’ livelihoods and well-being. Future investments should focus on narrowing that gap by helping smallholders build their livelihood resources, and in the process enable them to also take advantage of rural development.

## **5.6 Discussion**

Whereas many case studies in tropical developing countries have examined land use transitions (Lambin & Meyfroidt, 2010) and livelihood changes (Bhandari & Grant, 2007; Mahdi et al., 2009), the interrelationships of land use and livelihood changes and untangling the complexities in the connections between these changes and drivers, such as governance and globalization, is a relatively new focus of research. Although focused on land use, Lambin et al. (2003) pointed out the lack of complex place-based studies on the ‘sectoral causes of land use change and on the



mode of interaction between various causes.’ This is important in understanding how upland watersheds are remade under globalization and governance. Rural development and sustainable frameworks, of which the Sustainable Livelihood Approach is part, have also been criticized for failing to engage conceptually the forces of globalization (Scoones, 2009).

This chapter found similarities, connections and overlaps on the multiple factors that drove land use and livelihood change at the watershed level. Changes include: demographics, governance relating to policies and institutions, globalization that altered agricultural systems and triggered industrialization and development, and climate change. The characteristics of natural systems including soil and slope are specifically important to land use change. These are similar to the causes of land use change in tropical regions (Lambin et al. 2003) and Southeast Asia (Cramb, 2005; Douglas, 2006). External drivers such as globalization and governance were shown in this chapter to combine with local factors and lead to dynamic and complex decisions and actions at different locations and scales. Changes in agricultural systems caused by globalization have differential effects on farmers in the Cabulig that have widened the gap between farmer groups who have land and physical assets and those that do not. With various land tenure arrangements, land systems have improved but not necessarily farmers’ economic and livelihood status.

By using the SLA framework (Chambers & Conway, 1991) as a conceptual tool to guide the comparative study, this chapter examined the commonalities and differences in land use and livelihood decisions that farmers made at the farm level in Cabulig. The farms’ biophysical conditions and area, and the farmers’ available financial capital and labour, as well as experience and knowledge all influence farmers’ decisions over land use and livelihoods. As in other tropical acid uplands where soils are infertile and the environment fragile (Cramb, 2005), farming in difficult locations has left farmers with simpler land use and fewer livelihood choices. Although farmers are aware of environmental issues, the actual farming systems do not often demonstrate this. Personal values and aspiration, which are often economically focused to improve household well-being, maybe more important. Land uses which are good for the long-term may not be good for the short-term as they may reduce smallholders’ current farm income. These are various reasons for this:

- some of the more sustainable long-term options take several years before they become profitable,
- soil conservation measures do not directly increase crop production and profitability in the short-term and may be seen by farmers to only prevent the decline in productivity, and
- investments in crop inputs may be lost in poor seasons.

This has implications for farmers’ risk management for natural assets that they rely on in the long-term. They invest less of the opportunity cost of their time and other resources if they increase

shorter-term livelihood risks. Another finding is the important influence of the geographic location of farms and villages on land use, accessibility and distribution of livelihood resources. Different farmer groups in different locations and villages are differently positioned to adapt or take advantage of new economic opportunities. It is then argued that whilst these determinants were relatively similar across the six villages studied, the land use and livelihood outcomes resulting from the changes varied in magnitude across both space and time.

The case studies in Section 5.5 demonstrated how Cabulig has undergone a particularly rapid transformation in recent years under both changes to governance and globalization. This transition occurred in dynamic and complex ways where similar forces have had diverse consequences in different villages or farmer groups. Decentralized governance has influenced the way policies, institutions and political processes change land use. The reduced role of the national government has seriously impacted the support and services extended to poor rural households (Douglas, 2006). In Cabulig, the DA and DENR's extension services were devolved to LGUs who often have an infrastructure agenda rather than agricultural and environmental goals. This resulted in limited (or no) government policies and interventions that would help support farmers to strengthen their access to and control of livelihood resources needed to adapt to changing the environment and take advantage of new economic opportunities. This was indicated by farmers' comments that the lack of extension support may not have directly affected their land use but the presence of it would improve their farming livelihood and help them better cope with changes.

The case studies also highlighted how changes outside the watershed can alter the way globalization affects land use and farming livelihoods. In other developing countries, national or international migration and remittances is a significant livelihood dynamic (Kelly, 2011). In Cabulig, this dynamic has appeared more recently as employment opportunities have become available for both skilled and unskilled labour due to infrastructure development and industrialization in nearby cities and coastal towns. Exposure to these places and opportunities has influenced the aspirations of farmers and their children. They work in cities and abroad and send remittances to their parents for use on the farm and/or additional investments. The temporary migration of wives and young children is a livelihood strategy that enables some husbands and fathers to continue farming. In addition, globalization, through plantations, has twin impacts in that they create new livelihood opportunities for some rural people but limit options for others who do not have the land resources needed to take up new strategies (Rist et al., 2010). This is also evident in Cabulig where private companies provide livelihood options to landowners and farmers with transport but exclude smallholders who do not have sufficient financial resources.

Ultimately, land use and livelihood outcomes needed and desired by the farmers, in addition to the strategies adopted to achieve those outcomes, have shifted significantly over the years, although to varying degrees. This is due to the changing lifestyle preferences and increasing costs

of living and farming. Because of these changes, some farmers' old livelihood strategies in San Nicolas and Luna were particularly unsuited to the new socio-economic context as compared to those in Mat-i, Malagana and Aposkahoy where the plantations are located. Some farmers interviewed still lived very close to a subsistence lifestyle even when the government had already provided them with tenure in the late 1970s. This lifestyle was no longer suited to the very different socio-economic conditions emerging in 'modern' times. The land is scarce and the cost of living and farming has risen significantly, creating a far greater need for them to earn monetary income. The costs of children's education, electricity and mobile credits were all new emerging expenses that did not exist before. As discussed earlier, lifestyle aspirations are changing, particularly among children. Young ones' preferences for non-farm employment and education were indicative of a more urbanized lifestyle that could not be fulfilled by the farmers' traditional livelihoods.

The effects of these contexts and dynamics on land use and livelihood changes through different scales, spaces and time are under-emphasized in the way the SLA framework is typically used. The framework emphasizes the effect of access to resources on livelihood strategies in each context rather than considering the influence of shifting needs and desires for particular livelihood outcomes in a changing context, which Scoones (2009) addressed. Moreover, many studies that examine land use or livelihood change under policy-change and globalization have focused on their effects on access to economic resources (Rist et al., 2010; Thongmanivong et al., 2009) rather than on sociocultural impacts such as knowledge, motivations, preferences and farming household dynamics.

The findings in this chapter suggest that interventions need to be tailored to fit the specific local context and dynamics, which may vary significantly even within villages (Bhandari & Grant, 2007; Douglas, 2006). There are three strategies that the government and other stakeholders could pursue in Cabulig watershed and potentially in other upland areas. First, interventions at the watershed level need to be put in place that go beyond the common focus on sub-villages. These should particularly involve strengthening farmers' access to the resources they need to adapt their land use and livelihood strategies to the changing socio-economic conditions (e.g. skills development, pro-poor micro-credit services, promotion of collective actions and social networks). These require an effective system for extension service delivery. Second, there must be synergy between mediating government and private institutions, and their goals of environmental sustainability, economic growth and rural farming livelihoods. The Municipality of Claveria enacted a law in the late 1990s that prioritizes those farmers who have contoured their sloping farms when there are available livelihood projects. This concept of rewards for ecosystem services also emerged in a recent ordinance in 2015 that provides monthly cash incentives to indigenous forest guards for looking after Mt. Sumagaya. This concept can also be explored with the MNCs and other companies operating downstream. Finally, where synergies between

environmental sustainability and rural livelihood goals are not that strong, interventions must focus on reducing trade-offs between them. Interventions should offset the negative effects of environmental conservation programs on farming livelihoods. Whilst farmers are currently restricted from farming within the MBRNP and are encouraged to plant more trees with the NGP, there also need to be interventions to ensure that emerging new livelihood strategies do not put pressure on the natural resource base for fairness. Unplanned expansion of corporate plantations is an emerging threat to Cabulig's land use sustainability. The initial step would be to create an institution that has a good understanding of the complexities and dynamics of Cabulig, can integrate and oversee all the activities in the watershed, and can link it to the outside for more resources. To achieve this, there is a need to enhance the capability of LGUs to enforce land use regulations and prepare robust land use plans, including watersheds. These land use regulations and plans will serve as the LGUs' overarching framework for land use in the watershed and guide them in issuing permits to use lands for plantation development and other non-farm and non-forest uses.

Having explored the drivers of land use and livelihood change in Cabulig watershed over the years and the determinants of farmers' decision making in this chapter, the next will examine preferred land use development pathways for farmers and other stakeholders. It draws on the analyses in this chapter and those from Section 4.3.2.

## Chapter 6: Do the farming futures desired by farmers match the aims of external stakeholders?

*‘Aspirations are never simply individual. They are always formed in interaction and the thick of life... [that requires] a navigational capacity which is nurtured by the possibility of real-world conjectures and refutations [and]... thrives and survives on practice, repetition, exploration, conjecture, and refutation.’*

*Appadurai, 2004*

### 6.1 Introduction

Despite the important role of farming communities in achieving the goals of rural development, and sustainable land use and watershed management in the uplands, capturing farmers’ aspirations and capacities to achieve these goals has received little attention until recently (Appadurai, 2004; Fan & Chan-Kang, 2005). The concept of aspirations for well-being has generated a new, cross-disciplinary interest in the role of willingness, capacity and livelihood capitals in the fields of economics (Ray, 2003), rural education (Corbett, 2016), agricultural development (Leavy & Hossain, 2014) and natural resources management (Curtis et al., 2001). This concept of well-being provides an opportunity to achieve land use and livelihood change by supporting farmers to invest their hard work and assets in activities that meet their aspirations as well as the goals of external stakeholders.

External stakeholders include government and non-government organizations (NGOs), private companies and other actors who can have different values and priorities for how they think farmers’ lands should be used and managed (Seymour et al., 2010; van Noordwijk et al., 2015). Whilst there is potential for conflict between farmers and these stakeholders, all parties can also choose to be flexible and adaptive to opportunities for negotiations, and make better choices (Piñon et al., 2012). However, poor understanding of the processes of change internal to each of the internal and external stakeholders hinders decision-makers from developing and implementing mechanisms that would bridge gaps in aspirations and reconcile contesting preferences.

In this chapter, the concept of aspirations for well-being is explored in the Cabulig watershed to determine its relevance to the issue of changing farmers’ land use and livelihoods. It investigates

what farmers aspire to with respect to their well-being and that of their families<sup>73</sup> as well as their aspirations for the watershed, and how both these aspirations shape their preferences for particular land uses, crops and their livelihoods. These preferences are compared and contrasted with the land use and crops that external stakeholders would prefer farmers to adopt. The major stakeholders considered in this chapter are categorized into three groups: (1) the farmers, (2) the decision-makers including the policymakers, local government staff and planners, farmer leaders, and representatives from NGOs and private companies (referred to as ‘decision-makers’ from now on), and (3) agricultural and environmental ‘experts’ from academia, government and research institutions (referred to as ‘experts’ from here on).

This chapter draws on data from the key informant interviews (KIIs) with farmers and external stakeholders as well as the farming household (HH) survey data: the KIIs and HH survey data are used to gain depth and breadth of understanding, respectively (Table 6.1). Section 6.2 analyses how farmers’ current land use and livelihood employment reflect their aspirations for well-being. Section 6.3 discusses the land use and crop preferences of farmers and maps the factors influencing their choices. It also identifies the extent of differences between farmers’ and external stakeholders’ land use, crop choice and management preferences. Section 6.4 explores the linkage of farmers’ aspirations to their land use and livelihoods, and the implications of farmers’ and external stakeholders’ different land use/crop preferences. The concluding Section 6.5 draws on both qualitative and quantitative analysis to get a more rounded view of the interaction between farmers and external stakeholders’ aspirations for achieving sustainable land use and watershed management in the uplands.

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<sup>73</sup> The Millennium Ecosystems Assessment (2005) considers human well-being to include the aspirations for ‘a good life, freedom and choice, health, good social relations, and personal security’. I argue that it is how the farmers order financial status, basic needs, knowledge, priorities, and aspirations relative to one another that influences their preferences in land use/crop choice.

**Table 6.1 Overview of data sources, analyses and purposes by section**

|                                                                                                                  | Analyses                                                                                                                                                                                                                  | Primary data source             |
|------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------|
| Section 6.2: Determining farmers' aspirations, and to what extent these influence their land use and livelihoods | Ascertain farmers' aspirations for the acquisition of livelihood assets and improved well-being                                                                                                                           | Key informant interviews (KIIs) |
|                                                                                                                  | Document what land use and management practices farmers in the study villages intend to carry out in the next 10 years                                                                                                    | Farming household (HH) survey   |
| Section 6.3: Farmers' and external stakeholders' land use and management visions                                 | Identify the preferred land use and crop choices of farmers in the study villages                                                                                                                                         | Farming HH surveys              |
|                                                                                                                  | Explore the extent of any difference between the land use and crop preferences of farmers with those of external stakeholders, and investigate options to move closer towards a shared vision for land use and management | KIIs                            |

## **6.2 To what extent do land use and livelihoods reflect farmers' aspirations for well-being?**

In Cabulig watershed farmers' broad aspirations range across a continuum from 'survival' at one end to 'prosperity' at the other (Figure 6.1); in the KIIs the number of farmers falling in each category were 9 and 5<sup>74</sup>, respectively. Aspirations of an individual farmer are formed by their knowledge, values, observations and experiences, all of which are often place-based (village), situation-specific (partner's death) and context-dependent (social relations). While aspirations for some farmers necessarily change in response to these factors, their actual land use, crop components and/or management practices might not change. The knowledge gained from the KIIs on the survival and prosperity extremes is discussed in sub-sections 6.2.1 and 6.2.2, respectively.

### **6.2.1 Land use and livelihoods for survival**

Farmer informants whose aspirations were expressed in terms of survival tend to have adopted simple agroforestry systems. Their lands are mostly situated on the steeper sloping lands in difficult and vulnerable terrains and so they have limited crop choice. F05 said: *"I only want to continue growing those that we've planted because it's not possible to plant other crops. It [land] is very steep. Only banana and corn. I'll leave the forest trees around."* While many of them (10 out of 14) owned the lands they cultivate, some were only caretakers or under sharing arrangements of farm produce. Farmers who do not own the lands they till reported that they do not have the freedom to develop the land, rather they just follow their (absentee) landowners'

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<sup>74</sup> These are the 14 farmer KIIs which farms were sampled during the ACIAR Watershed Evaluation project's digital soil mapping

instructions. F08 shared: *“Our landlord is interested to plant cacao. He will join that program of Kennemer. We just plant what he says. We just work for him as daily paid labourer.”* The main source of income for the ‘survival’ aspirants is daily paid labour on nearby bigger farms. They cultivate their farms, whether owned or as caretakers, mainly for household food.



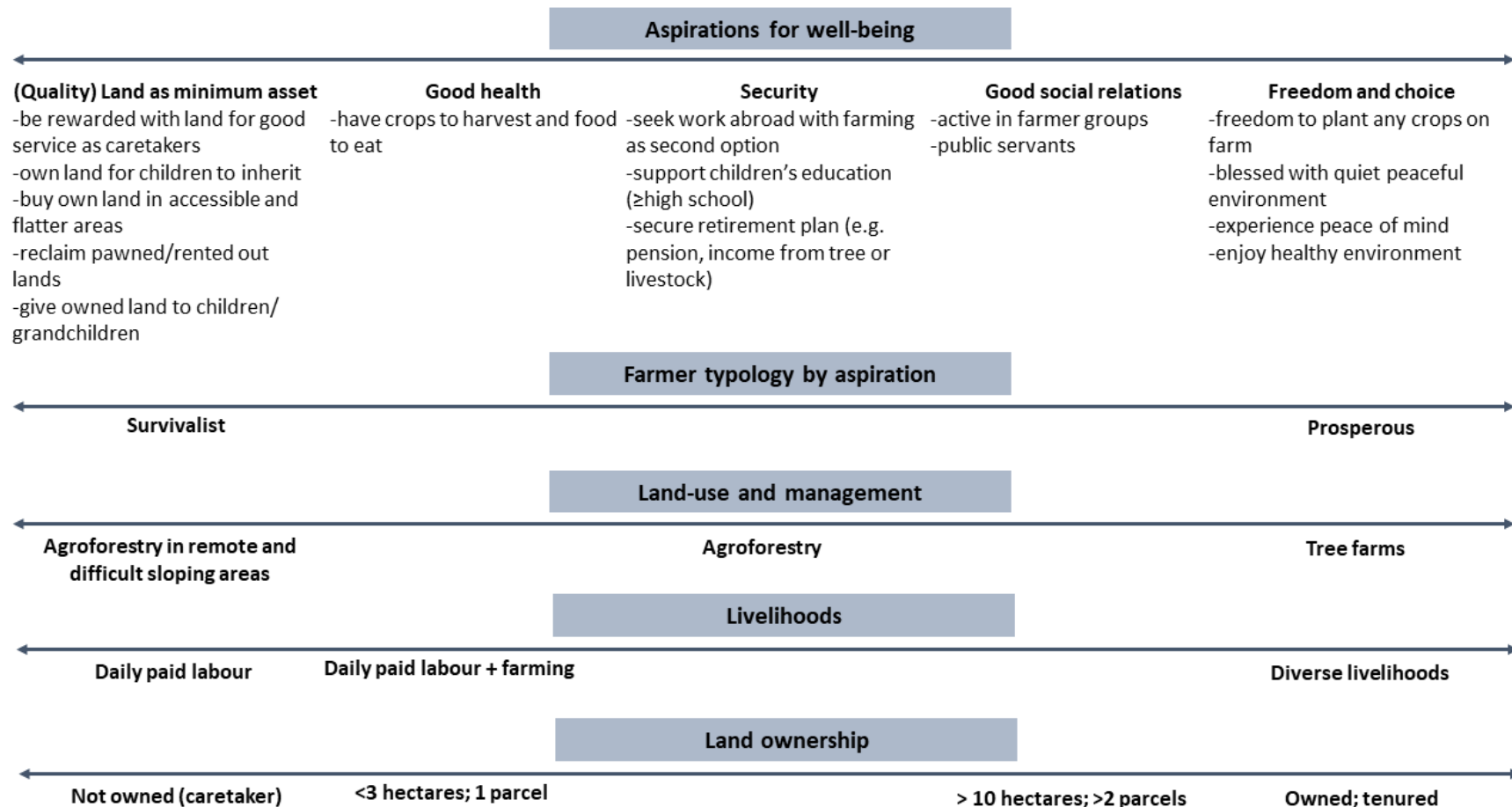


**Figure 6.1** The continuum of aspirations for personal and family well-being identified by farmers in the Cabulig watershed (2016 ), framed according to the Millenium Ecosystem Assessment (2005) constituents of well-being. These aspirations typically reflect the land ownership, livelihood activities, and land use and management of the farmers.

These farmers also have aspirations of acquiring the minimum assets to have a good life in farming. F07 commented: *“As long as we can harvest, we can eat, we’re happy. We must have food to eat... We are already contented that we can eat.”* For those who do not own the lands they till, they hope that they are rewarded with a piece of land for serving their landlords well (by developing their lands productively). F02 shared: *“[I hope] they will give me even just a piece of this farm. I will accept it. I have worked to death on this farm for a long time. These crops are all my hard work... I have children. They should inherit something from me.”* Others who have pawned or rented out their lands for their children’s education hoped to reclaim these lands soon. F04 said: *“When they [children] are finished in school, I will work on reclaiming my wife’s inherited land that we have pawned. We will never pawn or rent out our lands again.”* As their only asset, it is common for farmers with enough land area to use their lands to resolve their short-term financial needs, including their children’s education. While some are determined to regain land ownership, others have lost all their lands indicating the risk attached to this strategy.

In terms of social relations, many of the farmers belonging to this side of the continuum are not members of any farmer organizations (FOs); six have no social groups whilst three have been part of FOs but are no longer active. Their views on FOs varied from simply impassive to strongly hostile. F05’s lack of interest may partly be due to her (maybe introvert) personality as well as gender role within the household for most of her life – taking care of her siblings as a child and then her children as a wife. She was at home most of the time while her husband looked after their farming livelihood and community affairs. After her husband passed away, she took the role of head of the family, which included providing the basic needs of her children but not the community activities. She has never participated in any FO and when asked about the possibility of joining community activities, she simply said: *“I don’t like social activities”*. F12’s position on participating in FOs was strongly negative, which can be ascribed to his past experiences as well. He commented: *“Oh that’s [joining FOs] forbidden to me. I don’t like that. Why? Even if my education is just low... I know that when you join an organization, you must share financially. They say that no organization can stand without the members sharing financially. For example, the very first step in participating in an organization, there is already the membership fee. We haven’t started anything, yet they demand money straight away. If they want to help us, farmers, why get money from us when we don’t even have any? That’s my view... I have lost trust in anybody, especially those rich farmers, politicians.”* Some farmers do recognize the benefits of participating FOs such as F13 who commented: *“It’s good to join organizational activities because I learn new things. I learned about trees and contouring with Landcare before. I was trained by Del Monte to do alternative livelihoods other than farming.”* However, when internal challenges arise, such as poor leadership or financial mishandling, it can split the organization and leave lasting impressions and grievances on the affected members that can be difficult to heal and undo, as described by F08.

About their feelings towards farming, one farmer, F12, had a negative view and said: *“I’m not happy that I’m working now on a farm. No, I never dreamt in my life that I will become a farmer. That is honest to goodness feelings because I have nothing to lose if I say the truth.”* Similarly, others felt stranded and that they lack assets and have no other alternative but to farm despite their aspiration for ‘prosperity’. F05 shared: *“That [farming] has been my source of livelihood. If only I have finished school because I’ve had enough of farming. I’m already tired of it. I’ve nowhere to go because I haven’t finished anything. We’ll just have to bear farming’s difficulty... Unlike if you are professional, you can be flexible with livelihoods.”* However, the other farmers on the survival side of the continuum were contented being farmers. They related this mainly to their parents and grandparents who were farmers themselves, and to their low level of education. F11 commented: *“I’m happy with farming. I have to because we don’t have other livelihoods here... My parents were also farmers, and I followed them by also helping my husband on the farm.”*

There were similarly mixed aspirations around their children’s future livelihoods. Some aspired for their offspring to finish school, particularly those whose children were still young, so that they would have a better livelihood than farming. F12 revealed: *“I work hard to support their (children’s) education at Technical Education and Skills Development Authority because they already graduated high school so that they will have skills. One is into welding and the other is on piping.... My children, I will not let them become farmers like me. I forbid farming among my children.”* F13 also shared: *“I just want them (children) to get easier livelihoods because farming is so difficult... Maybe a construction worker because the pay is higher than a daily paid farmer, or a saleslady so that they will not work under the sun the whole day.”* Others were disappointed that their aspirations were not shared by their children. F11 commented: *“We laboured so hard to send them to college. All along they were busy with other things... It can be frustrating because as parents, all we want is for them to have a good life. Not the life we went through here in the mountain.”* In contrast, the women farmers interviewed were the only ones who expressed keeping their children on the farm, particularly the sons. F07 shared: *“I want him [only son] to farm because we have no one else to work on it. He has to continue farming.”*

### 6.2.2 Land use and livelihoods for prosperity

Farmer informants who aspire to a more prosperous future tend to have adopted more complex agroforestry systems, especially on sloping lands. These extend beyond the tree and agricultural crops (implemented by ‘survival’ aspirants) to include livestock and forage grasses. F06 commented: *“...That is why in my contours, I plant it with Napier grass. I put effort into this because my livestock has helped me greatly. Raising cows has more economic benefits than buying appliances as my neighbors do... But my cows, they become more expensive as they get matured. It’s the same as buying lands.”* These farmers also have more diverse income sources than survival aspirants, combining farming (including livestock) with non-farm activities (e.g.

public servants). They typically own more than one parcel of land with a total area of 5 to 18 hectares which allows them to devote some parcels to tree farms (e.g. Falcata, Rubber). One farmer with 'prosperity' aspirations, who does not have the assets and resources typical of others in this category, is F12: he is cultivating on leased cornland on less sloping land in Malagana, and shares his harvest with the landowner. However, he aspired to own land so he can plant Mahogany trees for income from timber.

Many informants have aspirations for greater financial security and some, despite good farming income, still seek better-paying livelihoods. One of the reasons is to ensure the education of their children. F01 commented: *"I didn't dream for them (children) to become farmers like me. Farming can be challenging sometimes. They have to study. Education is very important."* As said, many farmers relate their farming livelihood and lack of other economic opportunities to their low level of education. This self-identified lack of education did not limit their efforts to achieve their aspired livelihood status. Many are preparing for their retirement in various ways. One way is through their tree farms as shared by F09: *"It is important that I have durable crops permanently on my farm. These are good especially when I become old and my body can no longer move around. I cannot continue plowing... It's good that I already planted rubber trees while I can still plant. When the time [old age] comes, I will just be harvesting my rubber."* Trees are also seen by these informants as a strategy for coping with future uncertainties, such as more frequent flooding in downstream villages (e.g. San Nicolas) or landslides and droughts in the upstream villages (e.g. Aposkahoy, Mat-i).

With relatively secure livelihoods, these farmers tend to enjoy good social relations that give them personal fulfillment and satisfaction. Some farmers are keen to continue participating in and leading farmer groups because the knowledge they gain further builds their confidence and networks. F06 said: *"... For all the knowledge I gained from seminars and training in my groups, my understanding of things, they [fellow village councilors] cannot fool me even if they are millionaires. They are still disadvantaged because I know many things."* Others aspired to resume serving their communities as elected public servants like F09: *"This is my second term as a village councillor. I will run again in this October local election if things will work out as planned."* Farmer leaders and public servants state that they do not think of personal advantage but that of the wider community. In response, they are given due respect in the village, and that prestige increases their self-esteem.

Farmers with secured lands and livelihoods also tend to experience the 'good life' in farming. They seem to enjoy farming more than those focused on survival, and they can appreciate seeing the development of their farms over the years. F01 shared: *"What I like in farming is the freedom I have - when and how I want to work. Here, my parents give me the freedom to plant additional crops on the farm."* They value sustaining their farming and other livelihood activities for many

reasons, including being active and staying fit or feeling emotional joy knowing they will leave productive and sustainable farms to their children and grandchildren. As such, prosperous farmers are inclined to consider environmental protection and good social relations, which provide them with a peaceful and spiritual experience of a good life. It is important to note many of the farmers at this end of the continuum are mature to old age which influences their aspirations. F09 aspired that: “...my sloping areas, those that I cannot plow, will be fully planted with trees before I get old.”

### 6.2.3 Intentions of the wider farming community in the watershed

In the first survey of farming households (n=104), conducted by the ACIAR Watershed Evaluation project, farmers were asked ‘What are the three most important things that you aspire to improve with respect to farm productivity?’ As farming was their main source of livelihood, the majority of them aspired to improve their farms’ productivity by diversifying their farming system through integrating short-, medium- and- long-term crops (e.g. corn+banana+rubber) (Figure 6.2). Since they did not have the capital, they hoped to access financial assistance so they could access the minimum assets to make their farms productive and profitable. If they could do that, they would be able to provide their family’s basic needs, prioritizing food, and their children’s education.

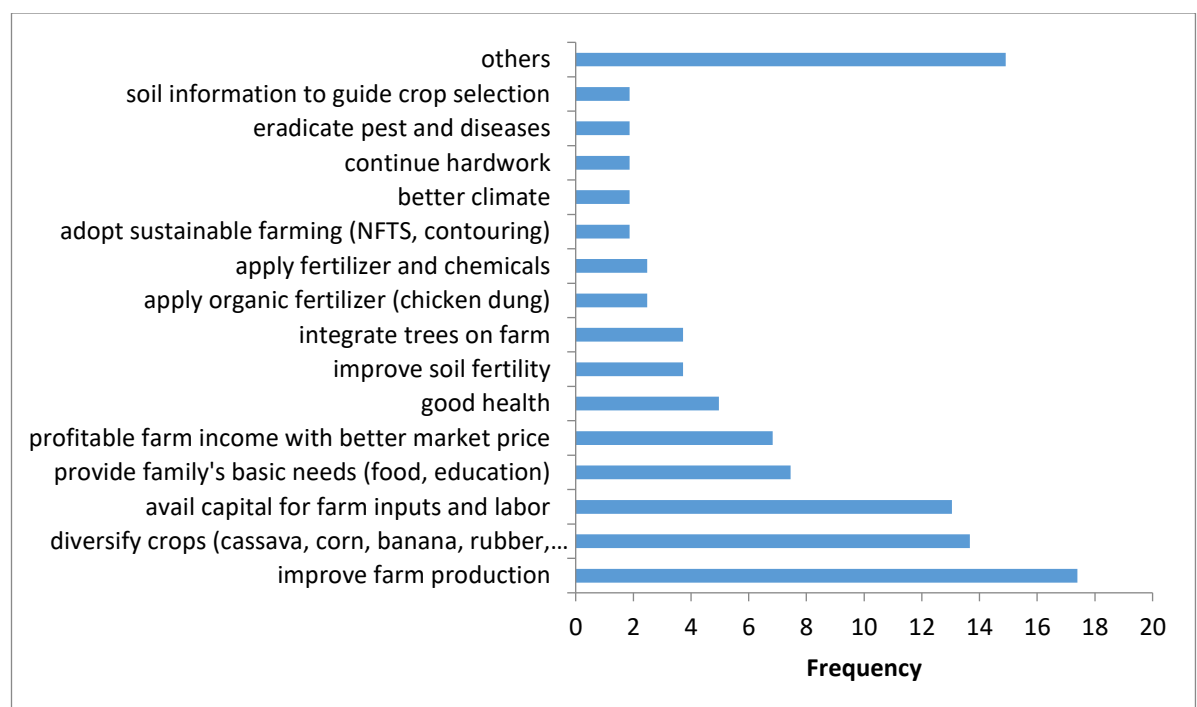


**Figure 6.2 Farmers’ productivity aspirations in Cabulig watershed from the first household survey (2013, n=104)**

I asked a different question of the farming households (n=500) in the main survey (Table 6.2). In a 7-point Likert scale ranking with 1 as very unlikely, specific statements were given to identify

the intended course of action with regards to their land use, land ownership and livelihoods in the next 10 years. In the whole of Cabulig, they were generally likely to adopt various soil and water conservation practices to improve their land use but this varied by village. Farmers from San Nicolas, Plaridel and Aposkahoy were very likely to diversify their crops. Aside from its economic benefits, crop diversification is considered environmentally-suitable in San Nicolas and Plaridel, particularly by those with farms along the Cabulig River, to mitigate the impacts of flooding and landslides, whereas in Aposkahoy it is considered inappropriate for the headwaters. Similarly, farmers from San Nicolas and Luna were very likely to construct contour hedgerows to reduce soil erosion. These villages have steep slopes that are still being cultivated. Other practices that farmers in different villages were likely to adopt include growing commercial crops, agroforestry, cover crops and minimum tillage. While growing commercial crops and agroforestry are popular, the deliberate growing of cover crops is a relatively new technique for many of them. In contrast, minimum tillage to reduce soil erosion is already practiced to some degree in different villages. While farmers from the sloping areas of Luna and Mat-i refer to this as their ‘urok’ (dibble) traditional system, others in Malagana and Aposkahoy associate it with using herbicide to plant hybrid corn and are hesitant to adopt it because of the perceived negative environmental impact of herbicides.

There are also mixed intentions about land ownership. Except in Malagana where land pawning/renting is prevalent, most farmers from the other villages were likely to maintain land ownership within the family. They have a close affinity to their lands, such that it was common to hear them intending to leave their lands as an inheritance to their children/grandchildren. It then follows that they do not intend to sell/pawn/lease their lands in the future. The caveat is the circumstances that they may face in the future – financial pressures or livelihood opportunities – may require a change in this intent. In contrast, some farmers were likely to purchase/pawn/lease their lands to expand their cultivation if they have the financial resources to do so, particularly in Plaridel where farmers have relatively high farm incomes. This is only a remote possibility for farmers in San Nicolas and Malagana. In the former, farm incomes are rather low and the best lands are mostly owned by absentee landowners. In the latter, land price has escalated with the influx of financiers either financing cultivation or renting/pawning their lands. There was also increasing awareness of the prohibition of these kinds of transactions in tenured forestlands (i.e. ancestral lands, community-based forest management areas). Those who have pawned out their lands will have to earn and save more to get back their land. This demonstrates farmers’ intention to keep ownership of their lands to continue farming, and in the process improve their land use and management practices while diversifying their livelihood activities.

**Table 6.2 Farmers' intentions by village in Cabulig watershed (2016). Responses are average with standard deviation in brackets.**

| Farmers' intentions |                                                                           | San Nicolas | Plaridel | Luna  | Mat-i | Aposkahoy | Malagana | Cabulig |
|---------------------|---------------------------------------------------------------------------|-------------|----------|-------|-------|-----------|----------|---------|
| Land use            |                                                                           |             |          |       |       |           |          |         |
|                     | I will grow commercial crops that are more profitable                     | 4 (1)       | 4 (1)    | 4 (1) | 4 (1) | 4 (1)     | 4 (1)    | 4 (1)   |
|                     | I will grow trees on my farm                                              | 4 (1)       | 4 (1)    | 4 (1) | 4 (1) | 4 (1)     | 4 (1)    | 4 (1)   |
|                     | I will grow different crops on my farm                                    | 5 (1)       | 5 (1)    | 4 (1) | 4 (1) | 5 (1)     | 4 (1)    | 4 (1)   |
|                     | I will plant cover crops to increase organic matter of my farm's soil     | 4 (1)       | 4 (1)    | 4 (1) | 4 (1) | 4 (1)     | 4 (1)    | 4 (1)   |
|                     | I will apply zero/minimal tillage to reduce erosion                       | 4 (2)       | 4 (1)    | 4 (2) | 4 (1) | 4 (1)     | 4 (1)    | 4 (1)   |
|                     | I will construct contour hedgerows to reduce soil erosion                 | 5 (1)       | 4 (1)    | 5 (1) | 4 (1) | 4 (1)     | 4 (1)    | 4 (1)   |
| Land ownership      |                                                                           |             |          |       |       |           |          |         |
|                     | I will encourage ownership of the farm to stay within the family          | 5 (1)       | 5 (1)    | 5 (1) | 5 (1) | 5 (1)     | 4 (1)    | 5 (1)   |
|                     | I will sell/pawn/lease this land in the future and migrate out of Cabulig | 3 (2)       | 2 (1)    | 2 (2) | 2 (2) | 3 (2)     | 2 (2)    | 2 (2)   |
|                     | I will sell/pawn/lease this land in the future and work in a plantation   | 3 (2)       | 2 (2)    | 2 (2) | 2 (2) | 3 (2)     | 2 (2)    | 2 (2)   |
|                     | I will purchase/pawn/lease lands to expand farming                        | 3 (2)       | 5 (1)    | 4 (2) | 4 (1) | 4 (2)     | 3 (1)    | 4 (1)   |
| Livelihood          |                                                                           |             |          |       |       |           |          |         |
|                     | I will continue farming as long as I live                                 | 5 (1)       | 5 (0)    | 5 (1) | 5 (1) | 5 (0)     | 4 (1)    | 5 (1)   |
|                     | I will access loan/credit to improve and expand my farming                | 3 (2)       | 4 (2)    | 3 (2) | 4 (1) | 3 (2)     | 3 (1)    | 3 (2)   |
|                     | I will diversify my sources of income while maintaining farming           | 4 (2)       | 5 (1)    | 4 (1) | 4 (1) | 4 (1)     | 4 (1)    | 4 (1)   |

For livelihoods, the responding farmers were very likely to continue farming as their livelihood, and likely to diversify their income sources. However, they were less certain with regards to accessing loans to expand their farming area. Considering their level of education, skills and the limited livelihood opportunities in the area, many thought there were not many livelihood options other than farming (Chapter 4.4). That said, they expressed a wish to add to their livelihood portfolio (e.g. small-scale business in addition to their farming activities). Farmers seem reluctant to access loans or credit to improve and expand their farming livelihoods, particularly in villages with relatively low financial incomes (San Nicolas, Luna).

#### 6.2.4 Farmers' willingness to change their land use

The respondents in the two HH surveys were asked '*Are you willing to change your land use?*' (n=604<sup>75</sup>). More than half of them (60%) were reluctant to change their current land use. Of the unwilling, about 67% are practising an agroforestry system while 33% have a solely agricultural system. 40% of farmers were keen to explore new land use and/or crops. Of these, many were inclined to agriculture, with about 14% wanting to change their agroforestry system to agriculture and around 11% just wanting to change crops within their agricultural system. In contrast, about 12% of them were disposed to add more trees to their agroforestry system; while 3% desired to change their agricultural land use into agroforestry. These results reveal farmers' preference for agricultural production, which in some cases would involve a change from agroforestry into agriculture. Knowing the factors that influence farmers' (un)willingness to change land use is crucial to develop appropriate interventions towards an outcome that would bring positive change in the watershed. Positive changes may entail adopting better land uses, particularly soil and water conservation measures, growing appropriate crops, and integrating trees on the farm.

The SPSS Generalized Linear Modelling tool was used to investigate factors linked to farmers' willingness to change (WTC). A backward stepwise process was used to eliminate insignificant factors (see Chapter 3.5.3). Table 6.3 presents the final model including diversity of livelihoods, ethnicity, range of skills, access to extension services, farming aspirations, the effect of typhoons and droughts, and slope as significant regression factors for farmers' WTC land use. Among these, farmers' farming aspirations is the most significant factor, which includes exiting from farming and engaging in other non-farm livelihood activities, continuing their farming livelihood but not necessarily expanding their on-farm activities (e.g. expand the area, add new crops), and expanding their on-farm activities. In the HH survey (n=604) over half of the respondents (58%) aspired to continue farming but not expand, 23% wanted to expand and 19% wanted to leave farming. Farmers' WTC land use is negatively related to diverse livelihoods ( $-0.135, p < 0.001$ )

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<sup>75</sup> This is the combined data sets from the ACIAR Watershed Evaluation project and this thesis' HH survey



and access to extension ( $-0.107, p<0.01$ ). On the other hand, the steepness of their farms' slope is also very significant, as it determines the possibility of changing their land use and/or crops to another use. Slope is negatively correlated to farmers' ethnicity ( $-0.296, p<0.001$ )<sup>76</sup>, diverse livelihoods ( $-0.096, p<0.05$ ) and to their access to extension ( $-0.138, p<0.001$ ), and positively correlated on the effect of drought ( $0.095, p<0.05$ ). While it is often assumed that indigenous farmers have steeper lands, the negative correlation of slope to ethnicity can be attributed to the dataset that is skewed towards non-indigenous (42%=indigenous; 58% non-indigenous).

Access to extension, diverse sources of income, and perceived risk of being affected by typhoons are positively correlated with farmers' inclination to change land use. Access to extension ( $p>0.001$ ) is particularly highly correlated with farmers' willingness to change land use. This suggests that extension services have a key role in influencing farmers' decision making with the possibility of directing that decision towards a desired land use outcome. In contrast, the diversity of farmers' skills ( $p>0.001$ ) is highly negatively correlated with their decision to change land use, and that the more skills they have the less likely they are to change their land use. This might indicate that the more skills they possess, the more potential sources of additional household income they have, and consequently the less they depend on farming alone.

**Table 6.3 Results of the final Generalized Linear Model for farmers' willingness to change their current land use systems in Cabulig watershed (2016) (Chi2=111.934,  $p<0.000$ )**

| Factor                    | Wald's Chi <sup>2</sup> | df | p-value  |
|---------------------------|-------------------------|----|----------|
| (Intercept)               | 14.0                    | 1  | 0.000    |
| Farming aspiration        | 1681.8                  | 10 | 0.000*** |
| Slope                     | 10.8                    | 1  | 0.001*** |
| Affected by typhoon       | 30.0                    | 11 | 0.002*** |
| Access to extension       | 6.3                     | 1  | 0.012**  |
| Diverse sources of income | 4.1                     | 1  | 0.043**  |
| Affected by drought       | 22.5                    | 13 | 0.048**  |
| Skills                    | 5.6                     | 2  | 0.061*   |
| Ethnicity                 | 2.9                     | 1  | 0.086*   |
| Farm group                | 1.9                     | 1  | 0.163    |
| Soil fertility            | 1.5                     | 1  | 0.216    |
| Health                    | 2.9                     | 2  | 0.229    |
| pH                        | 0.3                     | 1  | 0.605    |

\* $p<0.10$ ; \*\* $p<0.05$ ; \*\*\* $p<0.01$

### **6.3 Farmers and external stakeholders' land use and management visions**

Eliciting farmers' and external stakeholders' current and preferred use of land can potentially provide information for researchers, the government, donors and other concerned institutions to develop appropriate interventions that farmers may adopt and invest in. This section compares

<sup>76</sup> This suggests that Higaonan farmers are more likely to be situated on flatter lands.

and contrasts the crop preferences of farmers and external stakeholders, and the factors influencing the former's choices. This provides a basis for understanding farmers' land use and management decision making behaviour.

### 6.3.1 To what extent are farmers' preferred crops shared?

While the farmers who participated in the HH survey generally preferred agricultural land uses, the farmer KIs preferred agroforestry. However, the agricultural crop preferences identified in the HH survey were generally similar to those identified in the KI interviews with farmers. The open discussion during key interviews provided more specific results than the HH survey (e.g. squash rather than just vegetable). For agricultural land use, the informants preferred vegetables, particularly tomato, squash and mung bean, which are crops that are already being grown in the watershed. But F09 would like to try temperate vegetables such as broccoli and cauliflower. He commented: *"I think they will grow here because the coldness there [Lantapan<sup>77</sup>] and here is almost the same... Most of the crops that farmers plant here are just for the vegetables, apart from tomatoes, there is cabbage, Chinese cabbage. It's not grown here – lettuce, broccoli, cauliflower. These are widely grown in Lantapan."* The farmer informants also identified coconuts and rubber for the industrial trees, and Mahogany, Falcata and Gmelina for exotic trees. For the perennials, abaca was popular. Plantation crops were not identified. The informants also selected two existing crops, namely coffee and lauan for indigenous tree crops, which the surveyed farmers did not mention. They likewise mentioned two new crops: cacao<sup>78</sup> and Napier forage for livestock.

Individual cognitive maps for all 14 farmer informants were constructed from the interview transcripts to represent the factors influencing their land use and crop preferences. Sample maps are provided in Appendix 7. Since some farmers preferred several crops involving more than one of the six land use systems in Table 6.4, these individual maps were aggregated into maps representing four categories – trees (combining 3 maps), agroforestry (merging 5 maps), perennials (joining 3 maps) and agricultural crops (aggregating 3 maps). At the core of the maps are the farmers' preferred land use system and crops, their perceived benefits, and the key factors that would enable them to adopt these. Figure 6.3 shows the aggregate cognitive map for agricultural land use, in which the number of preferences identified were on par with those identified for trees and perennials. The direct motivating factors to (continue to) grow cash crops

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<sup>77</sup> Lantapan is an upland Municipality located in Manupali watershed, in the neighboring province of Bukidnon, which is known for producing temperate vegetables.

<sup>78</sup> In partnership with ICRAF, the Kenner Foods International, Inc. promotes cacao as a potential understory crop under agroforestry systems.

on agricultural land use systems were income, food for household consumption, and suitability for their soil and location. F13 said: *“I prefer to continue intercropping cassava with corn for income and food... It is good because if one fails, we can be assured of the other crop.”* Whereas F05 declared that: *“... it’s not possible to plant other crops. Only maize, and also banana. It’s so difficult down in Cabulig.”* This relates to F07’s comment: *“These [corn and tomato] are suitable in our soil here. The harvests are good.”* However, they are constrained by limited financial capital and cannot change unless they seek financing from big farmers/financiers. They need financial capital mainly to buy farm inputs, particularly fertilizer. Some expressed the belief that with available financial assistance from the government, their neighbors’ willingness to grow these kinds of crops would increase. Biophysical limitations (steep slopes) and geographic remoteness of their farms also affect their capacity to adopt these land use/crops, while drought is a circumstance that is deemed beyond their control.

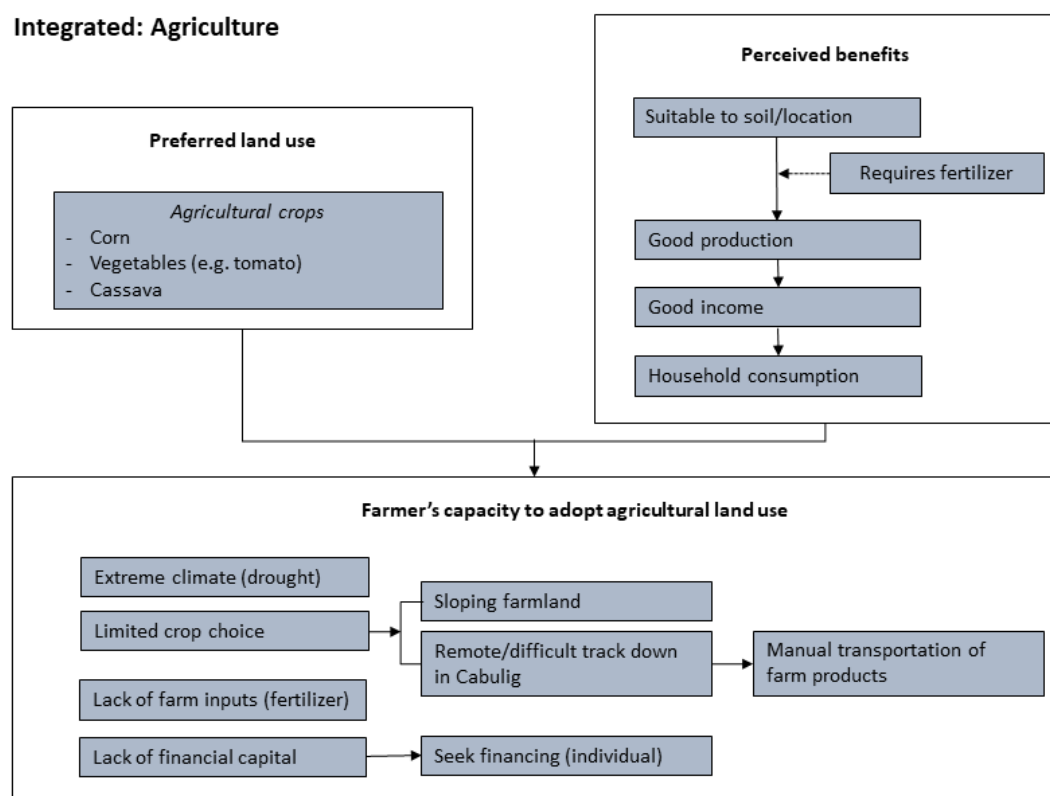


**Figure 6.3 Cognitive map of the aggregated factors influencing farmers' preference of agricultural land use in Cabulig watershed**

Farmers with a preference for agroforestry expressed more diverse factors with more complex linkages between them, as demonstrated in Figure 6.4. At the core of adopting an agroforestry system are two central tiers of factors with bi-directional arrows: namely the system's different components and benefits. The farmers knew that trees are the main crops in the system, and they favoured specific tree types for particular reasons. For example, F03 identified coconut among

others because their experience at a downstream location has led them to understand it can withstand the impact of climate change, particularly drought and flooding. In terms of benefits, income, food for their household, and environmental protection are considered central. They perceived that the system's diverse components would provide them corresponding income at different times. F06, in particular, mentioned the roles of trees and livestock in cases of emergency (hospitalization, children's education) and for his retirement. Agricultural crops are an essential part of the system, not just for income but also to meet their household's food requirements. Finally, they recognized what the system can do to their environment, particularly by reducing soil erosion, sustaining water availability, and in controlling landslides that result from the long period of high-intensity rainfall. This links to the ability of the tree component to withstand extreme events, such as droughts, typhoons and flooding.

Additional factors mentioned were the suitability of agroforestry in the sloping areas, entailing the adoption of contour farming, and the sustainability and high income of agroforestry which can gain them good social standing in the community. Meanwhile, they assumed that farmers know how to collect tree seeds and produce tree seedlings for the species they wish to grow. Thus, if the government can provide fertilizers when integrating trees on farms, neighboring farmers would be also be encouraged to adopt agroforestry systems. They related these provisions to the role of extension services including gaining additional farming knowledge and skills through farmer organizations. F13 commented: *"I learned about trees and contour farming with Landcare. Before, they were always here [facilitators] but now, not anymore. It was good because I learned new things that helped improve our farming livelihood."* However, lack of capital still came out as an important determinant of adoption, such that F09 mentioned providing NRM-based livelihoods to farmers.

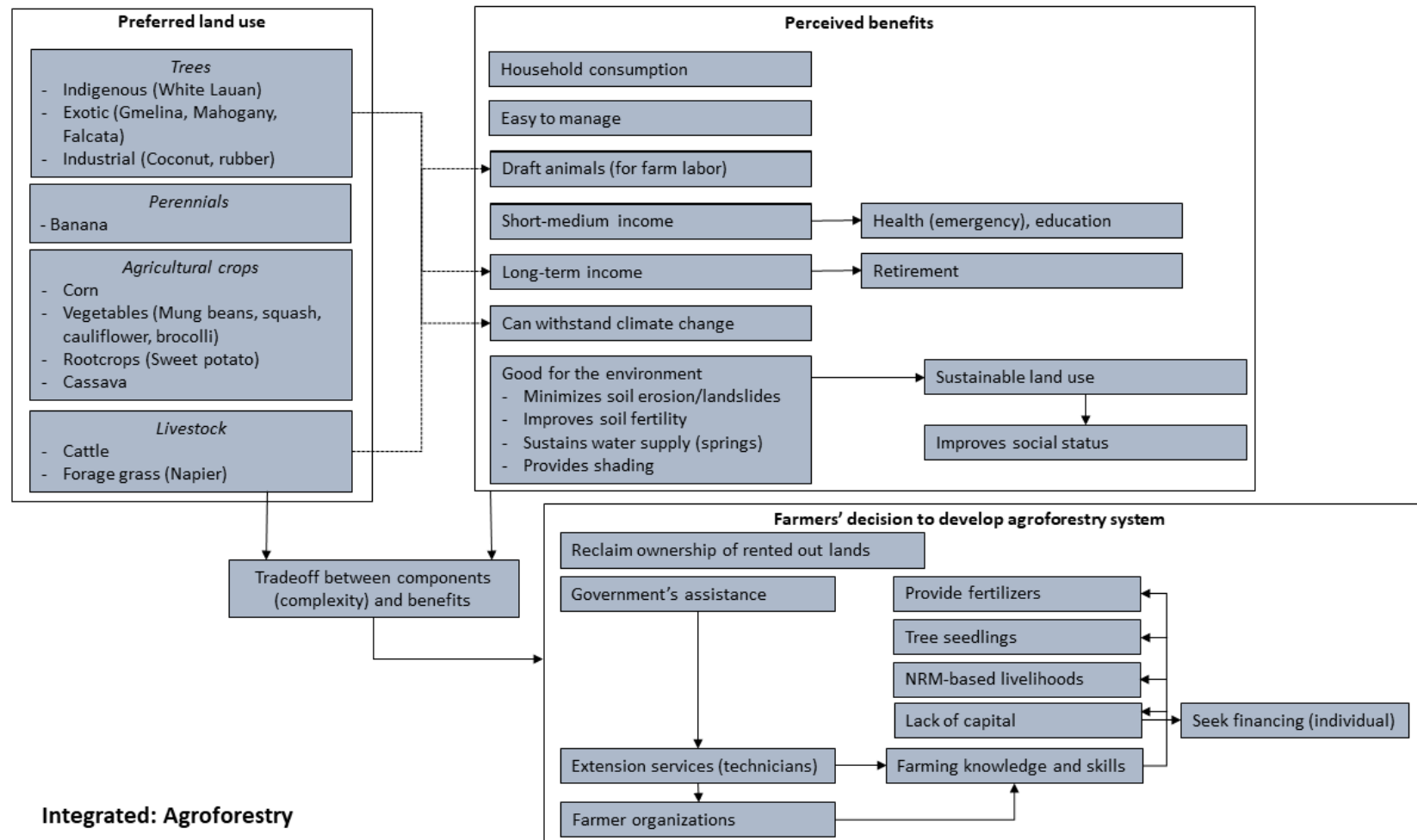


Figure 6.4 Cognitive map of the aggregated factors for farmers who prefer diverse crops/components for agroforestry land use in Cabulig watershed.

### 6.3.2 What land use and crop preferences are shared across the survey villages?

In Table 6.4, the preferred crops of farmers in the six villages are classified into six land use systems: agricultural crops, perennial crops, fruit trees, timber trees, industrial trees and plantation crops. From the HH survey, most farmers across the sample villages stated their preference for agricultural-based land uses (ranging from 55% in San Nicolas to 73% in Luna). Tree crops, particularly timber and fruit trees, are grown for a mix of reasons including watershed protection, income and food. However, the preference varies considerably across the villages. Other chosen crops are perennials (7%), particularly banana (4%), and tobacco and pineapple plantation crops (1%).

In agricultural land use systems, the two most preferred crops across the villages are vegetables and corn. For vegetables, this can be attributed to their higher profit relative to other crops, the relatively short duration of the crop, and the availability of a market. In contrast, corn is the second most important food crop (next to rice), particularly the open-pollinated white corn which is largely grown for household consumption. Preference for the more profitable yellow hybrid corn is increasing although remains less than white corn. There is variation across the villages in terms of specific crop preferences. Vegetables are widely chosen in the upper villages of Luna, Mat-i, and Aposkahoy, as well as in the lowland village of San Nicolas. In San Nicolas, there are vegetable gardens on the floodplain along the river. Corn is mostly favoured in Plaridel and Malagana, which is also those villages' major crop. In Plaridel, cassava, which is intercropped with corn, is also popular next to vegetables.

Farmers from San Nicolas preferred a combination of agricultural and tree-based land uses. Although agricultural crops are mainly for food consumption and income, their preference for tree crops can be attributed to their location, and the perception that they will help protect their area from flooding and flash floods. Tree crops also survive floods better than agricultural crops. Among the tree crops, Falcata is widely selected in all villages, particularly in Plaridel and Mat-i. Some of the crops mentioned are only grown in specific villages, such as roses in Mat-i.

**Table 6.4 Farmers preferred land use/crops as shared by the villages in Cabulig (2016)**

| Preference                          | Villages (% of responses from the HH survey) |          |      |          |       |           | Other crops**                                 |   |
|-------------------------------------|----------------------------------------------|----------|------|----------|-------|-----------|-----------------------------------------------|---|
| Land use                            | San Nicolas                                  | Plaridel | Luna | Malagana | Mat-i | Aposkahoy |                                               |   |
| 1. Agriculture land use system      |                                              |          |      |          |       |           | Napier (forage); cauliflower; broccoli        |   |
| Vegetables                          | 25*                                          | 15       | 30   | 17*      | 50    | 39*       |                                               |   |
| Yellow corn                         | 8*                                           | 7*       | 6*   | 37*      | 3     | 9*        |                                               |   |
| White corn                          | 8*                                           | 24*      | 6*   | -        | 9     | 6*        |                                               |   |
| Tomato                              | -                                            | -        | 12   | 6        | -     | 6*        |                                               |   |
| Upland rice                         | -                                            | -        | 3    | 6        | -     | 4         |                                               |   |
| Root crops                          | -                                            | -        | 6    | -        | -     | 4         |                                               |   |
| Cassava                             | 14                                           | 9*       | 9    | 6        | -     | 3         |                                               |   |
| Rose                                | -                                            | -        | -    | -        | 3     | -         |                                               |   |
| Irrigated rice                      | -                                            | 2        | -    | -        | -     | -         |                                               |   |
| Watermelon                          | -                                            | 4        | -    | -        | -     | -         |                                               |   |
| Total                               | 55                                           | 60       | 73   | 72       | 65    | 73        |                                               |   |
| 2. Perennials land use system       |                                              |          |      |          |       |           | Coffee                                        |   |
| Abaca                               | -                                            | 2        | 6    | -        | -*    | 1*        |                                               |   |
| Cacao                               | 3                                            | -        | 3    | -        | 3     | 3*        |                                               |   |
| Banana                              | 6*                                           | -        | -*   | 11       | 3     | 1*        |                                               |   |
| Total                               | 9                                            | 2        | 9    | 11       | 6     | 5         |                                               |   |
| 3. Fruit trees land use system      |                                              |          |      |          |       |           | Lauan (indigenous tree); palm oil; breadfruit |   |
| Avocado                             | -                                            | -        | -    | -        | -     | 1         |                                               |   |
| Jackfruit                           | 3                                            | -        | -    | -        | -     | 1         |                                               |   |
| Durian                              | -                                            | -        | 3    | 2        | 3     | 3         |                                               |   |
| Lemon                               | -                                            | -        | -    | -        | 3     | 1         |                                               |   |
| Mango                               | 6                                            | -        | -    | -        | -     | 1         |                                               |   |
| Lanzones                            | -                                            | -        | 3    | 2        | -     | 1         |                                               |   |
| Mangosteen                          | -                                            | -        | -    | -        | -     | 1         |                                               |   |
| Rambutan                            | 3                                            | -        | -    | -        | -     | 1         |                                               |   |
| Unspecified                         | 6                                            |          | -    | 2        | 3     | -         |                                               |   |
| Total                               | 18                                           | 0        | 6    | 4        | 6     | 10        |                                               |   |
| 4. Timber trees land use system     |                                              |          |      |          |       |           |                                               | - |
| Falcata                             | 6*                                           | 33       | 3    | 2        | 12    | 6*        |                                               |   |
| Mahogany                            | -*                                           | -*       | 3    | -        | -     | 1*        |                                               |   |
| Gmelina                             | 3*                                           | 2        | -    | -        | -     | 1         |                                               |   |
| Brazilian tree                      | -                                            | -        | -    | 2        | -     | -         |                                               |   |
| Unspecified                         | 3                                            |          | 3    | -        | -     | -         |                                               |   |
| Total                               | 12                                           | 35       | 9    | 4        | 0     | 0         |                                               |   |
| 5. Industrial trees land use system |                                              |          |      |          |       |           |                                               |   |
| Rubber                              | -                                            | 2        | -    | 2*       | -     | 1         |                                               |   |
| Coconut                             | 8*                                           | -        | -    | -        | -     | -         |                                               |   |
| Total                               | 8                                            | 2        | 0    | 2        | 0     | 1         |                                               |   |
| 6. Plantation crops land use system |                                              |          |      |          |       |           |                                               |   |
| Tobacco                             | -                                            | -        | 3    | 5        | -     | -         |                                               |   |
| Pineapple                           | -                                            | -        | -    | 2        | -     | -         |                                               |   |
| Total                               | 0                                            | 0        | 3    | 7        | 0     | 0         |                                               |   |

Note: - means crops that were not mentioned by the surveyed farmers; \* means crops that were identified by the farmer KIs; \*\* means other crops that were identified by the farmer KIs but not in the survey. For example, under agriculture land use, tomato is preferred by farmers from Luna, Malagana and Aposkahoy. A KI farmer from Aposkahoy preferred tomato but the informants from the other five villages did not. A farmer informant preferred Napier forage grass but this crop is not identified by the surveyed farmers.

### 6.3.3 To what extent are the crops preferred by the decision-makers shared by farmers in villages?

Seven of the KIs were decision-makers. Two of them (a village captain and a local government staffer) preferred agroforestry land uses that feature diverse timber and fruit trees, perennial crops, and agricultural crops (Table 6.5). It is important to note that informants from this group, particularly government staff and farmer leaders, have been exposed to various environmental training courses and seminars and so tend to be aware of new land use systems as well as having an understanding of crop suitability. As P06 said: *“I prefer those durable crops like coffee because it will stay. Also, fruit trees, but they are not planted here because of the cold weather. The coffee I believe is also feasible as it was planted here (Mat-i) before. There’s a new project here on cacao production.”* This shows that decision-makers take up available opportunities, as in the case of cacao where material, technical and marketing supports were established by Kennemer Foods International Inc. in recognition of the low livelihood assets of the farmers with whom this private agri-business company wanted to work.

**Table 6.5 The land use and crop preferences of decision-makers as compared to the preferences of farmers from the villages in Cabulig (2016)**

| Land use      | Crops          | Villages    |          |          |          |          |           |
|---------------|----------------|-------------|----------|----------|----------|----------|-----------|
|               |                | San Nicolas | Plaridel | Luna     | Malagana | Mat-i    | Aposkahoy |
| Agroforestry* |                | Medium      | Medium   | Very low | Very low | Low      | Low       |
|               | Mosizi         | -           | -        | -        | -        | -        | -         |
| Exotic trees  | Falcata        | /           | /        | /        | /        | /        | /         |
|               | Rambutan       | /           | -        | -        | -        | -        | /         |
| Fruit trees   | Guyabano       | -           | -        | -        | -        | -        | -         |
|               | Mangosteen     | -           | -        | -        | -        | -        | /         |
|               | Bread fruit    | -           | -        | -        | -        | -        | -         |
|               | Lanzones       | -           | -        | /        | /        | -        | /         |
|               | Durian         | -           | -        | /        | /        | /        | /         |
| Perennials    |                | Very low    | Very low | Very low | Very low | Very low | Very low  |
|               | Banana         | /           | -        | -        | /        | /        | /         |
|               | Cacao*         | /           | -        | /        | -        | /        | /         |
|               | Coffee*        | -           | -        | -        | -        | -        | /         |
| Agriculture   |                | Medium      | High     | High     | High     | High     | High      |
|               | Irrigated rice | -           | /        | -        | -        | -        | -         |

Legend: \*Highly preferred; Very low- 1-15%; Low- 16-30%; Medium- 31-60%; High-61-100%; / mentioned by surveyed farmers; - not mentioned by surveyed farmers

There is a range of motivations for preferring agroforestry, particularly its crop components. However, in general, the decision making informants were drawn to balance environmental sustainability with people’s economic needs. As P06 recognized: *“The only problem with focusing on [perennial] trees is it takes a while for income from these crops.”* Appropriate and location-based livelihood projects from the government can potentially fill this gap.

Of the remaining informants, a local government staffer preferred perennial crops, such as cacao and coffee, while a farmer leader favoured fruit trees, including Lanzones, Durian, Mangosteen



and indigenous Breadfruit. The other three were not able to give their crop preferences due to insufficient interview time.

The decision-makers are supportive of the HH-surveyed farmers' crop preferences to some extent but do not accord with farmers on land use. While the decision-makers prefer agroforestry/tree-based land use, the surveyed farmers mostly prefer agriculture. Several crops that this informant group preferred were not mentioned by the farmers from the villages, including the Musizi, Guyabano and Breadfruit. Using trees as an example, the environmental and economic benefits of the Musizi and breadfruit trees were known by some informants, but they were either unknown to farmers or were not preferred for some reason. Conversely, there were tree crops that were mentioned relatively frequently by the farmers such as Falcata and Durian, but which were not preferred by the KIs. Whereas perennials scored very low for many of the surveyed farmers, coffee and cacao were highly preferred by the informants. Some crops were only relevant to specific villages. For instance, P06 was the only informant who mentioned agriculture as part of an agroforestry land use system. He said that he preferred that farmers would grow irrigated rice for household consumption, which is only possible in some parts of Mat-i, Aposkahoy, Plaridel and San Nicolas.

#### **6.3.4 To what extent are experts' preferred crops shared by farmers in villages?**

All four expert KIs preferred farmers in the Cabulig watershed to implement agroforestry land use, especially in cultivated forest and agricultural lands (Table 6.6). Although their tree components varied from tree plantation to fruit and industrial trees, and perennial trees, they recognize the importance of agriculture for income and food security. As stressed by R02: *"Those available spaces in between trees will be used for planting cash crops... The overarching concept is that you produce for income and food for your children today while conserving the whole of Cabulig watershed for your grandchildren in the future."* The integration of these components is highlighted by R01: *"If you are interested in watershed protection, then it is agroforestry – with trees then with crops. But these should be chosen properly. Farmers planting annual crops would choose deep-rooted trees and also cover crops."* This preference is motivated mainly by environmental/technical issues, including the arrangement, structure and management of farm components. But they also factored in the crops' suitability, in terms of soil properties and climate, as well as social aspects, such as market and gender perception. R01 added: *"It is better if there are perceptions of men and women because men are thinking of asset build-up, and then women almost always are thinking of food, social security and sustainability."*

**Table 6.6 The land use and crop preferences of experts as compared to the preferences of farmers from the villages in Cabulig (2016). All stated preferences can broadly be classed as agroforestry.**

| Experts                 |            | Villages    |          |          |          |          |           |
|-------------------------|------------|-------------|----------|----------|----------|----------|-----------|
| Land use                | Crops      | San Nicolas | Plaridel | Luna     | Malagana | Mat-i    | Aposkahoy |
| Tree farms              |            | Medium      | Medium   | Very low | Very low | Low      | Low       |
| Fruit trees (orchards)  | Mangosteen | -           | -        | -        | -        | -        | /         |
|                         | Jackfruit  | /           | -        | -        | -        | -        | /         |
|                         | Lanzones   | -           | -        | /        | /        | -        | /         |
|                         | Rambutan   | /           | -        | -        | -        | -        | /         |
|                         | Durian     | -           | -        | /        | /        | /        | /         |
| Industrial trees        | Rubber     | -           | /        | -        | /        | -        | /         |
|                         | Palm oil   | -           | -        | -        | -        | -        | -         |
| Perennials              |            | Very low    | Very low | Very low | Very low | Very low | Very low  |
|                         | Cacao*     | /           | -        | /        | -        | -        | /         |
|                         | Coffee     | -           | -        | -        | -        | -        | -         |
| Agriculture/home garden | -          | Medium      | High     | High     | High     | High     | High      |

Legend: \*Highly preferred; Very low- 1-15%; Low- 16-30%; Medium- 31-60%; High-61-100%; / mentioned by surveyed farmers; - not mentioned by surveyed farmers

As in the case of decision-maker KIs, the expert KIs are supportive of the surveyed farmers' crop preferences but not their preferred land use. Again, the experts favour agroforestry, in particular cacao which they see has potential as an understorey crop in agroforestry system. Many of the fruit trees they identified as suitable were also preferred by the farmers, particularly in Aposkahoy (Mangosteen, Jackfruit, Lanzones, Rambutan, Durian and Rubber). One informant mentioned Oil Palm as a viable option. This crop is currently grown and managed in a plantation located in the village of Hinaplanan (inside Cabulig): it is not yet grown elsewhere in the watershed.

### 6.3.5 Suitability of farmers and external stakeholders' preferred crops

To assess the suitability of their preferences, the crops preferred by the farmers in the HH survey for whom there were corresponding GIS farm points (n=218) were overlaid on the ACIAR Watershed Evaluation project's digital land suitability maps (2016) (see Chapter 3.5.3). The majority (81%) of the preferred crops from Tables 6.5 and 6.6 are moderately suitable (Table 6.7). Most of these are already commonly grown crops like corn, cassava and vegetables among others. Land that is moderately suitable for a given use is defined as having major limitations to the sustained application of that use that reduce its productivity and/or increase the level of required inputs so that the overall advantage is significantly less than from highly suitable or suitable land (FAO, 1976). Growing these crops at the locations of the respondents' farms requires sufficient soil inputs (in particular lime since soil acidity is a frequent limitation), and appropriate land management practices, especially for soil conservation. For example, banana is identified as

moderately suitable on the broad mid-slopes of Mt. Balatukan because of the soil acidity. This limitation can be easily addressed by the Dole banana plantation with its technical and financial capabilities through appropriate application of lime but is less easily addressed by smallholder farmers. Only in Jasaan were some of the farmer-preferred crops suitable for the farmers' land. These include cassava on the flat hilltops, bell pepper and coconuts in plain or broad mid-slopes, and squash in the valleys (4%).

**Table 6.7 Suitability of farmers preferred crops\* when grown to the location of farms visited in the Cabulig (2016)**

| Physiographic units and landscape position | Soil-crop suitability (%) |           |                     |           |            |
|--------------------------------------------|---------------------------|-----------|---------------------|-----------|------------|
|                                            | Highly suitable           | Suitable  | Moderately suitable | Marginal  | Unsuitable |
| Jasaan (n=57)                              |                           |           |                     |           |            |
| High                                       | 0                         | 27        | 67                  | 0         | 7          |
| Mid                                        | 0                         | 7         | 70                  | 23        | 0          |
| Low                                        | 0                         | 8         | 58                  | 33        | 0          |
| <b>All</b>                                 | <b>0</b>                  | <b>12</b> | <b>67</b>           | <b>19</b> | <b>2</b>   |
| Escarpment (n=13)                          |                           |           |                     |           |            |
| High                                       | 0                         | 0         | 78                  | 22        | 0          |
| Mid                                        | 0                         | 0         | 75                  | 25        | 0          |
| <b>All</b>                                 | <b>0</b>                  | <b>0</b>  | <b>77</b>           | <b>23</b> | <b>0</b>   |
| Sumagaya (n=14)                            |                           |           |                     |           |            |
| Mid                                        | 0                         | 0         | 60                  | 40        | 0          |
| Low                                        | 0                         | 0         | 100                 | 0         | 0          |
| <b>All</b>                                 | <b>0</b>                  | <b>0</b>  | <b>86</b>           | <b>14</b> | <b>0</b>   |
| Balatukan (n=76)                           |                           |           |                     |           |            |
| High                                       | 0                         | 0         | 100                 | 0         | 0          |
| Mid                                        | 0                         | 0         | 92                  | 7         | 1          |
| Low                                        | 0                         | 0         | 100                 | 0         | 0          |
| <b>All</b>                                 | <b>0</b>                  | <b>0</b>  | <b>92</b>           | <b>7</b>  | <b>1</b>   |
| <b>Grand total (n=160)</b>                 | <b>0</b>                  | <b>4</b>  | <b>81</b>           | <b>13</b> | <b>1</b>   |

Note: \*Some crops (e.g. fruit trees, flowers) identified are not included in the suitability maps; Source: KI interviews (2016); Results are based on CSIRO's Digital land suitability Maps (2016).

Repeating this analysis for the external stakeholder informants of the watershed (n=11), Table 6.9 captures a similar result with most of the preferred crops considered moderately suitable (values around 3.0). These crops include those commonly grown in Cabulig (including corn, cassava, coffee and coconut), and new crops such as cacao and temperate vegetables like broccoli and cauliflower. The suitability of these crops varies across the watershed. For example, on the steep areas throughout the watershed, particularly the areas in the Escarpment physiographic unit, perennial trees and mixtures of perennials (e.g. cacao and rubber) are moderately suitable where agricultural crops, especially root crops (e.g. cassava), are unsuitable because of the erosion risk posed by the latter. This is particularly true in the sloping areas of Luna going down to the Cabulig

River where soils are also too shallow and rocky. Agroforestry or mixtures such as rubber and cacao provide the possibility of livelihood whilst also minimizing environmental risks, whilst agricultural crops provide a livelihood but at the risk of severe environmental degradation. In contrast, in the undulating areas of Mt. Balatukan mid-slopes, agricultural crops such as corn and vegetables are moderately suitable whereas coconut and rubber are also moderately suitable. In Malagana, cacao alone is found unsuitable in high landscape positions because of the low temperatures. Although the slopes are not as steep as those in the gorge, if farmers decide on agricultural crops, they need to adopt soil and water conservation technologies (SWC) such as contouring or best agroforestry systems (e.g. rubber+corn in wider alleys). Currently, poor soil properties limit crop choice over much of the Cabulig watershed without appropriate remediation (Ringrose-Voase et al., 2019). To address soil acidity in these areas, appropriate amounts and types of fertilizer as well as soil liming are required to sustain production, but most farmers cannot afford them.

Among the crops preferred by the informants, Oil Palm, which is grown in Jasaan, is moderately suitable in the mid and lower landscape positions in Mt. Balatukan but is suitable in most of Jasaan (~2.8 in Table 6.8). Whilst Oil Palm is suitable in Jasaan, it is also important to note other factors such as experience with this crop, available market and road infrastructure to determine its viability in these areas in Cabulig. The remaining preferred crops are classified as moderately suitable or marginal, except for irrigated rice that is unsuitable in most locations.

Although many areas are steep and have rocks and boulders present, they can be somewhat managed by farmers' hard work and willingness to adopt SWC practices (Figure 6.5). Rocks and boulders are moved, and SWC practices adopted on steep lands, to maximize their lands potential as many farmers do not have any other lands to cultivate or expand to, or other livelihood activities they can engage with in their areas.



**Figure 6.5** The steep slopes and rocky environment in some parts of Cabulig watershed limit farmers' crop options for farming livelihood: (right) Farmers in San Nicolas still grow banana, corn and vegetables on their steep and rocky lands; and (left) Migrant farmers in Mat-i arrange rock on their farms into rock walls to grow vegetables along the alleys.

**Table 6.8 Suitability of farmers and external stakeholders' (most) preferred crops by physio-landform in Cabulig watershed (2016)**

| Preferred crops | Physiographic unit/landscape position (Javellana) |     |     |     |            |     |     |     |          |     |     |           |     |     |     |             |
|-----------------|---------------------------------------------------|-----|-----|-----|------------|-----|-----|-----|----------|-----|-----|-----------|-----|-----|-----|-------------|
|                 | Jasaan                                            |     |     |     | Escarpment |     |     |     | Sumagaya |     |     | Balatukan |     |     |     | Overall ave |
|                 | High                                              | Mid | Low | Ave | High       | Mid | Low | Ave | Mid      | Low | Ave | High      | Mid | Low | Ave |             |
| Coconut         | 3.1                                               | 3.1 | 3.1 | 3.1 | 3.4        | 3.4 | 3.4 | 3.4 | 3.6      | 3.7 | 3.7 | 4.0       | 3.6 | 3.5 | 3.7 | 3.5         |
| Rubber          | 3.2                                               | 3.3 | 3.3 | 3.3 | 3.4        | 3.4 | 3.5 | 3.4 | 3.2      | 3.3 | 3.3 | 4.0       | 3.3 | 3.4 | 3.6 | 3.4         |
| Banana          | 3.1                                               | 3.1 | 3.1 | 3.1 | 3.4        | 3.4 | 3.4 | 3.4 | 3.1      | 3.1 | 3.1 | 3.0       | 3.0 | 3.0 | 3.0 | 3.2         |
| Cacao           | 3.1                                               | 3.2 | 3.2 | 3.2 | 3.4        | 3.4 | 3.4 | 3.4 | 3.7      | 3.8 | 3.8 | 4.9       | 3.8 | 3.8 | 4.2 | 3.6         |
| Coffee          | 3.2                                               | 3.3 | 3.3 | 3.3 | 3.4        | 3.4 | 3.5 | 3.4 | 3.2      | 3.3 | 3.3 | 4.0       | 3.3 | 3.4 | 3.6 | 3.4         |
| Corn            | 3.3                                               | 3.4 | 3.4 | 3.4 | 3.9        | 3.8 | 3.8 | 3.8 | 3.3      | 3.3 | 3.3 | 3.2       | 3.1 | 3.2 | 3.2 | 3.4         |
| Cassava         | 3.6                                               | 3.8 | 3.8 | 3.7 | 4.1        | 4.0 | 4.1 | 4.1 | 3.6      | 3.6 | 3.6 | 3.2       | 3.1 | 3.2 | 3.2 | 3.6         |
| Oil palm        | 2.7                                               | 2.8 | 2.8 | 2.8 | 3.4        | 3.3 | 3.4 | 3.4 | 3.2      | 3.3 | 3.3 | 4.0       | 3.3 | 3.3 | 3.5 | 3.2         |
| Rice            | 4.2                                               | 4.3 | 4.3 | 4.3 | 4.7        | 4.6 | 4.7 | 4.7 | 4.1      | 4.2 | 4.2 | 4.9       | 4.3 | 4.2 | 4.5 | 4.4         |
| Broccoli        | 3.3                                               | 3.4 | 3.4 | 3.4 | 3.9        | 3.8 | 3.8 | 3.8 | 3.3      | 3.3 | 3.3 | 3.2       | 3.1 | 3.2 | 3.2 | 3.4         |
| Cauliflower     | 3.3                                               | 3.4 | 3.4 | 3.4 | 3.9        | 3.8 | 3.8 | 3.8 | 3.3      | 3.3 | 3.3 | 3.2       | 3.1 | 3.2 | 3.2 | 3.4         |
| Mungbean        | 3.2                                               | 3.3 | 3.3 | 3.3 | 3.9        | 3.8 | 3.8 | 3.8 | 3.3      | 3.3 | 3.3 | 3.2       | 3.1 | 3.2 | 3.2 | 3.4         |
| Squash          | 3.5                                               | 3.5 | 3.5 | 3.5 | 3.9        | 3.8 | 3.8 | 3.8 | 3.3      | 3.3 | 3.3 | 3.3       | 3.2 | 3.2 | 3.2 | 3.5         |

Colour range and legend: 1- Highly suitable; 2- Suitable (yellow); 3- Moderately suitable (light orange, orange to dark orange); 4- Marginal (light red to red); and 5- Unsuitable; Source: KI interviews (2016); Results are based on CSIRO's land suitability Maps (2016).

### 6.3.6 Capacity to grow preferred crops and interventions to increase capacity

Out of the 242 farmers from the HH survey who expressed a preference to change crops, about 67% (n=179) of them considered that their desired crops were adoptable (i.e. that they could grow them). Those who considered themselves unable to grow the crop (33%, n=63) identified one or more reasons. The main reasons include a lack of financial capital (n=43), insufficient material inputs (n=11), limited household labour (e.g. due to old age of the farmer) (n=6), institutional reasons including a lack of government support (n=6), limited knowledge in growing the crop (n=4), small farm size and insecure land ownership (n=2). Other reasons given were unstable peace and order especially for remote farms, attack by pests and diseases, and limited arable lands due to rocky areas. With financial capital being the prevailing constraint, future interventions should focus on improving the financial assets of farmers and enabling them to grow their preferred crops.

The Generalized Linear Model tool in SPSS was again used to identify significant regression factors for farmers' capacity to change (CTC) land use (see Section 3.5.3). The final model includes the *available financial capital*, *education*, *land use values*, and *motivations* for farmers' (in) capacity to change land use and/or crops as the most significant factors. In addition, *farming aspirations* and *slope* were also significant (Table 6.9). CTC is positively correlated to the availability of financial capital ( $p < 0.001$ ) and their level of education ( $p < 0.001$ ). The availability of financial capital is negatively related to farmers' reasons for changing their land use ( $-0.191$ ,  $p < 0.003$ ). In the survey, their main motivation was profitability irrespective of whether they have the capital or not (64%, n=242). Education as a factor has a negative relationship with slope ( $-0.147$ ,  $p < 0.022$ ) and conservation practices ( $-0.145$ ,  $p > 0.024$ ), suggesting that less-educated farmers tend to be located in the most marginal and steepest areas. While financial capital directly reflects readily accessible monetary funds, farmers' educational attainment can support aspirations for land use change in a different way. Having higher education provides farmers with skills, and consequently opportunities for non-farm employment, which often provides better income. They also have better networks in the community and other villages that may improve their farming knowledge, access to credit and market connections.

**Table 6.9 Results of the final Generalized Linear Model for farmers' capacity to change their current land use systems and/or crops in Cabulig (2016). (Chi2=194.214,  $p < 0.000$ )**

| Factor                      | Wald's Chi <sup>2</sup> | df | p-value  |
|-----------------------------|-------------------------|----|----------|
| (Intercept)                 | 34.5                    | 1  | 0.000    |
| Available financial capital | 21.6                    | 1  | 0.000*** |
| Education                   | 175.4                   | 4  | 0.000*** |
| Land use values             | 546.2                   | 11 | 0.000*** |
| Reasons                     | 22.1                    | 4  | 0.000*** |
| Farming aspiration          | 8.1                     | 2  | 0.018**  |
| Slope                       | 2.8                     | 1  | 0.094*   |

|                        |     |   |       |
|------------------------|-----|---|-------|
| Conservation practices | 5.3 | 3 | 0.149 |
| Village                | 8.0 | 6 | 0.242 |
| Affected by Drought    | 1.3 | 1 | 0.251 |
| Access to extension    | 1.1 | 1 | 0.301 |

\* $p < 0.10$ ; \*\* $p < 0.05$ ; \*\*\* $p < 0.01$

The above results from the HH survey contrast with some views expressed from farmer informants regarding their capacity and that of their fellow farmers. When asked, *‘Do you think you and your neighbors can adopt this preferred land use/crop?’*, they have mixed views. F02 said: *“I think so because I’ve done it myself. You can see it in my area. You can see: there are my mahogany trees.”* This informant thinks that growing one’s preferred crops depends on a willingness to do so. As pointed out by F01: *“I’m not sure if they [farmer neighbors] are willing. I think not because I’m the only one who’s been planting this [coconut]. For them, whatever is growing there, that’s it.”* The decision-maker KI informants were more positive that farmers can adopt their preferred crops. P06 commented: *“Yes, because they have already planted those [coffee] here before, and the growth was good”*. P02 added: *“In Madaguig, there are Landcare members. In Man-ibay, there are also Landcare members... In Bantay Kalasan [Forest Guards], they are part of Landcare. When they discuss, they are very good. This indigenous people’s group is also empowered. They are very strong.”* This quote suggests that farmers who are members of social groups are likely to adopt preferred crops. P03 also raised the issues of land ownership. He commented: *“It [crop decision] is up to the landowners. Then most of the landowners are not here. It’s good if landowners’ inclination is farming with trees. But if their inclination is just to leave the soil as it is, they are not interested in trees, nothing.”* Meanwhile, the experts all agreed that farmers generally have a high level of awareness on the importance of planting suitable crops based on the location of their farms, given all the seminars and training provided, but that they are not necessarily able to do so. R02 commented: *“Their [farmers] orientation is more on the idea of working today, eating tomorrow. That’s working today so you can eat tomorrow.”* As discussed earlier, smallholder farmers’ aspiration to improve their farming is dampened by their need to survive (see Section 6.2.1). However, there is a difference between being aware and being able to implement. As R01 succinctly puts it: *“Farmers do not have the technical skills and the financial capital. For example, if you’re going to grow cacao, rubber, those perennial crops and trees, the problem is they don’t have available planting materials.”* This is where facilitation/agents of change are needed to provide appropriate and timely interventions.

Each group of KIs suggested a multitude of ways to improve their capacity, as well as that of their neighbors to adopt their preferred crops (Table 6.10). The farmers’ proposals tend to be fewer, simpler and more straightforward than the external stakeholders. The farmers only identified the provision of material support, particularly fertilizers. F03 suggested: *“We only need fertilizers. We can produce seedlings.”* F02 added: *“We can get fallen seeds from the trees here.”* This provision of fertilizer is also supported by an expert (R03). This expert recommended improving



the delivery of extension services and suggested that one strategy for doing so would be to develop collaborative information, education and communication activities led by the government and supported by NGOs and academia. This relates to R01's advice: *"Teach them [farmers] how to produce the seedlings, and then support community nurseries. This will develop their capacity and create a long-term impact."* Recognizing farmers' limited financial capital (F08, F09, F10, F12, P06), P02 suggested: *"Strengthen the partnership with multinational companies in providing livelihoods, which should not be based on the dole-out system<sup>79</sup>."* This would encourage farmers to adopt suitable land management practices. P03 went further by suggesting a focus on the landowners for quicker and better impact. Meanwhile, the experts also recommended policy interventions, such as R01's integration of financial and technical assistance to farmers in the municipal land use and development plans. R03's suggestion is tougher: *"To make the adoption of conservation agriculture mandatory in the context of livelihoods."* Making SWC adoption a policy imperative can be done but this also requires policing for effective implementation on the ground. If agriculture is not controlled in forest protection zone, efforts toward sustainable land use and watershed management will not be effective. While some of these are feasible suggestions, the challenge is ensuring that all farmers are reached, particularly those in remote areas who are often the poorest in the sector and receive little or no service from the government. As highlighted by P02, this takes *"political will."*

**Table 6.10 Stakeholders' recommendation to increase the capacity of farmers in Cabulig to adopt their preferred crops (2016)**

| Farmers                                                                                                                                                                                              | Decision-makers                                                                                                                                                                                                                                                          | Experts                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <ul style="list-style-type: none"> <li>• Provide material support (e.g. tree seedlings, fertilizers)</li> <li>• Make a road system (from down the steep gorges of Luna up to the village)</li> </ul> | <ul style="list-style-type: none"> <li>• Political will</li> <li>• Mobilize partnerships with multinational companies</li> <li>• Continue information, education and communication (IEC) activities with landowners</li> <li>• Develop industry and hard work</li> </ul> | <ul style="list-style-type: none"> <li>• Teach farmers how to produce tree seedlings</li> <li>• Support communal nurseries</li> <li>• Institutionalization with the financial support of tree seedling production in individual and/or community nurseries</li> <li>• Policy on the adoption of suitable land use and management practices (e.g. conservation agriculture)</li> <li>• Provide support for farm inputs (e.g. fertilizer)</li> <li>• Integrated IEC activities of government, academe and NGOs</li> <li>• Establish model farms</li> <li>• Improve extension service delivery</li> <li>• Address livelihood needs</li> </ul> |

<sup>79</sup> Dole-out system refers to giving out assistance to beneficiaries freely without condition. This system is seen as causing a problem because it promotes a culture of dependence.

Source: Key informant interviews (2016)

## 6.4 Discussion

### 6.4.1 Farmers' survival vs prosperity aspirations

The analyses revealed that farmers' aspirations are generally economics-driven and thus vary based on their current income level and livelihood conditions. Farmers with lower incomes care first and foremost about their livelihood income for them to survive. The concern of most smallholder farmers, whose main crop is corn, is simply to have a harvest that can provide food to the family until the next harvest while saving spare seeds for the subsequent cropping. For some, to gain extra cash profit is already a blessing. This may explain why some farmers in Cabulig keep on farming even if they are not necessarily gaining. This result affirms the study of Roberts (2015) in Lao PDR where farmers selected crops to grow based on whether they feed people and livestock in addition to income (marketability and selling price) and labour demands. The role of social relations within groups and outside networks in improving farmers' land use and livelihoods is not evident in the watershed, particularly in remote locations. While farmer formation has contributed to forest management and livelihoods of Bangladeshi indigenous communities (Nath et al., 2010), NGOs played a key role in this build-up. However, in the Cabulig watershed the presence of NGOs have seemed to have declined. Even though farmers who have not experienced collectives are keen to participate (Chapter 4.4.2), the narratives of farmers who are no longer interested in joining them suggest that government extension and NGO facilitators will have to make great efforts to encourage and rebuild many farmers trust in collective actions. Farmers' aspiration for their children to finish their education suggests that farming for smallholders like them is no longer feasible. F13 was very firm when he said: *"I have to change the program, our life's program – my children will not become farmers like me."* At best, the 'survivalist' farmers' aspiration for the distant future may be owning the lands they currently cultivate: as things stand this is beyond the reach of many of them. Worsening scarcity of (productive) agricultural land is a serious problem not just in Asia but also in Africa (Masters et al., 2013; Wiggins et al., 2010). Aspiring a harvest that meets basic health and livelihood resources thus seems to be driven by farmers' unstable livelihood incomes.

At the other end of the continuum, farmers with higher incomes are more likely to aspire to a prosperous future. Given they already have relatively good financial foundations, they have started considering strategies to sustain and expand their farming and/or diversify livelihood activities, minimize agricultural or climate-related risks and uncertainties, assure the future of their children and grandchildren, and plan for retirement. A stronger intent to secure their farming livelihoods was accompanied by a preference to adopt more complex agroforestry systems. This result is similar to that of Poppenborg and Koellner (2013) who said that farmers in the Haeen

watershed in South Korea begin to give attention to the environmental effects of their farming system once they have a sufficient financial base. With financial stability, they tend to enjoy their freedom in farming and the choices they make in land use, crops, management practices, and other livelihood activities. They also expressed pro-environment values and at times demonstrated higher levels of public service. Given their economic and social standing, and environmental values, these people may be future ‘influencers’ that could help others in their community endeavoring to improve their situation.

Reflecting on the influence of income on aspirations, farmers’ current livelihood status determines their land use and crop preferences, and favoured management practices. A preference for agricultural crops, particularly corn and vegetables, reflected a reliance upon household consumption and short-term income. This is consistent with the analyses in Chapter 4 which found that many farmers in Cabulig have limited livelihood assets, namely low farm income, small farm size, frequent lack of land ownership, lack or weak social groups, and poor access to extension services. This is generally common in many upland watersheds in Asia, as in the Kali-Khola watershed in Nepal where limited farmlands, unavailability of household labour, and lack of access to extension services contribute to the insecurity of farmers’ livelihoods (Bhandari & Grant, 2007). However, the effect that geographic location has on farmers’ vulnerability to extreme events also influences crop choice. Farmers from the downstream study villages are more likely to integrate tree crops into their farming systems because of previous calamities they have experienced. This is consistent with a synthesis by Lasco et al. (2014) of Southeast Asian and African case studies that highlight the versatile role of trees and agroforestry systems in reducing smallholders’ exposure to climate-related risks. Farmers’ understanding of the relationship of land use both at farm and watershed scales and the value of integrating trees (i.e. shifting from agriculture to agroforestry) can improve their livelihoods and enhance their capacity to respond to climate change and uncertainties.

#### **6.4.2 Gaps in farmers’ and external stakeholders’ land use and crop preferences**

As could be expected there is general agreement between the crop preferences from the farming HH survey and the farmer KIs. However, they differ from the land use preferences of the decision-makers and the experts. Farmers generally favoured agricultural land use, whereas the external stakeholders prefer farmers to adopt and invest in agroforestry/tree-based systems (fruits, exotic or industrial trees). Although many of the farmer informants favoured agroforestry due to their knowledge of crop suitability and its role in watershed protection, this was overridden in the aggregated cognitive map on agricultural land use (see Figure 6.3) by their economic need for cash crops and the production of food for their households. Thus, the decision-makers’ and experts’ preference for agroforestry/tree-based systems does not correspond to farmers’ land use

aspirations. In particular, the farmers' have no financial capacity to buy the expensive seedlings of the industrial trees, like rubber, or perennial tree crops, such as cacao and coffee, suggested by the decision-makers. While some farmers have already started growing these crops (farmers aspiring to prosperity) because of their social networks, most smallholders do not know the current or future demands for these crops, nor have the financial resources to buy the seedlings and inputs, such as lime and fertilizer, nor the connections in the government to get free seedlings. To promote agroforestry, decision-makers can work with experts to develop appropriate tree-crop-livestock systems that combine their preferred tree/perennial crops with farmers' selected agricultural crops. Bringing these land use options to all farmers entails an effective and timely extension delivery system to give information and support to trial options so they can make informed decisions. Enabling farmers to adopt such systems requires improving their livelihood capitals, particularly financial assets. There is no doubt that the intentions of decision-makers are both economic and sustainable. However, they need to acknowledge the reasons for farmers' preferred systems and crops, as well as their aspirations for well-being. By integrating farmers' motivations and the experts' knowledge, they can better design land use and livelihood interventions (policies, plans, projects, incentives) that could reconcile differing priorities and meet more than basic livelihood needs, by increasing the sustainability of watershed management in the uplands. Importantly this avoids wasting limited funds from the government and other donors' on interventions that do not meet farmers' aspirations and preferences.

## **6.5 Conclusions**

Rather than relying on economic approaches, the analyses in Section 6.2 focused on aspirations for well-being in an attempt to identify the range of motivations that might influence farmers' land use/crop decisions. Whilst the findings highlighted the critical importance of financial motivations, other factors influenced land use and crop preferences. These include farmers' aspirations, the farm's biophysical characteristics, and its geographic location in the watershed. Current adoption of agroforestry systems builds on crop diversification and varies in terms of components, arrangements, hierarchy and others, and consequently, the environmental benefits and economic returns to the farmers. Case studies from developing countries provide some evidence that agroforestry contributes to landscape restoration and resilience, as well as in achieving food and livelihood security making it the most feasible land use and farming system in upland watersheds (Prabhu et al., 2014). Cases include food trees in Africa, coffee-based agroforestry in Latin America, and agroforestry in rubber dominant landscapes in Southeast Asia. However, it requires various support to fully benefit the adopters (Prabhu et al., 2014). Government, policymakers and development practitioners who want to achieve land use change and the reversal of the current unsustainable management practices in upland watersheds need to develop interventions that also improve farmers' livelihood capitals, namely financial capital.

This includes value adding activities of agroforestry products for better income. Much improvement is needed to improve the reach and effectiveness of extension services for farmers, and to identify land use systems and crops that are both environmentally sustainable and economically desirable. This is particularly important given that many of the preferred crops of farmers and external stakeholders' are currently unsuitable or moderately suitable in most of the watershed but could become suitable with appropriate management interventions (e.g. conservation farming, liming or integration into agroforestry systems). This suggests the fragility of Cabulig's land resources and environment, which is unsuitable for current agricultural practices. It also alludes to a knowledge gap not just among farmers but also with external stakeholders about their land use preferences. The bottom line is that appropriate land use and management interventions through effective extension service delivery is a policy imperative.

This understanding of farmers' decision making behaviour is of key importance not just for farmers themselves, but also for the government and policymakers to have a more balanced view of profitability and sustainability in designing and implementing land use programs in upland watersheds. Ignoring how farmers form their preferences and the extent of any mismatch with the priorities of external stakeholders may reduce the likelihood of successful implementation of land use and watershed management interventions (van Noordwijk et al., 2015). This is most useful when incorporated in the development of watershed management and land use plans (i.e., engaging farmers and factoring in their needs, land use preferences and aspirations in the preparation of plans). However, there is still limited understanding of how farmers' willingness (or not) to adopt better land uses relates to their capacity to realize the change. Chapter 7 will investigate this using the Bayesian network modelling technique.

# Chapter 7: Modelling farmers' willingness and capacity to adopt more sustainable land uses using Bayesian Networks

## 7.1 Introduction

Supporting land use in upland watersheds and managing it sustainably needs a holistic understanding of key environmental, societal, and cognitive processes and factors, and how their complex interactions influence the decisions and practices of different stakeholders. Designing interventions can be complicated where trade-offs or impacts must be evaluated or where there are factors (usually) outside the control of implementers that can prevent or alter the intended outcomes. Integrated assessment (IA) with its intrinsic dimension and enabler, integrated modelling, is often used to better understand complex environmental and societal problems, and support decision making processes (Hamilton et al., 2015; Jakeman and Letcher, 2003). Among the many available modelling tools that can be used in IA, the Bayesian network (BN) approach is often applied to natural resources management (NRM) problems and has proved well-suited to investigations that explore the potential effectiveness of interventions (Marcot & Penman, 2019; Nash et al., 2013; Shenton et al., 2011). Kelly et al. (2013) argue the selection among five different integrated modelling types, one of which is Bayesian networks. Choice advised is based on factors including model purpose, type of data, breadth of subsystem components, spatial dimension and treatment of uncertainty. Of particular relevance in selection of BNs as the integrated modelling choice here is the exploration (versus prediction) purpose (see later) and necessary capacity to deal with qualitative and quantitative data as often occurs in the more human decision making aspects of a problem.

BNs can be used to represent a network of interactions between factors (variables) from the primary action(s) and drivers to the intended outcome(s). The cause-and-effect assumptions are represented by the interactions or links between variables. The approach can also use different types of data (qualitative and quantitative) from multiple sources (e.g. surveys, interviews). Importantly, the relatively simple interactive graphical maps of the BN approach have been proposed by several authors (Drury et al., 2017; Gonzalez-Redin et al., 2016; Pollino & Henderson, 2010) as tools that a range of stakeholders, including policymakers, can easily understand.

BN applications of relevance to this thesis include those of Chen and Pollino (2012) who discuss key considerations when developing models, Ticehurst et al. (2011) and Frayer et al. (2014) who both parameterized their models with quantitative survey data, and two applications using the sustainable livelihoods approach by Merritt et al. (2016) and Newton et al. (2006). Despite the potential value of the BN approach, there are relatively few applications to land use decision

making, especially in the context of upland watersheds in tropical developing countries. In the European context, Aalders (2008) incorporated the characteristics of land managers in the BN modelling process to enhance understanding of the land use change, while Celio and Grêt-Regamey (2016) used a similar approach with local actors in a spatially explicit manner.

This chapter explores the utility of the BN approach in further understanding farmers' willingness and capacity to change land use within the Sustainable Livelihoods Approach (SLA) framework. Section 7.1 contextualizes the use of the BN approach in this thesis, including the process of developing the models. The purpose is to explore the main factors that influence the land use decisions of farmers in the Cabulig watershed, southern Philippines, and which factors are the most influential in explaining the farmers' willingness and capacity to adopt land uses that are environmentally and economically sustainable. The conceptual framework underlying the model development is shown in Figure 7.1. Section 7.2 discusses the model for willingness to change (WTC) and its use for a scenario analysis that considers farmers' access to the extension. Section 7.3 explores the model for the capacity to change (CTC) and undertakes scenario analysis that considers access to financial capital. Section 7.4 critiques the model development, performance, and use in scenario analysis, and in doing so highlights the implications for the application of the BN and identifies strategies for improving the models. Section 7.5 provides the conclusions of this Chapter.

### 7.1.1 Model purpose

The primary aim of the BN models is to integrate different aspects of land use and management to explore farmers' decisions and actions. This information is important in planning land use and management projects in upland watersheds where the involvement and positive response of farmers to intervention are vital for successful implementation.

The model context is limited to the *surveyed* farmers from the Cabulig watershed. Qualitative data (i.e. the key informant interviews [KIIs] and focus groups), along with the results from the statistical analyses in Chapters 6.2.4 and 6.3.5, are used to inform the models' structure (i.e. which variables to include and how to link them). The quantitative household (HH) survey data are used to populate the models and to refine the model structure (Table 7.1). These data were collected during fieldwork in 2013, 2015 and 2016. It is important to note that the models represent the environmental and socio-economic conditions at the time of data collection.

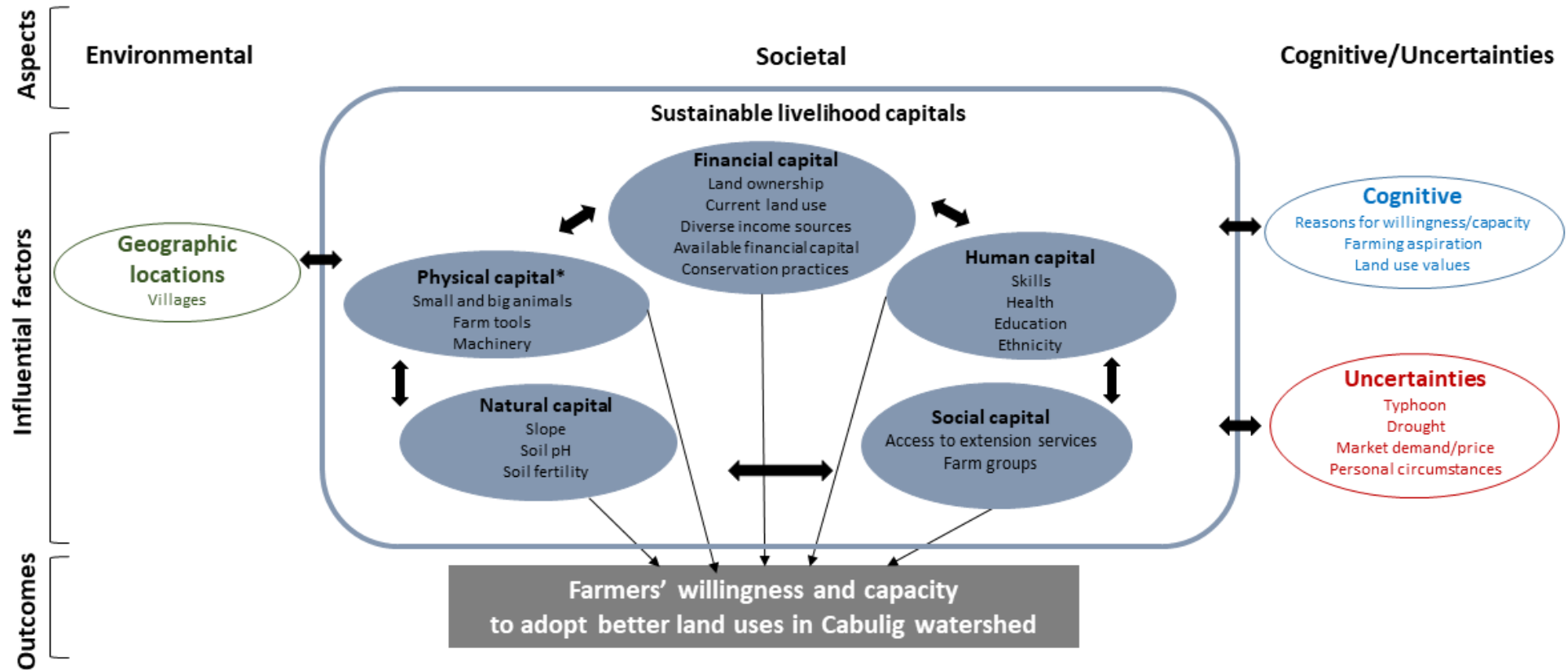


Figure 7.1 The conceptual underpinning of the farmers' willingness and capacity to change land use in Cabulig watershed, drawing on the Sustainable Livelihoods Approach. In this Chapter, natural capital assets are referred to as environmental considerations or variables.



**Table 7.1 Overview of data sources used in this chapter and the analyses undertaken**

| <b>Data sources</b>                       | <b>Analyses</b>                                                                             | <b>Purposes</b>                                                                                                                                                                                                                                                            |
|-------------------------------------------|---------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Farming household survey                  | Variables significant to farmers' willingness and capacity to change land use               | Identify the variables that are most sensitive to farmers' willingness to change (Section 7.2) and capacity to change (Section 7.3); understand the interactions between variables; and simplify model structures where data was not sufficient to support more complexity |
| Key informant interviews and Focus groups | Cognitive mapping of factors affecting farmers' willingness and capacity to change land use | Identify the variables important for farmers' decision making to inform the Bayesian network structure                                                                                                                                                                     |

For the quantitative survey data used to populate the BN models, 604 farming HHs were sampled across the landscape to characterize the farmers' land use and livelihood conditions in different villages in the watershed. The model endpoints are '*willingness to change*' and '*capacity to change*'. These two outcomes are separated because of the HH data available for use in each model. A total number of 604 farming HHs was used in the WTC model, while the CTC model only used 'cases' for the 242 farming HHs who said they were willing to change their land use.

### **7.1.2 Recap of key knowledge from Chapters 4-6**

The potential drivers and processes influencing farmers' WTC and CTC land use were initially identified through a review of existing literature on upland watersheds in developing countries, particularly in Southeast Asia where environmental and socio-economic conditions are somewhat similar (Chapter 2.2 and 2.3). The review included the drivers and processes affecting land use change in upland watersheds, and factors that determine farmers' land use and management practices on-farm. The results were reflected in the conceptual framework that was presented in Chapter 3.2, which was used as a basis for the collection of primary data through farming HH survey, KIIs, and focus groups in the case study site. Important variables identified from the individual qualitative and quantitative analyses are shown in Table 7.2. These variables are categorized into 'driving' factors, 'intermediary' variables that influence the desired outcome, 'intervening' factors which are the mediation or actions required to achieve the outcome, and the 'objective' or desired outcome of intervention (Figure 7.2).

**Table 7.2 Important variables for farmers' willingness and capacity to change land use that were identified in Chapters 4-6**

| Data source                | Factor category                                                                                                                                                                   |                                                                                                                                                                                          |                                                                                                                                                                                              |                                |
|----------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------|
|                            | Driving                                                                                                                                                                           | Intermediate                                                                                                                                                                             | Intervening                                                                                                                                                                                  | Objective                      |
| Common to all data sources | <ul style="list-style-type: none"> <li>• Crop preference</li> <li>• Available financial capital</li> </ul>                                                                        | <ul style="list-style-type: none"> <li>• Skills</li> <li>• Farm income</li> <li>• Other sources of income</li> <li>• Knowledge</li> </ul>                                                | <ul style="list-style-type: none"> <li>• Financial assistance</li> <li>• Access to extension</li> <li>• Manage climate change risks</li> </ul>                                               | Willingness to change land use |
|                            | <ul style="list-style-type: none"> <li>• Available financial capital</li> <li>• Land ownership</li> </ul>                                                                         | <ul style="list-style-type: none"> <li>• Other sources of income</li> <li>• Farmer organization</li> </ul>                                                                               | <ul style="list-style-type: none"> <li>• Access to extension</li> <li>• Manage climate change risks</li> </ul>                                                                               | Capacity to change land use    |
| Household survey           | <ul style="list-style-type: none"> <li>• Affected by typhoon</li> <li>• Affected by drought</li> <li>• Slope</li> </ul>                                                           | <ul style="list-style-type: none"> <li>• Diverse sources of income</li> <li>• Ethnicity</li> <li>• Skills</li> <li>• Farming aspiration</li> </ul>                                       | <ul style="list-style-type: none"> <li>• Access to extension</li> </ul>                                                                                                                      | Willingness to change land use |
|                            | <ul style="list-style-type: none"> <li>• Slope</li> <li>• Available financial capital</li> </ul>                                                                                  | <ul style="list-style-type: none"> <li>• Farming aspiration</li> <li>• Education</li> <li>• Land use values</li> <li>• Reasons</li> </ul>                                                |                                                                                                                                                                                              | Capacity to change land use    |
| Key informants             | <ul style="list-style-type: none"> <li>• Slope</li> <li>• Land ownership</li> <li>• Affected by drought</li> <li>• Market price</li> <li>• Available financial capital</li> </ul> | <ul style="list-style-type: none"> <li>• Soil fertility</li> <li>• Skills</li> <li>• Farm income</li> <li>• Knowledge</li> <li>• Crop preference</li> <li>• Products/harvests</li> </ul> | <ul style="list-style-type: none"> <li>• Technical assistance</li> <li>• Subsidies</li> <li>• Environmental protection</li> <li>• Land management</li> <li>• Financial assistance</li> </ul> | Willingness to change land use |
|                            | <ul style="list-style-type: none"> <li>• Available financial capital</li> <li>• Land ownership</li> <li>• Farm size</li> <li>• Number of parcels</li> </ul>                       | <ul style="list-style-type: none"> <li>• Other sources of income</li> <li>• Farm income</li> <li>• Farmer organization</li> <li>• Crop preference</li> <li>• Knowledge</li> </ul>        | <ul style="list-style-type: none"> <li>• Individual financing</li> <li>• Technical assistance</li> <li>• Financial assistance</li> <li>• Subsidies</li> </ul>                                | Capacity to change land use    |
| Focused group discussion   | <ul style="list-style-type: none"> <li>• Crop type</li> <li>• Available financial capital</li> <li>• Market price</li> <li>• Climate change</li> </ul>                            | <ul style="list-style-type: none"> <li>• Farm income</li> <li>• Knowledge</li> <li>• Skills</li> </ul>                                                                                   | <ul style="list-style-type: none"> <li>• Technical assistance</li> <li>• Financial assistance</li> <li>• Available financing</li> </ul>                                                      | Willingness to change land use |
|                            | <ul style="list-style-type: none"> <li>• Available financial capital</li> </ul>                                                                                                   | <ul style="list-style-type: none"> <li>• Other sources of income</li> <li>• Integrated trees on the farm</li> <li>• Diversified crops</li> <li>• Farmer organizations</li> </ul>         | <ul style="list-style-type: none"> <li>• Technical assistance</li> <li>• Financial assistance</li> <li>• Available financing</li> </ul>                                                      | Capacity to change land use    |

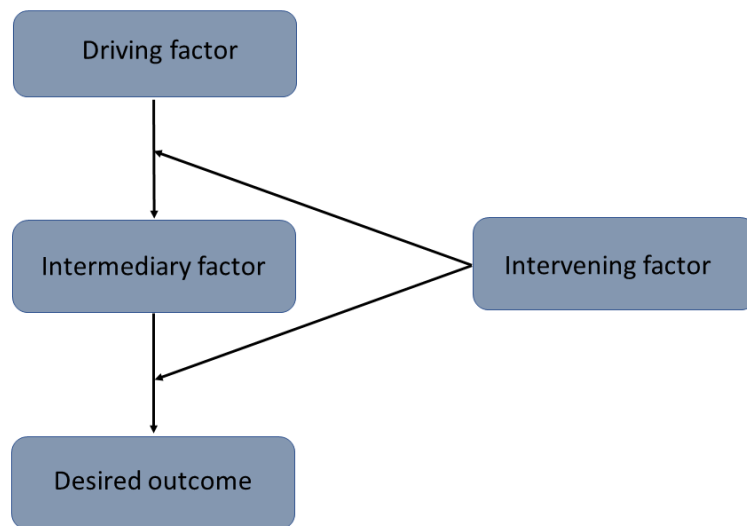


**Figure 7.2 Categories of factors influencing farmers' willingness and capacity to change their land use in Cabulig watershed where 'intermediary' factors influence the desired outcome while 'intervening' factors are the mediation or action needed to achieve the desired outcome.**

The analyses indicated that both the willingness and capacity of the farmers to change outcomes are influenced by many driving, intermediate, and intervening factors. In the context of this Chapter, identifying and studying the mechanisms by which an intervening factor achieves its effect (desired outcome) is of great interest. By investigating the interactions and processes between factors to clarify how the driving, intermediary and intervening factors achieve an outcome or not, the behaviour of the factors and how they relate to the others (cause-effect) will be better understood and there is the possibility that alternative, more effective intervention strategies can be identified.

These factors, and their interactions, have been identified as affecting the decision making of the farmers and their ability to act, and are presented schematically in Figure 7.3. The arrows indicate the direction of the hypothesized cause-and-effect.

Figure 7.3 represents the aggregated factors influencing farmers' decision making and actions. The decisions and actions of farmers are generally influenced by the condition of their livelihood capitals and cognitive factors, as well as by the type and level of support provided by the government, non-government organizations (NGOs), and the private sector. Similarly, uncertainties, such as market prices and demand, and the effect of changing climate also have a bearing on the dynamics of farmers' decisions and strategies. As revealed in Chapter 6, improving farmers' willingness and capacity to adopt better land use was highest when the livelihood assistance *vis-à-vis* gain is at a maximum. This suggests that to attain the desired outcome of agencies, which is to improve farmers' livelihood, maintain ecosystem services, and possibly, greater food security, the interventions they design and implement should focus on improving the status of farmers' livelihood assets to support their transitioning to more suitable land use.

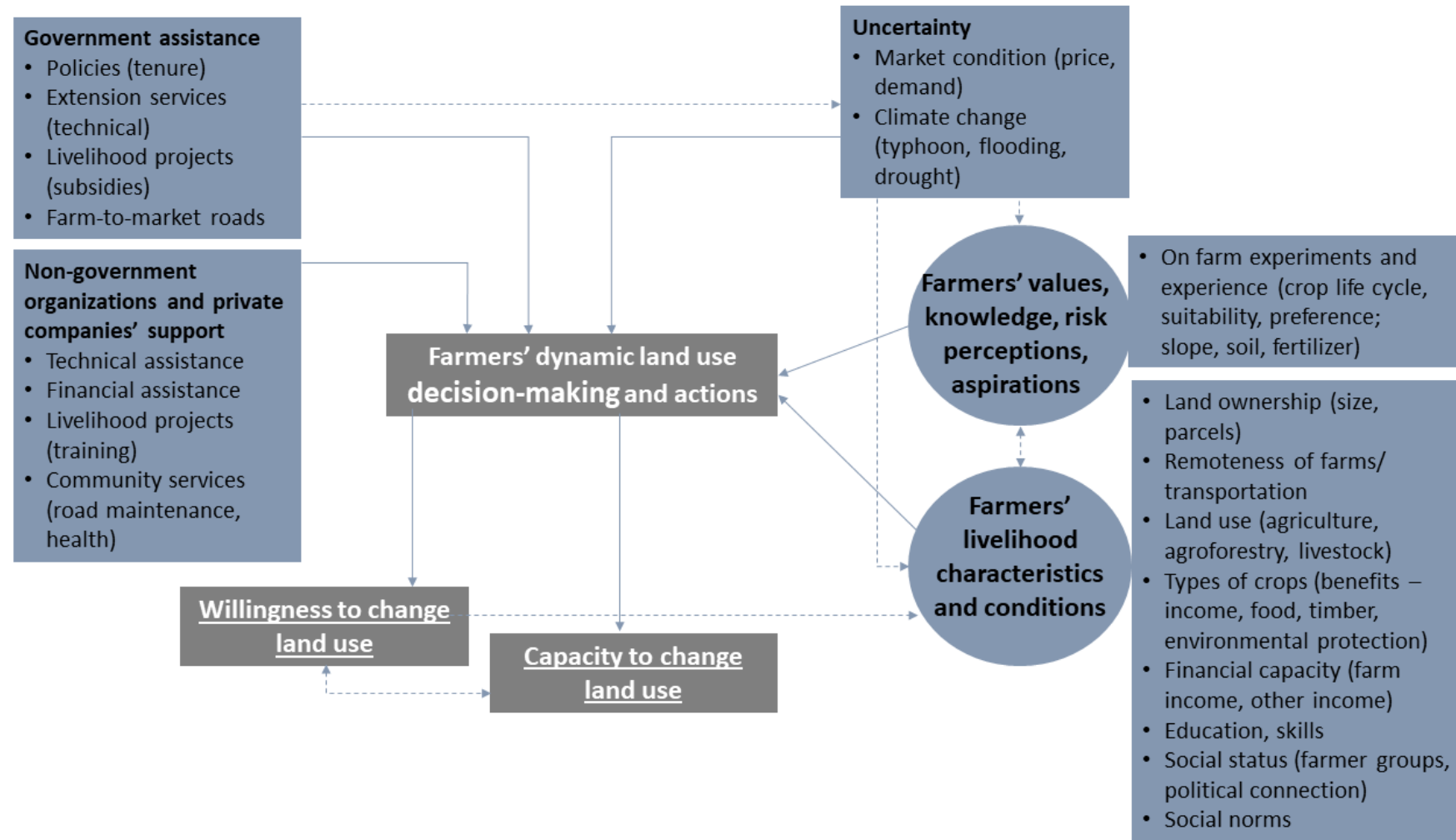


Figure 7.3 A schematic of key factors influencing farmers' willingness and capacity to change land use in Cabulig watershed.

### 7.1.3 General model development process

Two BNs were developed: willingness to change and capacity to change. Figure 7.4 summarizes the technical steps involved in the model development process, which draws on Hamilton et al. (2015) and Jakeman and Letcher (2003) for the model development process, Frayer et al. (2014) and Ticehurst et al. (2011) for integrating quantitative and qualitative data in the modelling, and Merritt et al. (2016) and Newton et al. (2006) for using the SLA framework in BNs (Chapter 3.5.3).

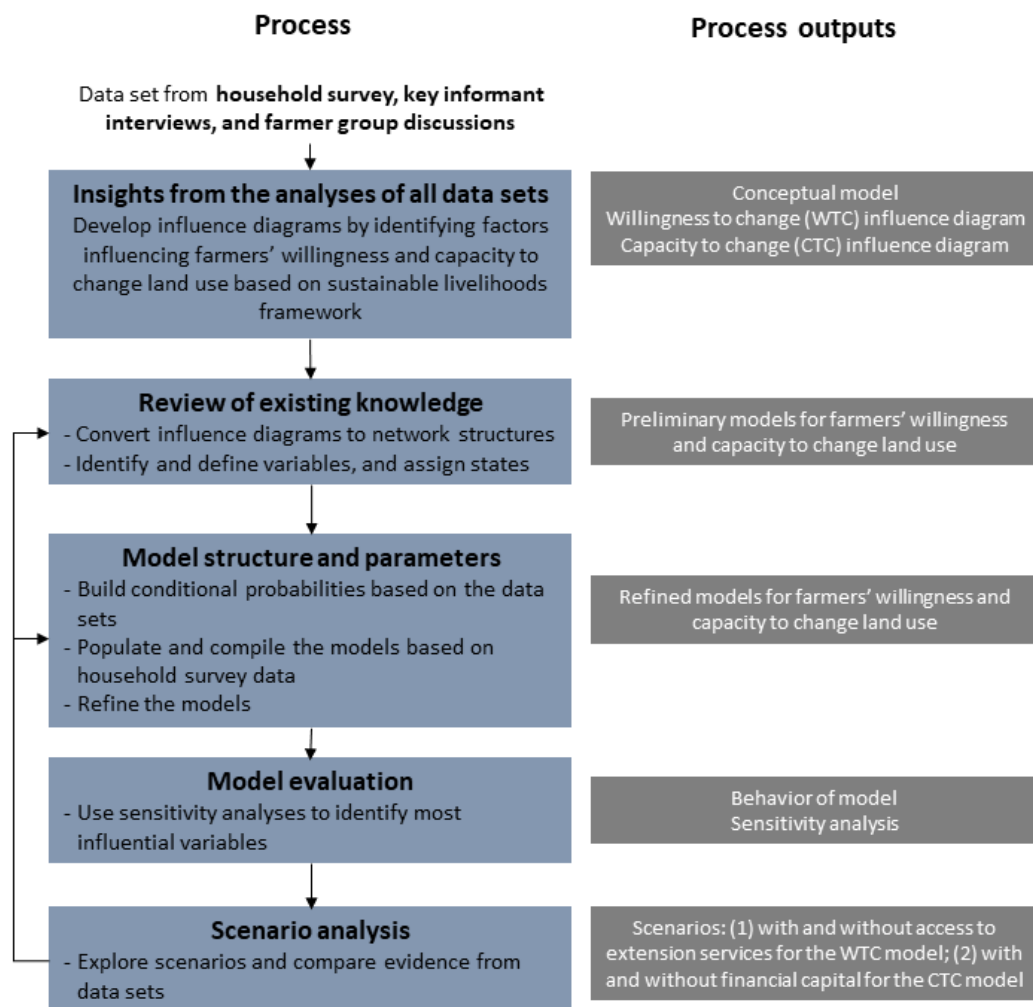


**Figure 7.4 Steps in developing the Bayesian network models for farmers' willingness and capacity to change land use in Cabulig watershed, as adapted from Merritt et al. (2015), Frayer et al. (2014), Chen and Pollino (2012), Ticehurst et al. (2011), and Newton et al. (2006).**

#### *Developing the initial structure of the models*

BN models were developed using the Netica software (Norsys Software Corp.). Not all the factors identified in the above conceptual models were included in the final influence diagrams (model structure) for the two BN models. The structures of the models were determined by the availability

of HH survey data, the statistical significance obtained from the survey data between the objective factors and all other variables, or because they were identified as important during focus groups and/or KIIs.

### ***Populating the models and simplifying the model structure***

To populate the BN models through the conditional probability tables (CPT) for variables, Netica's default counting-learning algorithm was used. This is the process for 'learning' the CPTs from a file of cases. The data used to populate the CPTs was the quantitative information collected from the HH survey. Simplification of the model structure was needed for some variables and their linkages, and this was identified based on the data. Data scarcity issues were identified when the CPT showed 'flat' distributions for rows where there was no data to learn the relations (i.e. when the combination of each parent variable did not exist in the HH data set). The necessary changes involved the deletion of variables, links between variables, and/or the number of states in a variable.

### ***Evaluating the 'final' models***

The two models were evaluated by sensitivity analysis to identify the variables that have the most influence on farmers' willingness and capacity to change land use. This was done by using the 'sensitivity to findings' functions in Netica. This function works by systematically varying the evidence entered into each of the nodes to simulate WTC and CTC and records the probability distribution for the states of this output node. The resulting mutual information (MI) statistic indicates the variance in the WTC and CTC nodes that is explained by changes in the respective input nodes.

## **7.1.4 Use of the models**

### ***Understanding model behaviour***

Relationships were explored in the two BN models to test underlying assumptions. For example, the village variable reflects different locations within the Cabulig catchment, and their geographical context influences, such as the farmers' decision making, livelihood assets, and the environmental conditions of their farms, which are linked to the outcome variables, ( '*willingness to change land use*' and '*capacity to change land use*'). Relationships that were not supported by evidence (data) were deleted to simplify the model. Possible explanations for why any relationships that were identified in earlier Chapters but not supported in the BN models are discussed in Section 7.4.

## ***Exploring possible interventions***

The BN models enabled the creation of scenarios to enhance farmers' WTC and CTC land use. Whilst the models allowed observation of the current structure or condition, they also enabled consequences of interventions to be explored through scenario analysis. In this way, the models could help policymakers and watershed managers explore the feasibility of these interventions and come up with better decisions for sustainable land use and watershed management. In this thesis, optimistic and pessimistic scenarios were created for each model: (1) with and without access to extension services for the WTC model; and (2) with and without financial capital for the CTC model.

## ***7.2 Willingness to change***

### ***7.2.1 Model structure and evaluation***

For farmers' WTC land use, the descriptions of the variables in the BN are shown in Table 7.3. The *village* is considered as a geographic variable (location) but also sets the probability distributions for the likely treatment (namely interventions like extension services), livelihood asset categories (e.g. land ownership), and biophysical considerations (e.g. slope). The structure of the BN model (the 'influence diagram') is shown in Figure 7.5.

In the BN, the environmental aspects (corresponding to the natural capital assets in Figure 7.1) are represented by *slope*, *pH* and *soil fertility*. The financial assets are represented by *land ownership*, *current land use* and *conservation practices*, and human assets by farmers' level of *skills*. Social assets are captured by *access to extension services*, and cognitive factors by their *willingness to change* their land use, the *reasons* motivating such a decision, and their risk perception around the uncertainty that is *affected by drought*.

### ***Behaviour of the model***

Two slope categories are defined (0-18%; >18%) based on the land classification of the 1975 Revised Forestry Code (Presidential Decree 705) where lands having >18% slopes are considered public domain. In this catchment, the *slope* is correlated with *soil pH* and *fertility*. In general, the soils are acidic (low pH) and infertile because they are highly leached and weathered due to the high rainfall, which is common throughout the uplands of Southeast Asia. The acidification process can be exacerbated by farming. However, in the Cabulig catchment, the steepest slopes are associated with the gorges where the Cabulig River and its tributaries have dissected the landscape, exposing less weathered parent material. As a result, the soils on these slopes tend to be less acidic and more fertile. The BN model captures this relationship between *slope* and *soil pH*.

While previous studies relate land use and management practices, particularly conservation practices, to soil fertility as one component of soil quality (Cramb, 2005; Mercado et al., 2016; Motavalli et al., 2013), the data collected does not support this complexity being reflected in the model. Questions were asked about soil type, fertility and soil management practices (see Section 2 of the survey in Appendix 4). The data on soil management was not sufficient to determine relationships with soil fertility; rather pH was found to be the strongest explanatory variable for soil fertility. Thus, in the model, *land ownership* is connected to *soil pH* as a surrogate for management practices. Narratives from the KIIs suggest that land ownership has a bearing on how farmers use and manage farmland (see Sections 4.2.1 and 6.2.3). If they own the land, they are more likely to invest in the future of their land. However, it is interesting to note that even if the surveyed farmers own the land they cultivate, and the soil quality is good, their willingness to change is still quite low (see Section 6.2.4). These farmers are likely influenced by a lack of inputs or other limitations posed by the slope on their land use and/or crop options, or an aversion to risk. Although the relationship between *land ownership* and *soil pH* is included in the BN model, it is much weaker than that between *slope* and *pH*. After controlling for slope, there is a small effect of land ownership with lands that are ‘not owned’ being more likely to be acidic than ‘owned’ land. The assumption in Table 7.3 that ‘*A farmer who owns the land he/she is cultivating invests more in soil amelioration to improve the farm’s soil quality*’ may be true but there is little evidence that it has a strong effect on soil pH. Additional data on fertilization could be collected to test this further and help refine the model, and by deleting the link if the data refutes the assumption.



**Table 7.3 The definitions, states, data sources and relationships behind the data used to populate each variable in the sub-BN of farmers' willingness to change land use in Cabulig watershed. The *p*-values indicate the significance of the correlation between each variable and the dependent variable, namely the willingness to change, and are from Chapter 6.2.4. In this column, N/A means that the variable was added to the BN based on the findings of the key informant interviews or is the dependent variable (WTC).**

| Variable              | Definition                                                                       | States                                                                                                                                                                             | The survey question(s) or data source                                                                              | Relationship to child variables and assumptions                                                                                                                                                                                                                                                                                                                                                                                | <i>p</i> -value (GLM-SPSS) |
|-----------------------|----------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------|
| Willingness to change | The inclination of the farmers to change their current crop/land use to another. | No;<br>Stay in agriculture but change crop; Change from agriculture to agroforestry, Stay in agroforestry but add (more/different) trees; Change from agroforestry to agriculture. | Are you willing to change your current crop/land use?                                                              | <b>Reasons</b> A farmer's willingness (or not) to change land use/crop is influenced by key motivations/limitations important to him/her.                                                                                                                                                                                                                                                                                      | N/A                        |
| Slope                 | The gradient of the farms visited.                                               | 0-18% (low to moderate slope); >18% (steep slopes)                                                                                                                                 | Extracted from map of the slope by averaging over an 80m radius circle (2 ha) centered on the farm (ACIAR project) | <b>pH</b> Farms on steeper slopes are generally less acidic because the soils are younger due to erosion and therefore less weathered, whereas on flatter areas soils are generally more acidic due to greater weathering and also due to constant cultivation.<br><b>Soil fertility</b> Steeply sloping farms are likely to be more fertile because the soils are less weathered (see above) and less intensively cultivated. | 0.013                      |

| Variable       | Definition                                                                                                                                                       | States                                                  | The survey question(s) or data source                                                                                                                     | Relationship to child variables and assumptions                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | p-value (GLM-SPSS) |
|----------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------|
| <u>Village</u> | The barangays (villages) within whose boundaries cultivated farms are located.                                                                                   | San Nicolas; Plaridel; Luna; Mat-i; Aposkahoy; Malagana | (Profile) Pre-determined and checked by GPS                                                                                                               | <p><b>Slope</b> Each village has a distribution of gradients of cultivated farms.</p> <p><b>Soil fertility</b> Each village has a distribution of soil fertility of cultivated farms.</p> <p><b>Affected by drought</b> The impact of drought on cultivated farmers varies between villages, an indicator of position in the watershed.</p> <p><b>Access to extension</b> The location of cultivated farms in the villages influences farmers' access to the extension. Farms located in remote areas do not receive any extension support.</p> <p><b>Land ownership</b> The land tenure of a village depends on its land classifications (i.e. forestland, alienable and disposable), which consequently affects farmers' land use and/or management.</p> <p><b>Current land use</b> The biophysical conditions of a village influence the distribution of land use or crops commonly grown by farmers.</p> <p><b>Conservation practices</b> The biophysical characteristics of a village influence the type of conservation measures adopted by farmers.</p> | 0.066              |
| pH             | The acidity or alkalinity of a farm's soil is based on a logarithmic scale on which 7 is neutral, with lower values more acidic and higher values more alkaline. | 0-5.5 (acid); >=5.5 (not acid)                          | Extracted from map of soil pH at 0-25 cm depth (measured 1:5 in water) by averaging over an 80m radius circle (2 ha) centered on the farm (ACIAR project) | <b>Soil fertility</b> A farm's soil acidity has an inverse relationship to its fertility                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | 0.29               |

| Variable            | Definition                                                                                                                                                               | States                                                     | The survey question(s) or data source                                                                                                                                                                                 | Relationship to child variables and assumptions                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | p-value (GLM-SPSS) |
|---------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------|
| Affected by Drought | The experience (or not) of a farmer's livelihood having been affected by drought.                                                                                        | Yes; No                                                    | Has your farm and farming livelihood been affected by drought?                                                                                                                                                        | <b>Reasons</b> Experience the impact of drought on a farmer's cultivated land/s and farming livelihood can influence his/her motivations to change the current land system to another.                                                                                                                                                                                                                                                                                                                                                                                                         | 0.051              |
| Soil fertility      | The soil fertility of a cultivated farm is indicated by the sum of exchangeable bases.                                                                                   | 0 to 5 me/100g soil (Foley et al.); >5 me/100g soil (high) | Extracted from map of the sum of exchangeable bases at 0-25 cm depth by averaging over an 80m radius circle (2 ha) centered on the farm (ACIAR Watershed Evaluation project)                                          | <b>Willingness to change</b> A farm's soil fertility condition can influence a farmer's inclination to change his/her land system.                                                                                                                                                                                                                                                                                                                                                                                                                                                             | 0.030              |
| Land ownership      | Whether or not the farmer owns the land he/she is cultivating. Ownership means that a farmer holds a title or tax declaration form as proof of having control over land. | Owned; not owned                                           | (Table) Please provide information on parcels owned and/or managed by land use type. (Choices) Owned and cultivated; owned but cultivated by others; owned but not cultivated; cultivated but owned by others; tenure | <b>pH</b> A farmer who owns the land he/she is cultivating is more likely to invest more in amelioration of soil acidity.<br><b>Skills</b> With land as a key farming capital, a farmer who owns the land he/she is cultivating is likely to have the extra financial capital to diversify his/her skills.<br><b>Reasons</b> A farmer who owns the land he/she is cultivating has more flexibility to change or improve their current system.<br><b>Conservation practices</b> A farmer who owns the land he/she is cultivating has the freedom to apply soil and water conservation measures. | 0.096              |
| Current land use    | The farmer's current land use/crops.                                                                                                                                     | Agriculture; Agroforestry                                  | (Table) Please indicate the current land use of parcel 1, 2... What is the dominant crop? What is/are the associated crops)                                                                                           | <b>Willingness to change</b> The benefits (or the lack of them) enjoyed by a farmer from his/her current land use/crop influences his/her inclination to change.<br><b>Reasons</b> A farmer's current land use is influenced by his/her motivations. For example, the coverage by trees and conservation measures adopted may reflect his/her desire to protect the environment.                                                                                                                                                                                                               | N/A                |

| Variable               | Definition                                                                                                                                                                                                                                                          | States                                                                   | The survey question(s) or data source                                                                                                                            | Relationship to child variables and assumptions                                                                                                                                                                                                                                                                                                                                                                                                                                                      | p-value (GLM-SPSS) |
|------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------|
| Conservation practices | The conservation practices adopted by a farmer to lessen the impact of extreme events.                                                                                                                                                                              | None; Soil protection (e.g. ground cover, contouring); Plant Trees; Both | If affected by drought, what are your coping strategies?                                                                                                         | <b>Affected by drought</b> Farmers who have adopted conservation practices should be less affected by drought.                                                                                                                                                                                                                                                                                                                                                                                       | N/A                |
| Skills                 | The variety of a farmer's knowledge and skills other than farming.                                                                                                                                                                                                  | Scored based on the number of skills: Low (1); Medium (2-3); High (>3)   | (Table) Please indicate the number and type of skills that you possess.                                                                                          | <b>Willingness to change</b> A farmer with diverse skills does not depend on farming alone for their income. Their inclination to explore potentially more productive and/or sustainable crop/land use systems could increase.                                                                                                                                                                                                                                                                       | 0.016              |
| Access to extension    | Whether a farmer has benefitted (or not) from any extension services provided by the government, non-government agencies, and/or private companies. Services include improving farming knowledge and practices, livelihood strategies, and/or financial assistance. | Yes; No                                                                  | Have you benefitted from any extension activities about (1) sustainable land use and management; (2) loans or financing, and/or (3) livelihood support programs? | <b>Willingness to change</b> Farmers with access to extension services should have more crop/land use options, livelihood activities, and/or financial sources, which may influence their inclination to change their current system.<br><b>Skills</b> Farmers with access to extension services from different providers are more likely to have more skills in addition to farming alone. Some agencies provide farmers with skills training to diversify their livelihoods and sources of income. | 0.006              |
| Reasons                | Farmers' motivation for their (un)willingness to change crop/land use system to another.                                                                                                                                                                            | Inputs; Food consumption; Profitability; Environment                     | In continuation of the willingness question... If no, why? If yes, why?                                                                                          | <b>None</b> This variable is included to aid with the exploratory analyses conducted later in this Chapter.                                                                                                                                                                                                                                                                                                                                                                                          | N/A                |

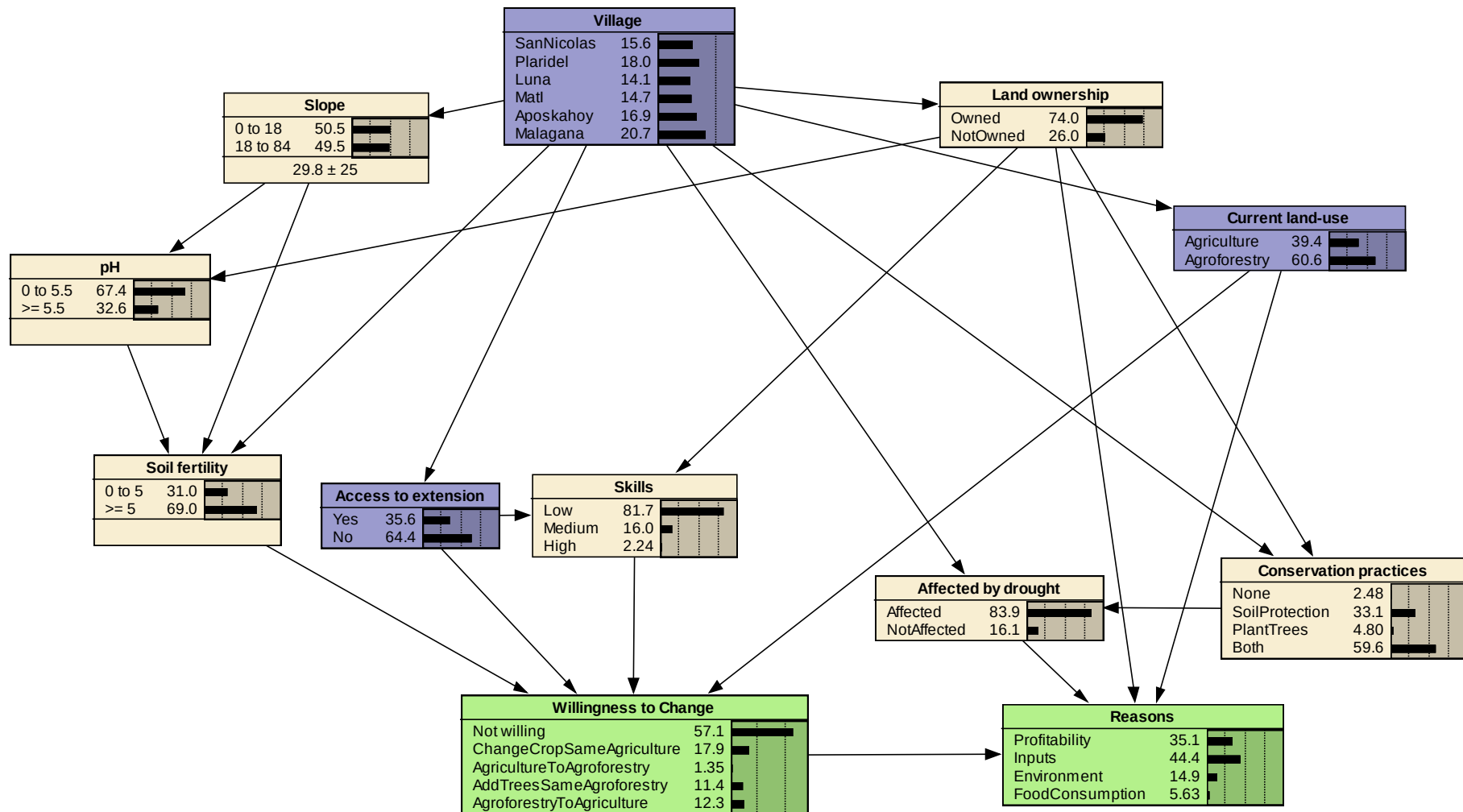


Figure 7.5 BN model for farmers' willingness to change land use in Cabulig watershed. Coloured variables are the focus of the scenario analyses in Section 7.2.2. The variables in beige and blue boxes drive the factors that influence the outcomes in green boxes although only the blue boxes are 'conditioned' (altered) in the scenario analysis.

The *villages* vary in the distribution across the states of *land ownership*, reflecting the different proportions of lands classified as alienable and disposable (A&D) and forestland across the village areas. In Chapter 4.4.1, most of the surveyed farmers own the lands they cultivate except in Plaridel where the majority of its total area is A&D, and where outmigration and land renting are common and 75% of farmers do not own their land. *Land ownership*, in the BN, influences the variety of farmers' *skills*, whereby farmers with owned lands are assumed to have the capacity to diversify their non-farming skills beyond farming more than those who do not own their lands (see Table 7.3). These skills can be potential sources of income, which may influence farmers' *willingness to change* and the *reasons* behind such a decision. Another key factor influencing farmers' WTC land use that varies across villages is *access to extension services*, which is discussed further in Section 7.2.3.

The types of *conservation practices* that farmers commonly adopt vary across the villages. For example, in both Plaridel and San Nicolas, about 75% of respondents implement soil protection measures as well as planting trees, while in Aposkahoy 53% implement soil protection measures only, and 41% do both. Conservation is also influenced by *land ownership* as farmers are more likely to invest in soil protection and/or tree planting when they own the land. Conservation practices could be expected to mitigate the severity of the impact of extreme weather events on farmers' land use, in this case the severity of *drought*. Most of the farmers have adopted conservation practices but were still affected by drought (84%). Those who have not adopted conservation measures have a slightly higher (87%) likelihood of having been affected by drought. However, this difference is small and the evidence from the household survey to support the assumption that conservation practices mitigate against the impact is not strong<sup>80</sup>. Farmers who are affected by drought are mainly driven by inputs and profit, although environmental protection and food consumption are highlighted. Farmers not affected by drought are mainly driven by profit, inputs, and environmental protection.

## ***Sensitivity analysis***

The results indicate that for *willingness to change*, *current land use* (Mutual Information statistic<sup>81</sup>, MI=0.398) and *skills* have the strongest influence (MI=0.024) (Table 7.4). *Reasons* (MI=0.333), which is the child of WTC, also has a strong relationship. *Reasons* were an insignificant variable in three iterations of SPSS Generalized Linear Modelling (Chapter 6.2.4)

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<sup>80</sup> The responses in Section 6.1 of the survey questionnaire (Appendix 4) were insufficient to differentiate between the impacts for those who did or did not implement adaptations strategies. It may be the way the question was framed or asked did not capture the whole story.

<sup>81</sup> Mutual information is a measure of the mutual dependence between the two variables or, in other words, the degree of sensitivity of one node to another.

and were not included in the final regression model. The *reasons* variable was added to the BN structure because the qualitative analyses indicated it was a factor influencing farmers' WTC and it turned out to be an influential variable in the model. Ticehurst et al. (2011) noted that BN models can identify some important variables that are found not significant using other statistical methods. In the WTC model, the sensitivity to the *reasons* variable suggests the importance of accounting for farmers' cognitive understanding of their land use decisions and management practices (Chapter 6). However, in this model *reasons* is added as a child of WTC to help with the interpretation of results (i.e. not as a predictor). More research is needed to explore whether the model could be further developed to have this variable as a predictor.

The variables above are followed by *access to extension* (MI=0.074), *village* (MI=0.026), *skills* (MI=0.024), and *soil fertility* (MI=0.017). Changes to slope, pH, conservation practices, drought, and land ownership variables in the sensitivity analysis have relatively little influence on WTC.

**Table 7.4 Sensitivity of 'willingness to change' to a finding at another node**

| Variables              | Mutual information |
|------------------------|--------------------|
| Current land use       | 0.3980             |
| Reasons                | 0.3331             |
| Access to extension    | 0.0739             |
| Village                | 0.0251             |
| Skills                 | 0.0238             |
| Soil fertility         | 0.0174             |
| Slope                  | 0.0029             |
| pH                     | 0.0022             |
| Conservation practices | 0.0022             |
| Affected by drought    | 0.0016             |
| Land ownership         | 0.0003             |

Overall, cognitive factors (reasons) and indicators of natural, financial, human and social capital are all influential (Chapter 4). This reflects the current situation where the majority of the farmers practise subsistence or small-scale farming, and thus rely on household labour and not on physical assets (e.g. mechanized operations involving tractors). For social capital, few farmers have access to extension, which was reflected in the low participation of farmers in social groups (Chapter 4.4.1). From a management perspective, of the variables in the BN that can be controlled, access to extension is likely to be the priority intervention. Consequently, this variable is used in the following scenario analysis.

## 7.2.2 Scenario: Improving access to extension for increasing farmers' WTC land use

### *Scenario description*

For this discussion, 'farmers' will refer to farmers whose land use is agriculture (see Section 4.3.1) and 'agroforesters' to those whose land use is agroforestry.

In the BN model (Figure 7.5) *access to extension* is the child node of *villages*. It is a binary variable with the state ‘yes’ or ‘no’, where ‘yes’ means a farmer has access to extension services (215 out of 604 survey respondents) and ‘no’ means they do not (389 of the survey participants). The ‘unconditioned’ probability values show farmers’ access to extension services is low (Yes is 35.6% in Figure 7.5); this is the percentage of *all* respondents in the HH survey who reported they have access to extension.

The variables that are directly relevant to this section’s scenario analysis are displayed in colour in Figure 7.5. Scenarios were created by altering the *access to extension* and *current land use* variables. For the optimistic scenario for farmers, the *current land use* variable was conditioned to 100% agriculture whereas *access to extension* was also conditioned to 100% as shown in Figure 7.6. Other scenarios were created similarly. The scenarios were initially created for all villages, and then for each village independently. *Willingness to change* and *reasons* are the outputs of interest. The effect of increasing or decreasing access to extension services is modeled to explore the possible impacts on farmers’ and agroforesters’ WTC land use. Since the HH survey results revealed low access to extension services, the first scenario was pessimistic with farmers’ access to extension activities decreased to zero. The second, optimistic scenario explored the influence of increasing access to extension services to 100%. These are extreme scenarios that are intended to demonstrate the model behaviour and indicate the potential boundary of impact for both farmers and agroforesters.

### ***Extent of changes under the scenario***

Figures 7.7 and 7.8 compare the current (at the time of the data collection), pessimistic and optimistic extension scenarios on farmers’ and agroforesters’ WTC land use in Cabulig.

With current access to extension, more than half of the surveyed farmers (58%) are unwilling to change from agriculture, about 37% would consider planting other cash crops but remaining in agriculture, and the remainder would consider shifting to agroforestry (top panel of Figure 7.7). Under the pessimistic scenario, the proportion of farmers unwilling to change land use increased to 70%. In the radar plot, this increase in the ‘Not willing to change’ state reflects the reduced probability of WTC crops (down to 26%) or to switch to agroforestry (down to 4%). In the optimistic scenario, fewer farmers are unwilling to change land use (36%). Those farmers willing to change are more likely to change crops within the agricultural land use (55%). Only a small number are likely to shift from agriculture to agroforestry (8%).



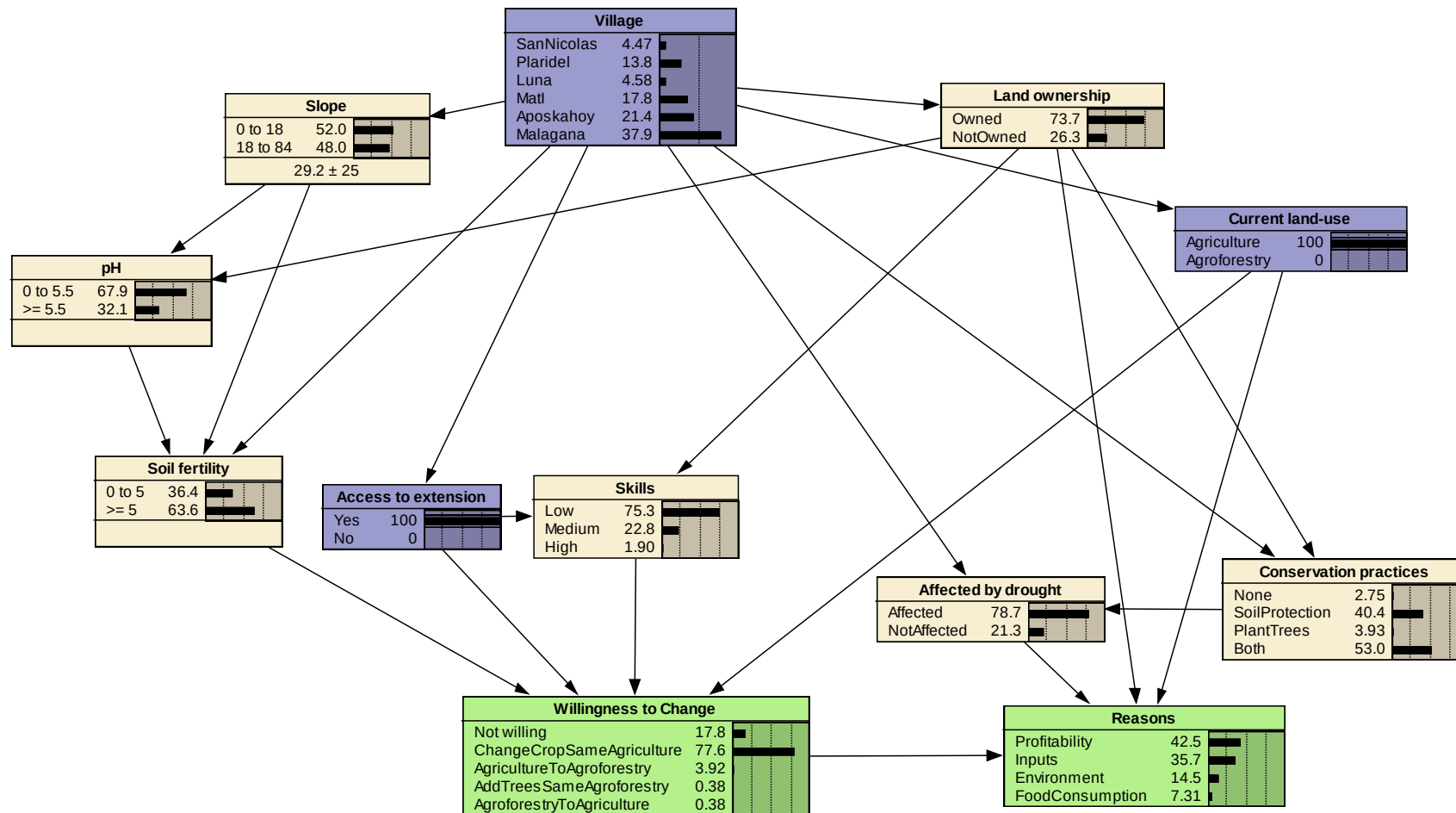


**Figure 7.6** The optimistic scenario for farmers' (as opposed to agroforesters') WTC is created by setting access to the extension to 100% and current land use to 100% agriculture. The changes in the probabilities of all the other variables from Figure 7.5 show the results of this scenario.

The scenario results for agroforesters are shown in Figure 7.8. Overall, the scenarios result in smaller changes than for farmers. With the current state of access to extension, about 60% are unwilling to change land use. A fifth are willing to change from agroforestry to agriculture (20%), and a similar proportion is prepared to add more trees to their agroforestry system. There are comparatively very little changes in the pessimistic scenario, with slightly more agroforesters unwilling to change land use (64%) and slight decreases of agroforesters willing to add more trees to their current agroforestry system (18%) or to convert from agroforestry to agriculture (17%). In the optimistic scenario, agroforesters unwilling to change land use lowers to 53%, matched by an increased likelihood of a change from a tree-based farming system to agriculture (26%) with little change in the probability to add more trees to their agroforestry system.

A deeper examination of changes under the optimistic scenario reveals possibly undesirable long-term impacts on the watershed. Full access to extension increases the likelihood of farmers changing crops from 37% to 55% with less impact on the willingness to convert to agroforestry (0% to 8%). With agroforesters, the impact of full extension slightly increases the number willing to abandon agroforestry in favour of agriculture (20% to 26%). This infers that improving access to extension services for both farmers and agroforesters may result in the expansion of agricultural production in Cabulig rather than agroforestry. Such decisions by farmers and agroforesters would be considered undesirable by NRM experts and government who want to increase tree cover in Cabulig for many reasons, including to reduce erosion and landslides, improve water quality, and decrease the risk of flash flooding.

Although subtle, the level of skills also influences farmers' and agroforesters' WTC in both scenarios (bottom panel of both Figure 7.7 and Figure 7.8). The influence is most notable for farmers and agroforesters in the optimistic scenario. There is a slight increase in farmers with medium skills (from 16% to 23%) with the 7% increase reflected in a lower percentage for low skills (the proportion of farmers with high skill levels is unaffected). This trend and level of change are the same for agroforesters. In the household data set, relatively few respondents reported they had high skill levels (13 out of 604), too few to develop robust relationships for this state, and the probability of being in this state is not sensitive to scenarios.

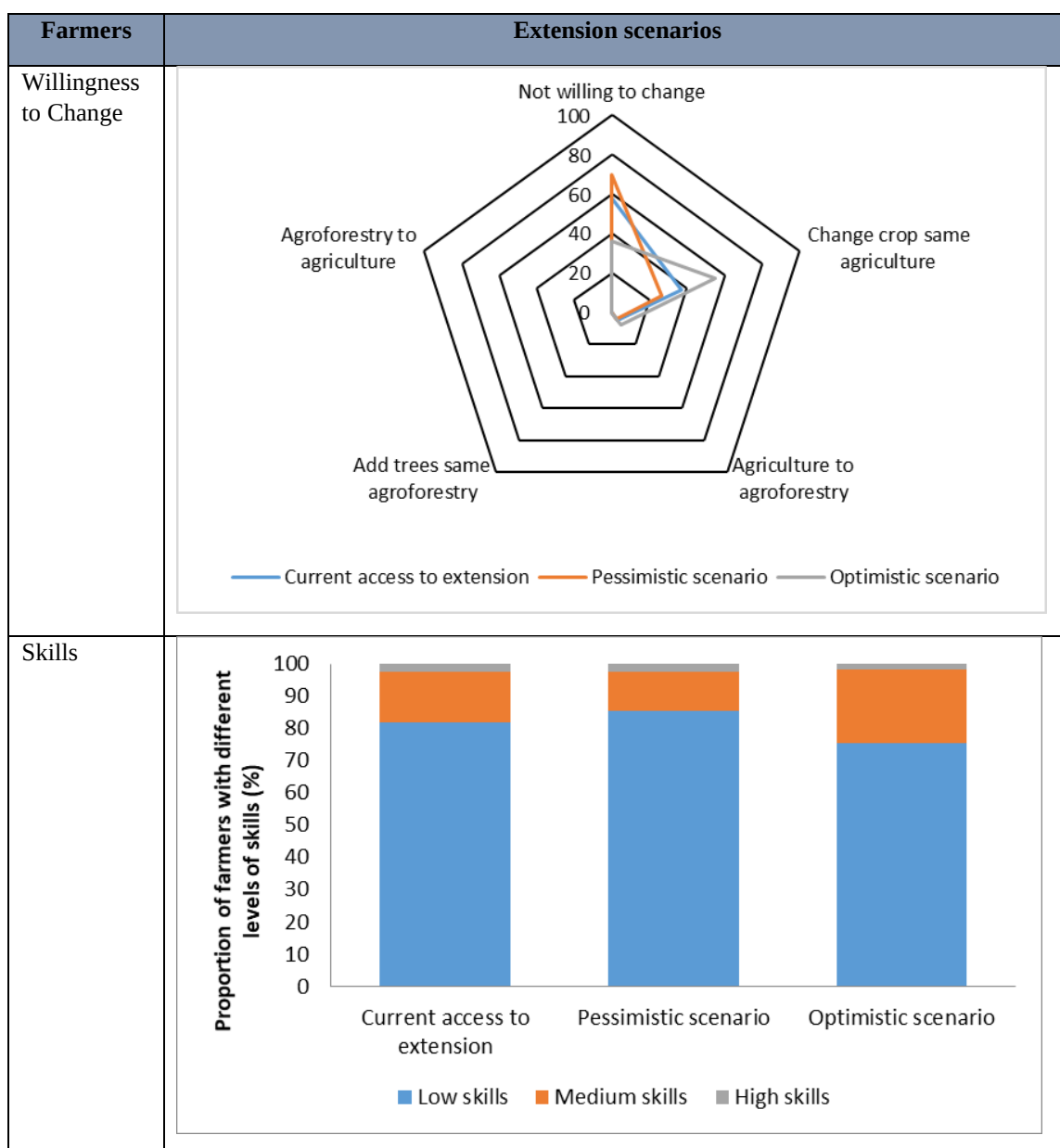


**Figure 7.7 Comparison of pessimistic and optimistic scenarios for all farmers surveyed in Cabulig.**

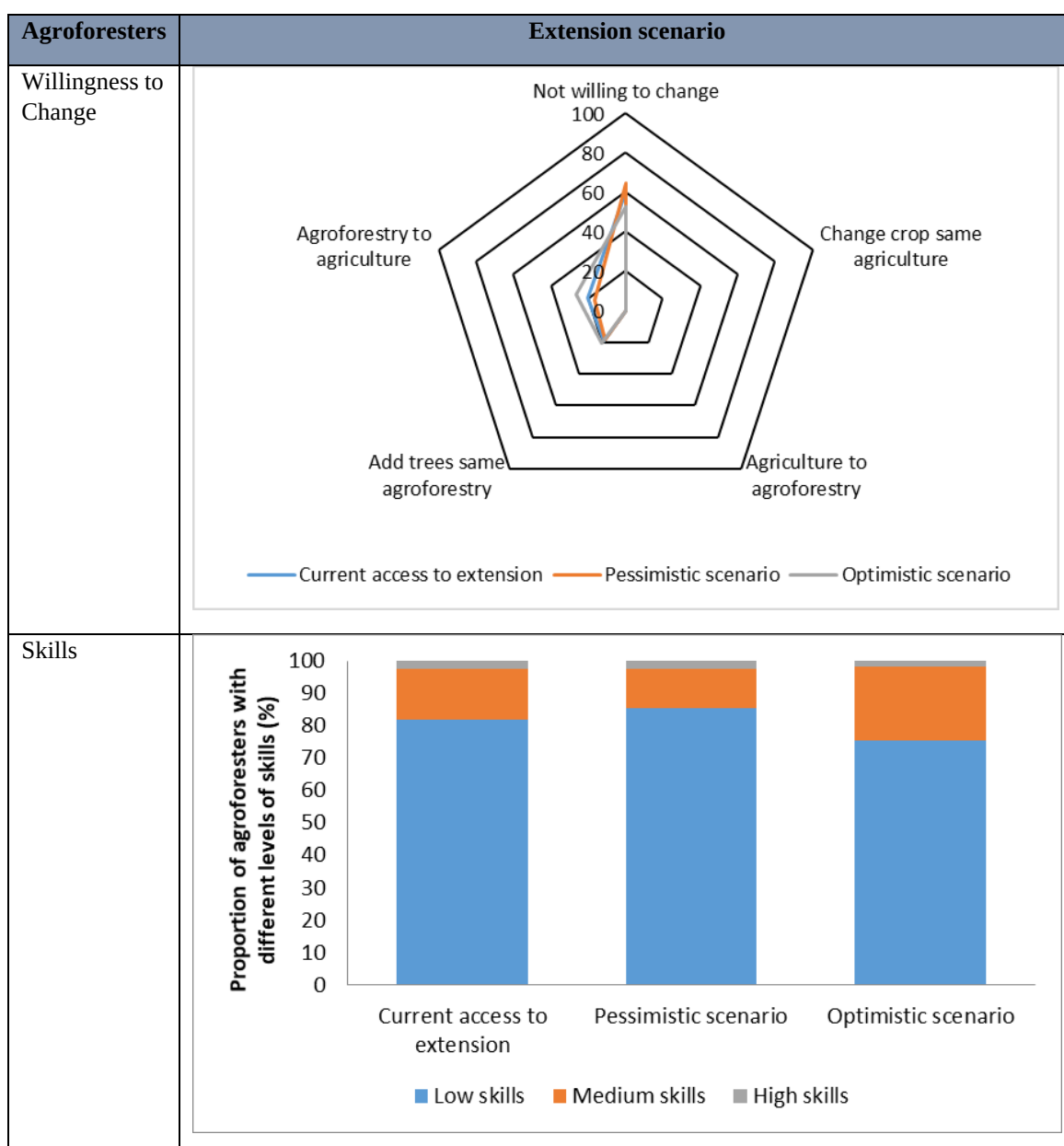


**Figure 7.8 Comparison of pessimistic and optimistic scenarios for agroforesters in Cabulig.**

### ***Reasons for any willingness to change***

To explore possible reasons for any WTC, Figures 7.9 show the distribution of the *reasons* variable when WTC is conditioned to different states. The major reason driving the willingness (or not) to change land use, for both farmers and agroforesters, is economic. For farmers and agroforesters unwilling to change it is the cost or accessibility of inputs that hinder them (78% and 60%, respectively). For those willing to change it is because they perceive an increase in profitability or, in some cases, lower-cost or more accessible inputs for the alternative land use.

For farmers wanting to change which annual crops they grow, 48% are driven by profit (Figure 7.9, top), up from 9% for those who are not willing to change, suggesting they have a preference for high-value cash crops that could improve their income. Some 28% believe that the new crop

would have cheaper or more accessible inputs. The few farmers who want to change their production system to agroforestry also give profit as their main motivation. This might reflect some farmers' perception that integrating tree crops can improve agricultural production in the long run as well as sustain it<sup>82</sup>. Inputs are less important to this group (18%).

Agroforesters wanting to add more trees to their farms or change to agriculture are motivated by profit (76% and 81%, respectively) (Figure 7.9, bottom). Environmental protection is given as a reason by relatively few agroforesters wanting to add more trees to their current system (19%), and food consumption (10%) also is not a major reason for agroforesters to want to change to agriculture. These results suggest that only if agencies can help smallholders address their input constraints and profitability by changing the way they do an extension, such as increasing the focus on profitable agroforestry, could WTC to (or remain in) agroforestry be expected to increase.

### ***Village variations under the optimistic scenario***

Among the surveyed villages in Cabulig watershed, Luna and Malagana are the extremes in terms of farmer access to extension services, with 13% of farmers in Luna reporting access compared to 51% in Malagana (Figure 7.10). The results are similar for agroforesters.

Consequently, there are relatively large differences between Luna and Malagana in the optimistic scenario depending on current land use (Figure 7.11 and Figure 7.12). More farmers are willing to change crops within their agricultural system in both villages, but the increase for farmers in Luna is greater (34%, i.e. from 34% to 85%) than in Malagana (9%). The greater increase in WTC in Luna is at least partially because the optimistic scenario applies to more farmers than in Malagana (i.e. 87% reported no access to extension in Luna versus 49% in Malagana). In Figure 12a it is modelled that most farmers in Luna would change crops (87%), perhaps believing it would offer better income considering the surveyed farmers' low average income. This preference may also be motivated by Luna's relatively fertile soil which may grow better vegetables (see red circle in Figure 7.12a), as well as its greater proximity to markets in Claveria and Cagayan de Oro (not reflected in the BN except through the *village* variable). However, whilst cropping on the fertile soils may temporarily give good yields, it carries the risk of erosion because these soils are also on steep slopes. This would not be considered desirable by catchment/natural resource managers.

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<sup>82</sup> PO5 shared: "... I've developed my farm into agroforestry. I can give example that/ my farm before was degraded. But now, I already have trees, big trees... I already have owls... rattlesnakes... in the middle of my productive farm. Why? Because it's natural environment is now back."

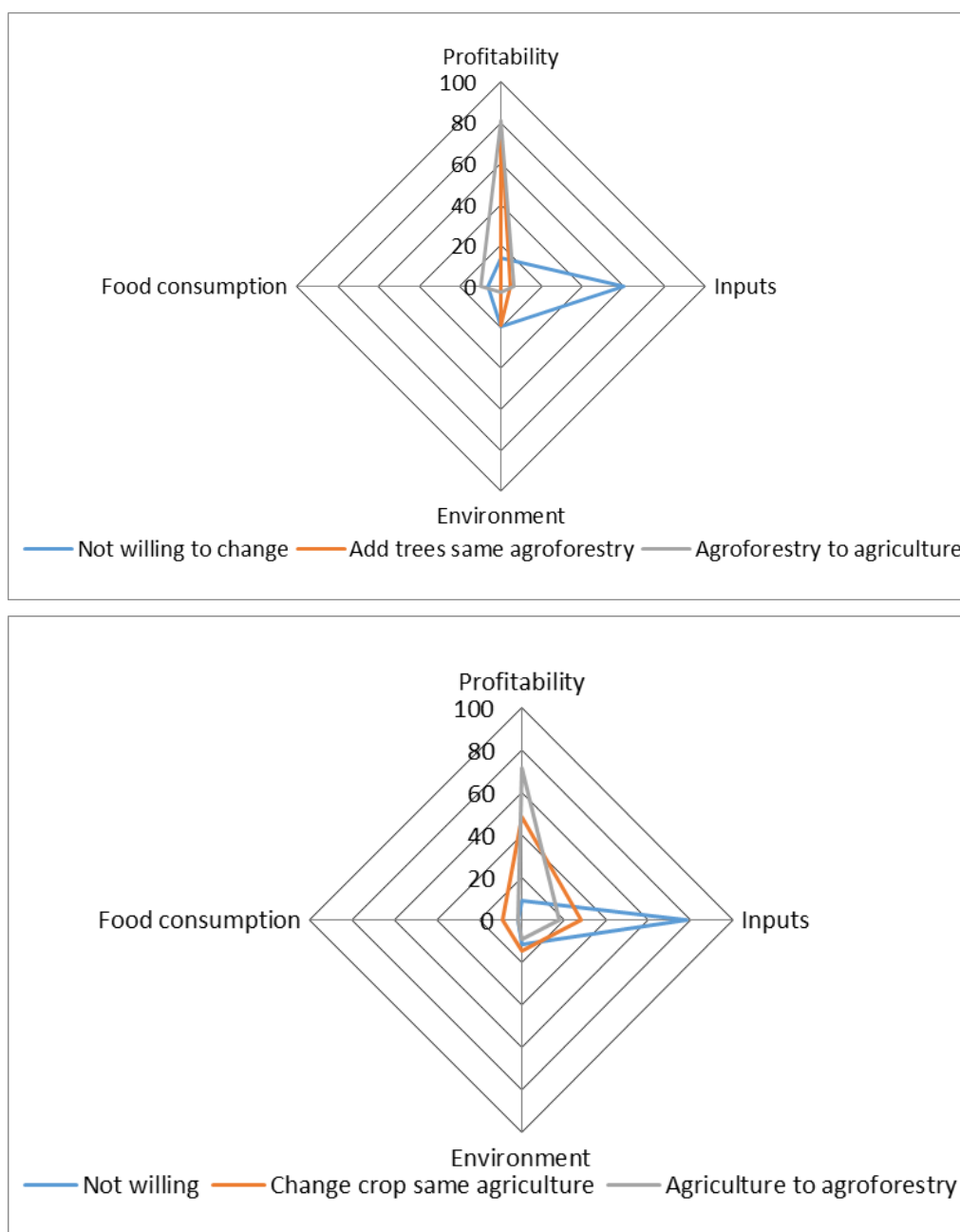


**Figure 7.9 Exploring farmers (top) and agroforesters' (bottom) reasons for changing or not changing land use in Cabulig watershed.**

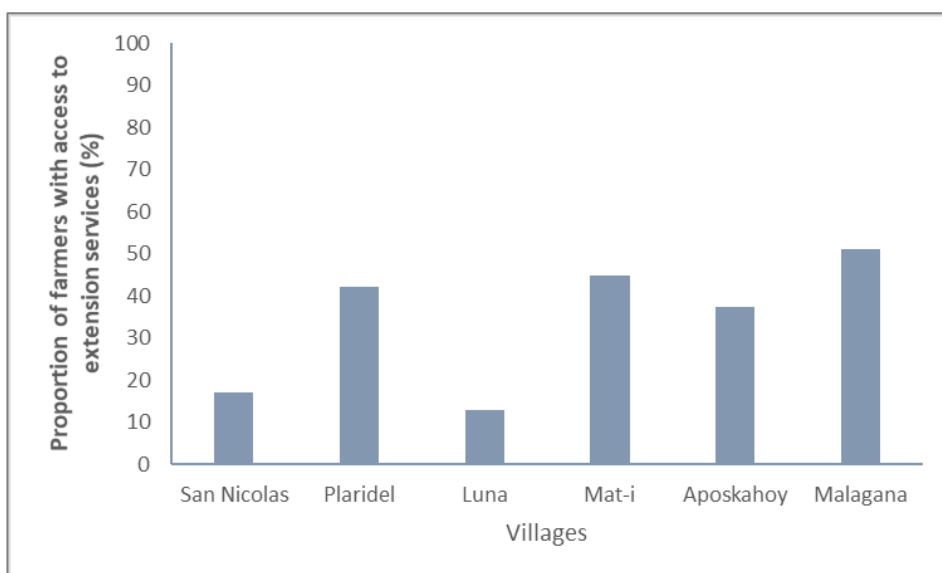


**Figure 7.10 Likelihood of farmers' access to extension services in the studied villages of Cabulig watershed.**

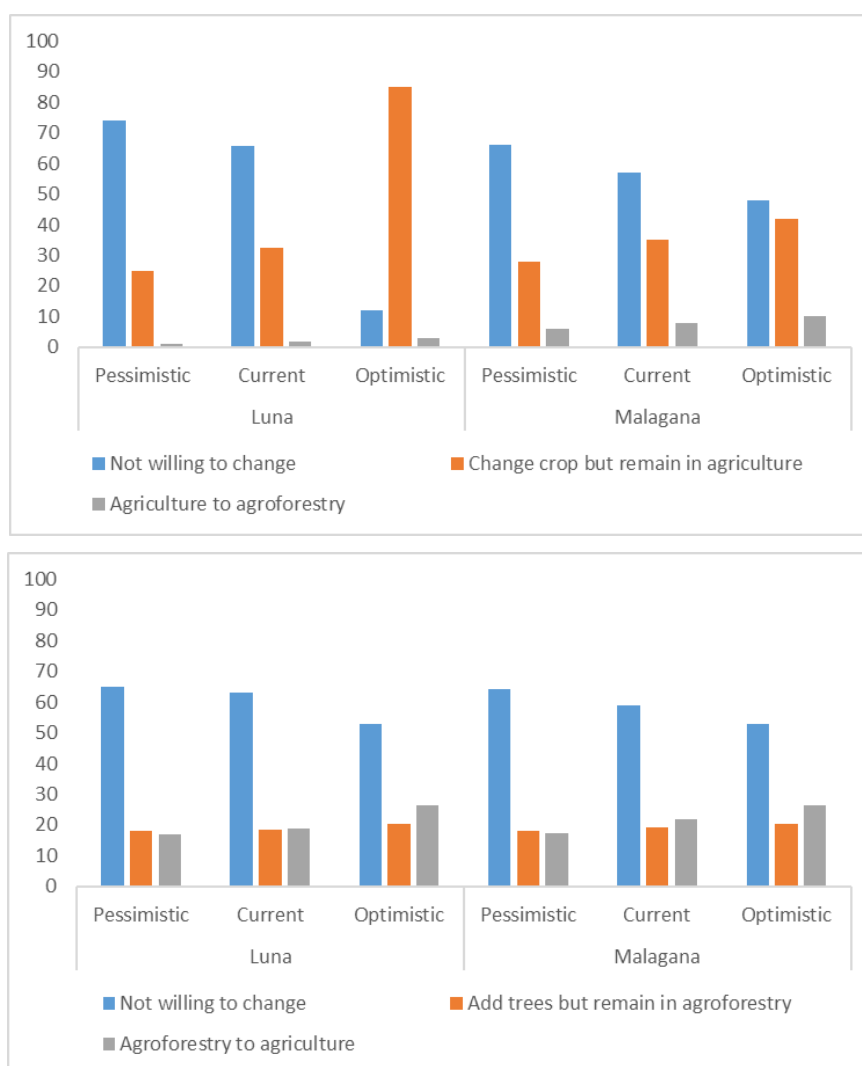
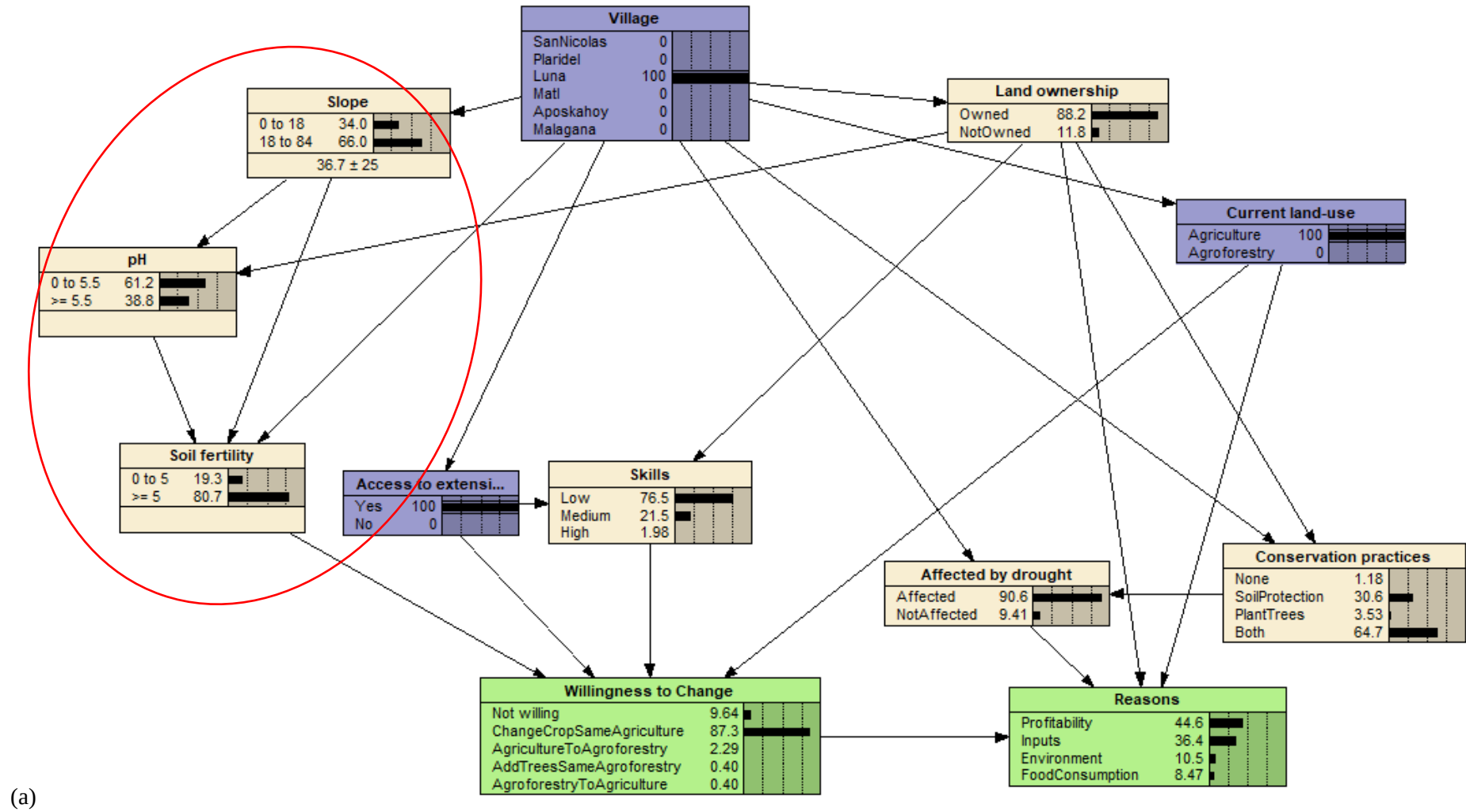


**Figure 7.11 Exploring farmers' (top) and agroforesters' (bottom) willingness to change land use in Luna and Malagana villages in Cabulig watershed.**





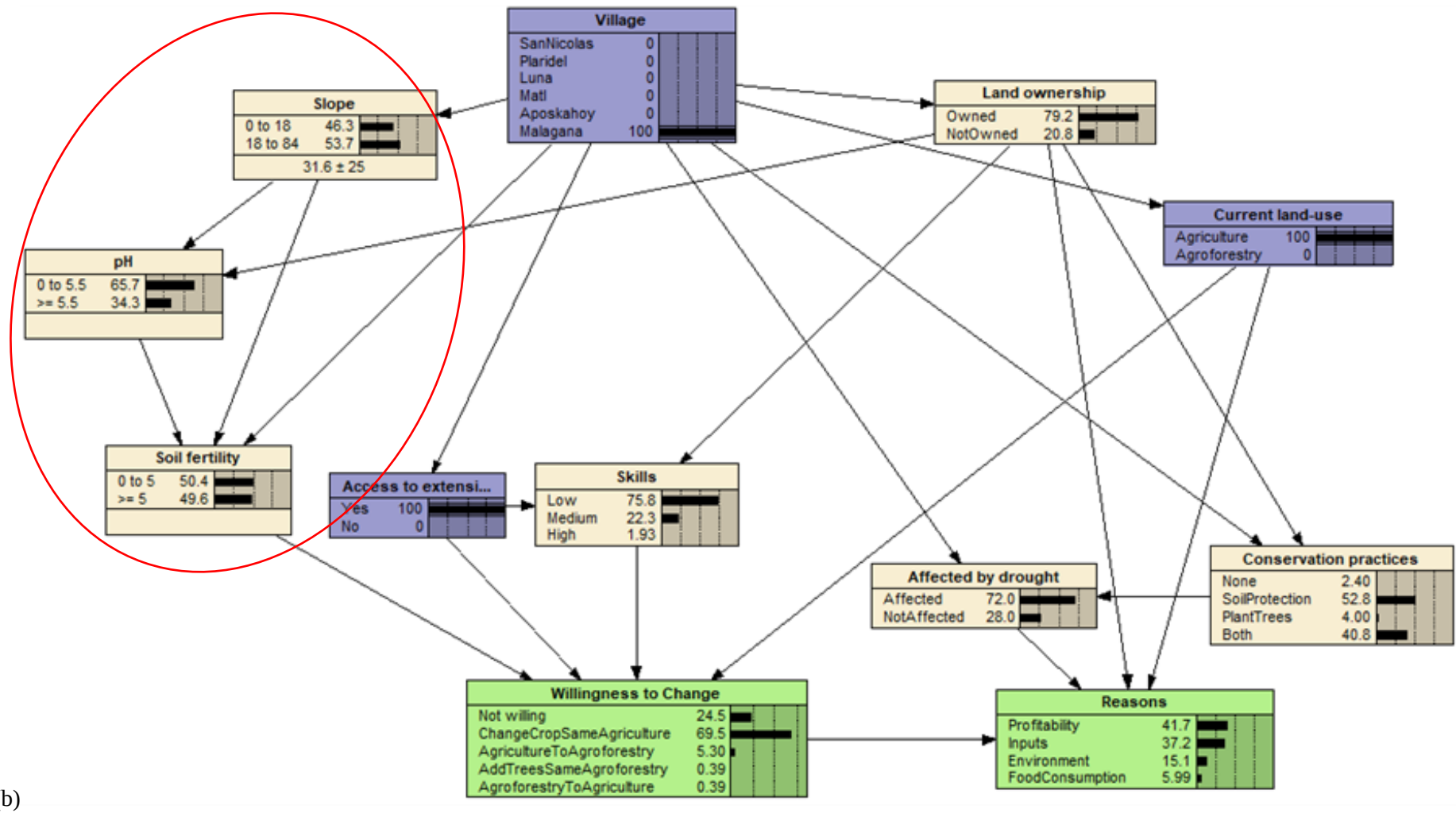


Figure 7.12 Notable differences between farmers in Luna (a) and Malagana (b) for unconditioned variables under the optimistic scenario. Soil fertility is better in Luna than in Malagana (red circle)

The response to improved extension is much more muted for agroforesters in both Luna and Malagana, with those willing to change modelled to increase by 10% and 6%, respectively (see Figure 7.11, bottom panel). In both villages most of the extra agroforesters who are willing to change wish to convert to agriculture, with increases for this option of 9% in Luna and 4% in Malagana. This could be because the short turn-over of agricultural crops (e.g. tobacco, corn) provides a more suitable level and timing of income than agroforestry<sup>83</sup>.

If the modelled pattern materialized in reality, it would have major implications. The provision of extension services directly increases farmers and agroforesters' WTC land use, with the greatest impact in areas currently with the poorest access to extension, as in Luna. Agroforesters exposed to extension have been more willing to give up their tree-based system and move into agriculture. On the steeply sloping lands, even a slight increase in a shift to agricultural crops could have a disproportionate effect on the watershed, particularly on soil erosion (Valentin et al., 2008).

In Malagana, where 51% have already accessed extension, there is consequently less change in farmers' and agroforesters' WTC land use. It could be that they are already adopting the land use that they want. For agroforesters, it would be interesting to know if their tree-based systems are deliberate, with the planned integration of trees, or accidental, where trees, especially native ones, have been randomly left in place across the farm because clearing them was not permitted.

The effects of some other variables in the BN become more obvious when looking at village differences compared to effects across the whole of Cabulig (see *soil fertility*, *conservation practices*, and *affected by drought* in Figure 7.12). The effect of these variables suggests the local influence and interplay of different factors on the expected outcomes should be considered within the context of individual villages.

The importance of profitability and accessing inputs highlights the need for extension services to improve financial outcomes for farmers if land use patterns are to change to more sustainable alternatives. Whilst improving extension increases WTC, it appears that it could result in fewer farmers using agroforestry, even in vulnerable areas (such as the steep slopes in Luna), because most extension to date has been focussed on how to grow agricultural crops. If environmental policy objectives to improve watershed function are to be met, it is vitally important that extension

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<sup>83</sup> For example, F11 shared: "We go for small income but sustainable because our farming is just small-scale... Sometimes we have to seek financing from madam. That's all we can do... After tobacco, maybe we plant corn when it already rains... If all corn, we can crop two to three times a year. It takes 4 months for corn before it can be harvested."

identifies profitable agroforestry alternatives for use in vulnerable parts of the landscape, and works with farmers, communities and other stakeholders to promote their uptake<sup>84</sup>.

## 7.3 Capacity to change

### 7.3.1 Model development

The BN that was developed for capacity to change (CTC) aims to model the factors influencing the ability of farmers to change land use. A major pre-cursor is the farmer's WTC, as modelled in the previous section, so the CTC model includes only farmers who expressed a WTC. In contrast to the WTC model, the CTC model does not consider farmers and agroforesters separately. In the description and discussion of the CTC model, all relevant respondents are considered together because of reduced data and for simplicity will be referred to as 'farmers'. Moreover, current land use was also not found statistically significant in farmers' CTC land use.

#### **Model structure**

Figure 7.13 shows the intended BN model structure for farmer capacity in the study villages. It was developed to demonstrate the impacts of environmental, societal and cognitive aspects of their livelihood assets on their ability to adopt the desired land use. It consisted of nine nodes, 20 links, and 2562 conditional probabilities. However, converting this to a robust working model was not possible given the reduced dataset; only 242 of 604 respondents were willing to change land use (see Chapter 6.2.4). This limited data set meant the model required simplification to populate the nodes with enough confidence in the relationships to use in sensitivity and scenario analyses. Nonetheless, the structure in Figure 7.13 could form the basis for future data collection and analysis.

Figure 7.14 shows the 'simplified' BN model for farmers' capacity to change land use with 7 nodes, 12 links, and 226 conditional probabilities. The *village* parent variable is directly linked to farmers' human (education, health) and financial capital indicators (available financial capital), as well as their cognitive processes (farming aspirations, reasons). Table 7.5 describes the variables in the BN.

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<sup>84</sup> The Landcare Program provided alternative sustainable land use options for farmers to choose from based on the biophysical characteristics of their farms, needs, livelihood capitals and aspirations. However, this Program only covered a limited number of villages in Cabulig and has already ended in 2008. Although the Program has resulted to the enactment of incentivizing adoption of sustainable farming practices, enforcement has been affected by changing Mayors with different political agenda.

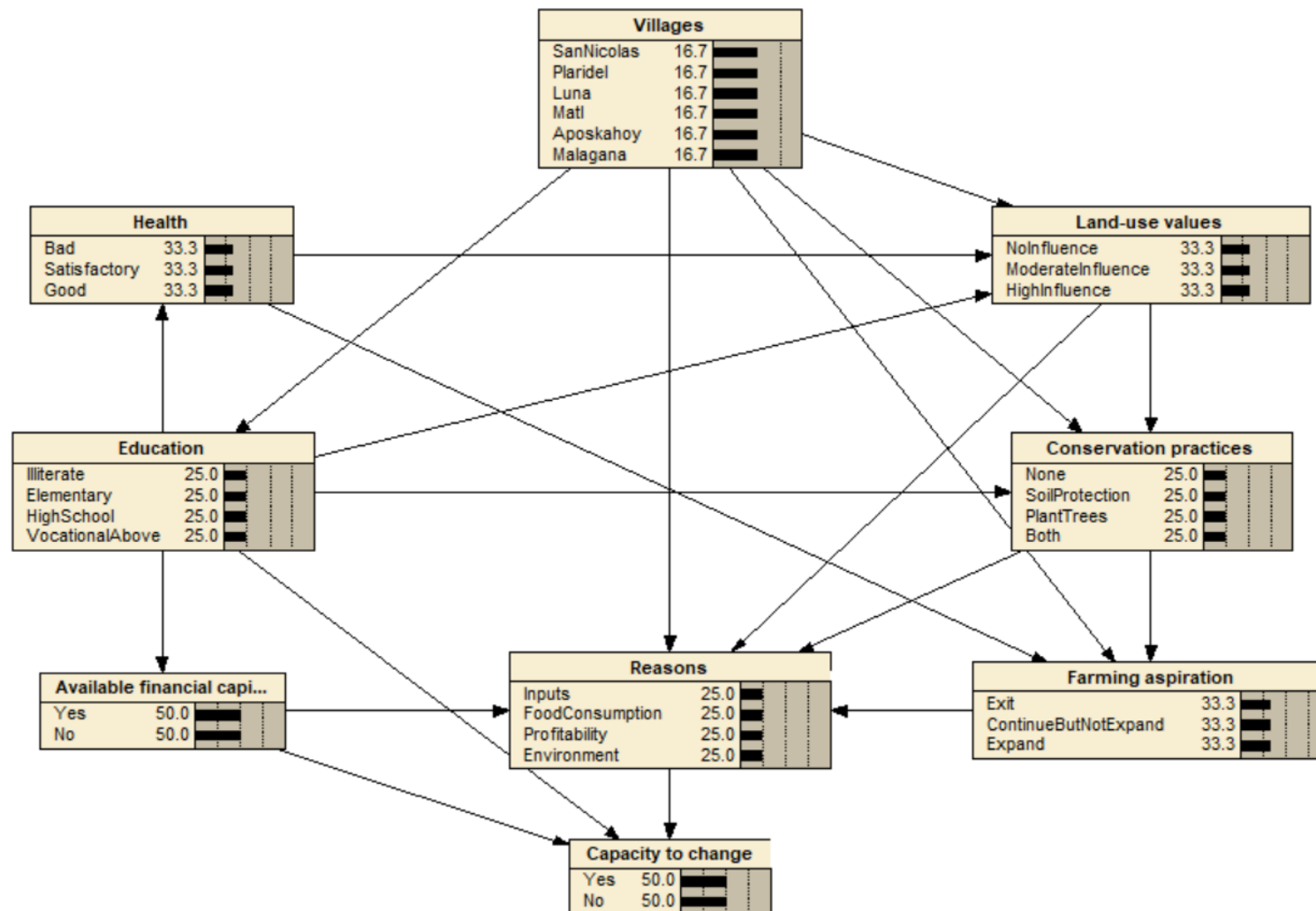


Figure 7.13 Intended BN model for farmers' capacity to change land use in Cabulig watershed

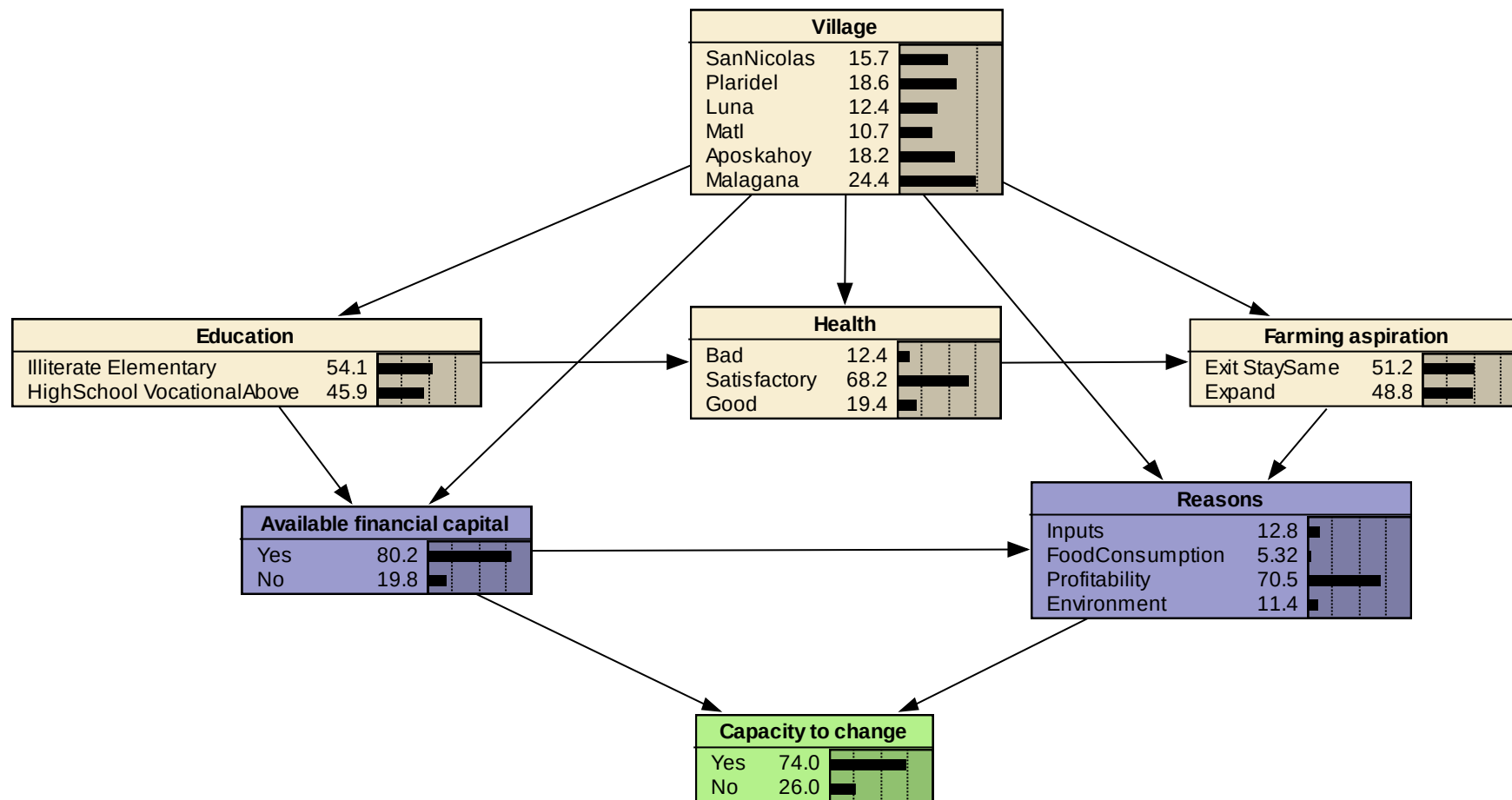


**Figure 7.14 Simplified BN model for farmers' capacity to change land use in Cabulig watershed. Coloured variables are the focus of the 7.3.1 discussion. Variables in beige and blue boxes influence the outcomes in the green box although only variables in blue boxes were altered in the scenario analysis in Section 7.3.1.**

**Table 7.5** The definitions, states, data sources and relationships behind the data used to populate each variable in the sub-BN of farmers' capacity to change land use in Cabulig watershed. The *p*-values indicate the significance of the correlation between each variable and the dependent variable, namely the capacity to change, and are from Chapter 6.3.6. In this column, N/A means that the variable was added to the BN based on the findings of the key informant interviews or is the dependant variable.

| Variable           | Definition                                                                     | State                                                  | The survey question(s)                                | Relationship to children and assumptions                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | <i>p</i> -value (GLM-SPSS)                                                                     |
|--------------------|--------------------------------------------------------------------------------|--------------------------------------------------------|-------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------|
| Capacity to change | The ability of the farmers to change their current crop/land use to another.   | Yes; No                                                | Are you willing to change your current crop/land use? | None                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | Dependent variable                                                                             |
| <u>Village</u>     | The barangays (villages) within whose boundaries cultivated farms are located. | SanNicolas; Plaridel; Luna; Mat-i; Aposkahoy; Malagana | (Profile) Pre-determined and checked by GPS           | <p><b>Education</b> The remoteness, road condition, and/or availability of school facilities in a village influence the farmers' levels of education.</p> <p><b>Financial capital</b> The biophysical and socio-economic conditions of a village influence the economic livelihood activities in the area and determine the farmers' financial assets.</p> <p><b>Health</b> The remoteness, road condition, and/or availability of health centers in a village influence the farmers' state of health.</p> <p><b>Farming aspirations</b> The biophysical and socio-economic conditions of a village influence farmers' aspirations on their farming livelihood.</p> <p><b>Reasons</b> The biophysical and socio-economic context of a village influence farmers' motivations for their (un) willingness to change current land use.</p> | 0.242 (Added as it was expected to capture the context of the villages in the child variables) |

| Variable                    | Definition                                                                                              | State                                                                              | The survey question(s)                                                                                                                                                                                    | Relationship to children and assumptions                                                                                                                                                                                                                                                                                                  | p-value (GLM-SPSS) |
|-----------------------------|---------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------|
| Education                   | The highest level of education completed by the farmers interviewed.                                    | Grouped into two states: Illiterate or Elementary; HighSchool, Vocational or Above | (Profile) Please choose the highest level of education attained.                                                                                                                                          | <b>Available financial capital</b> Farmers with lower education have more time to engage in different livelihood activities. This enables them to have diverse sources of income than those who farm alone.<br><b>Health</b> Farmers with higher education are more aware and conscious about diet and lifestyle that affect their health | 0.000              |
| Available financial capital | Whether the farmer has the financial capacity to grow their preferred land use or not.                  | Yes; No                                                                            | If not adoptable (preferred land use/crop), why? Choices: Too costly; unreliable market; labour-intensive; no government support; not enough knowledge; others                                            | <b>Capacity to change</b> It is assumed the availability of financial capital influences farmers' ability to change their current land system, especially if their preferred crops are input-intensive.<br><b>Reasons</b> It is likely that a farmer's financial status influences their motivations for making a decision.               | .000               |
| Health                      | The health condition of the farmer including their family members.                                      | Bad; Satisfactory; Good                                                            | (Table) Please indicate the condition of your health including your family.                                                                                                                               | <b>Farming aspiration</b> Healthy farmers are more likely to aspire to continue farming than those who are sickly or unhealthy.                                                                                                                                                                                                           | N/A                |
| Farming aspirations         | The farmers' future desires with regards to their farming livelihood.                                   | Exit; Stay Same; Expand                                                            | What are your intentions?<br>→ I will sell/lease this land in the future and migrate out of Cabulig; I will continue farming for as long as I live; I will purchase and/or lease lands to expand farming. | <b>Reasons</b> Farmers whose aspiration is to continue farming will be more motivated to earn a better profit.                                                                                                                                                                                                                            | .018               |
| Reasons                     | The farmers' motivation for their willingness (or not) to change their crop/land use system to another. | Inputs; Food consumption; Profitability; Environment                               | In continuation of the willingness question... If no, why? If yes, why?                                                                                                                                   | <b>Capacity to change</b> Farmers will have different motivations for changing their current system, and these will influence their capacity to realize the change.                                                                                                                                                                       | .000               |

*Available financial capital* directly affects farmers' *capacity to change* land use and is the child node of *education*. Monetary funds are a key capital for farming, along with land and labour resources, especially for those engaged in commercial agricultural production where there are expensive inputs. The availability of financial capital can also influence farmers' *reasons* for the type of land use adopted or planned. In Plaridel, many of the farmers who claimed to have the CTC land use were those who were relatively well-off, with a higher annual income (Chapter 4.4.1)<sup>85</sup>. In this case, it is likely that, with available financial capital, farmers have a greater capacity to change land use, which reflects their ability to address any input shortages and aim for greater profit.

Farmers' *educational level* also influences their *capacity to change land use* (Table 7.5), but the relationship is somewhat complicated (Figure 7.15). Although there were similar proportions in the two educational groups (low education 54%, high education 46%), a greater proportion of farmers with low education had CTC (78%, Table 7.6) compared those with high education (69%). Farmers with low education and CTC (Group A in Figure 7.15) may have more diverse livelihood activities giving them other sources of income that can support their change of land use or lower the financial risk of doing so. This is the case in the village of Mat-i where, although farmers have a relatively low level of education, they claimed to have the capacity to implement their desired land use<sup>86</sup>. They have diverse sources of income such as employment in the banana plantation (e.g. casual labourers) and government agencies (e.g. nutrition and health workers, watchmen of waterworks facilities), as well as small-scale businesses (e.g. sari-sari store, bakery). As such, the risk of changing their land use is lower than that of those who rely on farming alone for their livelihood<sup>87</sup>. The smaller proportion of farmers with low education but without CTC (Group B) may be subsistence farmers who rely on farming alone.

A greater proportion of farmers with high educational attainment have no CTC (31%, Group C) than those with poorer education. They are farmers whose farm may not be their primary source of income. Instead, their main income comes from employment by an institution using their

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<sup>85</sup> For example, apart from her sari-sari store, 1034PLA is a female-farmer who owns and cultivates their 3-hectare farm. Half of this is planted with tobacco while the remaining area is planted with cassava. She said: *"With the climate changing, I prefer to plant cassava because it can withstand drought. The capital is also lesser, lesser management requirement, while the income is higher. I planted the new ryon variety that can be harvested from 6-9 months, which enable us to harvest twice in 1.5 years. It's a good income."*

<sup>86</sup> For example, F04 preferred to plant abaca because of good income and its suitability in his forested area as an understory crop. On his capacity to plant it, he added: *"Many farmers are already planting that [cacao] here so I think I can also do it... but with government assistance, the better."* He reached elementary grade. Although his source of income is farming alone, his household members have other works (i.e. son works at the banana plantation).

<sup>87</sup> For example, F07, a female-farmer whose main source of income is farming plant sweet potato but when asked for her preferred crop, she said: *"Corn. Plant tomatoes. We will plant many vegetables if we have sufficient capital."* She added: *"We cannot afford these because we don't have money to buy fertilizer, chicken dung. They will never grow without chicken dung."*



acquired skills or training, or they are engaged in business using their wider economic and/or social connections. Such farmers may have less focus or time allocated to farming since their main source of income is not farming. Alternatively, they may be renting land to grow high-value crops (e.g. cassava, hybrid corn), but since their preferred land use is tree-based, they are unable to change land use. This is prevalent in Plaridel and Malagana where land renting is common amongst farmers with higher income and higher educational attainment and who have diverse livelihood activities. Finally, slightly fewer farmers with high educational attainment have CTC (69%, Group D in Figure 7.15. ) than the poorly educated group (Group A). Although they have diverse livelihoods, they may rely on hiring labour. Even if they are only renting land, they may simply want to change to agricultural crops within their current production system. The risk of changing crops or land use is less as they have other sources of income.

**Table 7.6 Farmers' CTC as influenced by education in Cabulig watershed**

| Type of farmer                                                         | Number     | %         | % of educational group |
|------------------------------------------------------------------------|------------|-----------|------------------------|
| Low education with the capacity to change (Group A in Figure 7.15)     | 102        | 42        | 78                     |
| Low education without the capacity to change (Group B in Figure 7.15)  | 29         | 12        | 22                     |
| <i>Total with low education</i>                                        | <i>131</i> | <i>54</i> | <i>100</i>             |
| High education with the capacity to change (Group D in Figure 7.15)    | 77         | 32        | 69                     |
| High education without the capacity to change (Group C in Figure 7.15) | 34         | 14        | 31                     |
| <i>Total with high education</i>                                       | <i>111</i> | <i>46</i> | <i>100</i>             |
| Total                                                                  | 242        | 100       |                        |

Source: HH survey (2016)

With this influence of educational level to farmers' capacity to change land use, the future trend will mostly likely have younger farmers in Cabulig becoming more educated, at least complete Junior High School, with the government's 4Ps that provides cash grants to poor families to improve education among others (see Chapter 4.4.1). With more skills, they may have more diversified livelihood activities, including non-farm related activities. Farm labor will be a limiting factor to agricultural production; hence, farmers may invest on farming systems that are not labor intensive, such as those dominated by perennial, fruit or timber trees. Such trend may result to a new group of farmers that are more educated with more diversified livelihoods leading to a combination of A, C and D in Figure 7.15.

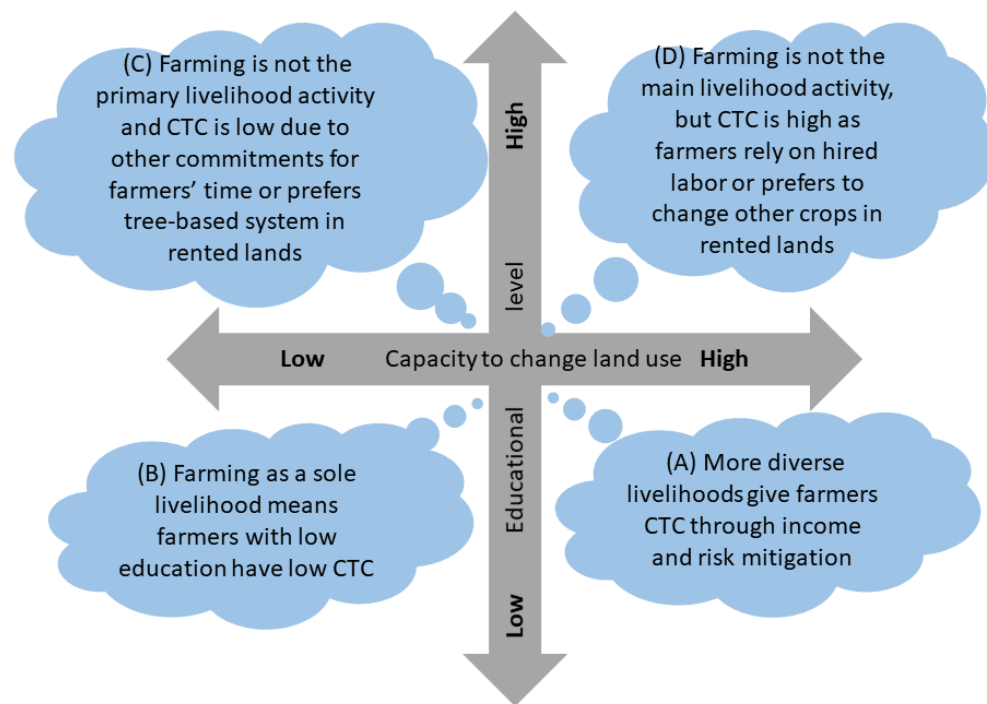


**Figure 7.15 Hypothesised farmers' livelihood activities in Cabulig watershed and the relationship between their education and capacity to change land use.**

### **Model sensitivity**

Farmers' CTC land use is influenced by *available financial capital* and *reasons*. It is a binary variable with the states 'yes' and 'no', where 'yes' corresponds to farmers having the capacity to develop their preferred land use and crops (179 of the 242 survey respondents) and 'no' means that the farmers do not have such a capacity (63 of the survey participants). All variables are unconditioned in Figure 7.13, reflecting the current situation across all surveyed households where about 74% claimed they have the CTC land use; while the remaining 26% said they do not. The most influential variable influencing *farmers' capacity to change* land use is *available financial capital*, with *reasons* nearly ten-fold less (Table 7.7). This demonstrates the overriding importance of financial status on farmers' ability to pursue their land use and management practices.

**Table 7.7 Sensitivity of 'capacity to change' to a finding at another node**

| Variables                   | Mutual information |
|-----------------------------|--------------------|
| Available financial capital | 0.3864             |
| Reasons                     | 0.0409             |
| Education                   | 0.0084             |
| Farming aspiration          | 0.0009             |
| Health                      | 0.0006             |
| Village                     | 0.0003             |

### 7.3.2 Scenario: Improving the financial capacity of farmers

Two simple scenarios for farmers' CTC land use are explored based on the importance of *available financial capital* and *reasons* (Figure 7.14). The first scenario is pessimistic where no farmers have available financial capital (akin to the survivalists in Chapter 6). The second, optimistic scenario has financial capital available to all farmers (the prosperous in Chapter 6). Given the relatively small data set, the analysis considers the aggregated situation for all the study villages across the Cabulig watershed.

Under the pessimistic scenario, farmers' CTC is negligible (2%). The proportion for whom the availability/cost of inputs is the reason increased by 11 to 23% mainly at the expense of those concerned with profitability (Table 7.8). The results in Chapter 4.2 indicate that financial holding is a major instrument of production, which gives farmers capacity to buy inputs to cultivate lands and/or hire labour with further capital. Under the optimistic scenario, farmers' CTC land use is likely to increase (74% to 92%) with the pattern of *reasons* similar to the current situation. This result appears to contrast with findings in Chapter 6 that well-off farmers consider environmental protection. However, looking at the HH survey, only 3 of 242 farmers with CTC have not adopted any form of conservation practice. The majority have adopted soil protection, planted trees, or both, which might indicate that farmers already understand the interconnectedness of environmental protection and long-term productivity, but primarily see such measures as ensuring their profitability.

**Table 7.8 Farmers' capacity to change land use in Cabulig watershed as influenced by available financial capital**

| Variable                    | State            | % Likelihood under different scenarios |             |            |
|-----------------------------|------------------|----------------------------------------|-------------|------------|
|                             |                  | Current                                | Pessimistic | Optimistic |
| Available financial capital | Yes              | 80                                     | 0           | 100        |
|                             | No               | 20                                     | 100         | 0          |
| Reasons                     | Inputs           | 13                                     | 23          | 12         |
|                             | Food consumption | 5                                      | 7           | 6          |
|                             | Profitability    | 71                                     | 62          | 71         |
|                             | Environment      | 11                                     | 8           | 12         |
| Capacity to change          | Yes              | 74                                     | 2           | 92         |
|                             | No               | 26                                     | 98          | 8          |

## 7.4 Discussion

This chapter integrated the data and knowledge gained in Chapters 4, 5 and 6 into two BN models that were used to explore potential interventions designed to affect land use change in the Cabulig watershed. The use of the SLA framework in developing BN models of farmers' WTC and CTC land use decisions revealed various significant factors representing the human, natural, social and financial capital dimensions. With the BNs' capacity to integrate both quantitative and qualitative

data, the models were able to use both the HH data and information from the KIIs. This enabled exploration of the interaction, influence and causality of variables as provided by the evidence.

### 7.4.1 Model development and performance

The BN models provided simple graphical maps of farmers' WTC and CTC land use in Cabulig watershed, which enabled exploration of relationships between and among significant variables and the logic of trade-offs or effects. The WTC and CTC BN models were intended to be combined into one but this was not done to reduce the complexity of the models, especially given the smaller data set available for the CTC. In the BN for farmers' WTC, *current land use* is the most influential variable followed by *access to extension* and *skills*. These factors differ from the results of the regression modelling done in Chapter 6.2.4 where the most significant factors for WTC are farmers' farming aspirations, slope, and perceived risk of being affected by typhoons, which cover cognitive processes and natural assets. The difference can be attributed to the analytical methods used (Zong et al., 2013), where in a BN the variables being in the network means that a change in one influences all other variables. This differs from the rules in regression, which assumes that when a variable changes, all other variables remain the same.

The BN for WTC's most influential factors are broadly in agreement with previous studies, indicating the importance of natural, human and social capitals in changing crops and land use systems amongst farmers in developing countries (Karki et al., 2011; Liu et al., 2018; Mwangi & Kariuki, 2015); although no study was found that specifically identifies these three factors together. Aside from contextual factors, this difference may also be attributed to the methods applied because previous studies used conventional statistical tools while this study employed the BN approach that can identify and explain the interactions between and among linked variables. Another potential reason is the use of different indicators and/or conceptual frameworks in understanding key aspects of farmers' land use decision making so that direct comparison with significant factors from previous studies is not possible.

The farmers' CTC model emphasized the critical need for financial capital, as represented by the *available financial capital* variable. Farmers who claimed they have the capacity to change land use have better livelihood conditions, as reflected by their diverse livelihood activities. Having a diverse income source reduces the risk of changing crops or land use system. Moreover, *education* is influential with lower education matched by an increased likelihood of CTC, which can be attributed to focus on developing the farms and time availability for farmers to change crops or land systems that also require new knowledge and skills. This result contrasts with much of the literature where education, among other factors, was positively correlated with adoption of specific land use and management practices in Africa (Kassie et al., 2015; Teklewold et al., 2013). It is important to note that in this result, greater educational attainment affects farmers' ability to focus on their farms and availability of time for what they regard as a supplemental livelihood.

This context of education supports the study in Tanzania where years of education significantly influenced the fisherfolks' willingness to engage in aquaculture; hence it was suggested to policymakers for long-term investment to drive aquaculture uptake (Slater et al., 2013). Although education is generally low in both countries, farmers with higher education in Thailand would plant more perennial crops while those in Vietnam would diversify their crop portfolio (Nguyen, 2017). Meanwhile, these two variables are consistent with the results of the regression model for CTC in Chapter 6.3.5 where available financial capital and education (human capital) together with land use values and reasons emerged as the most significant factors.

### 7.4.2 Scenario analysis

The scenarios concerning access to extension show that improving extension may increase villagers' WTC land use, especially in villages currently with the poorest access to extension as in the case of Luna. Those farmers willing to change generally want to change crops within an agricultural system, with a small minority wanting to adopt agroforestry. Those agroforesters willing to change are split almost evenly between those wanting to improve their agroforestry system with the addition of more trees and those wanting to switch to agriculture. In all cases, the main motivation for not changing was the cost or unavailability of inputs, whereas that for changing was improved profitability.

Improving the availability of financial capital is likely to increase farmers' CTC land use. The motivation is mainly profitability. This reflects the current livelihood status of most farmers in Cabulig as 'survivalists' (Chapter 6.2). Although environmental protection is closely linked to economic development, it is only by ensuring economic benefits for farmers that sustainable land use and watershed management can be achieved, a finding supported by Poppenborg and Koellner (2013).

The BNs developed were used primarily to explore the possible impacts of better access to extension services and available financial capital as interventions to farmers' WTC and CTC land use, respectively. Although the scenarios were coarse representations of social and economic interventions, the extreme pessimistic and optimistic scenarios highlighted some opportunities and risks for real-world management interventions. Improving access to extension in the WTC model unsurprisingly suggests an increased probability of farmers' WTC land use. However, the risk associated with this is that there may be an expansion of agricultural land use at the expense of agroforestry. This reflects the current extension works in Cabulig where the focus is the development of high-value agricultural crops (government extension on hybrid maize) supported by commercial inputs (seeds and chemical companies) and/or plantation crops (corporate plantation companies). With the limited (or lack) of agroforestry extension services, farmers' inclination is more towards agricultural land use.

The results are highly relevant to government, NGOs, and other interest groups involved in land use and management in the region, particularly concerning the impact of extension on WTC. Improving farmers' access to extension may act against policies to protect the watershed if the extension is not properly integrated with such policies. If extension simply focusses on better agricultural crop production, it could further endanger the integrity of the watershed by encouraging farmers to move from agroforestry to agriculture to increase profit. It is not enough to simply improve access to extension services, existing programs need to be redesigned and integrated with natural resources management policies. There is a need for more balanced, holistic extension work that considers both farmers' economic progress and environmental sustainability. Previous studies have identified the feasibility of agroforestry system of meeting these twin goals in upland watersheds (e.g. Miller et al., 2019).

### 7.4.3 Implications for practice or further research

One advantage of BNs is that they readily support the integration of local knowledge into model-based research, particularly in setting assumptions between and among nodes or variables. That said, some issues were encountered in this study when populating the models with HH data. It is important to note the multiplicative nature of conditional probability tables in a BN such that any increase in the number of states for parent or child variables (see Box 3.1 in Chapter 3.5.5), increases the number of possible combinations – and thus the data requirements to capture each combination – in a multiplicative manner. Cain (2001) argued that there should be at least 20 cases for each combination of states of the parent nodes, which was not achieved for all variables in both BN models. This is a challenge in social science, particularly in IA applications of BNs (Merritt et al., 2016; Ticehurst et al., 2011). In this study, some relationships in the WTC model were simplified by deleting links that the outcome variable was not sensitive to. This was required even more so in the CTC model because the reduced number of cases for the CTC model (226) was insufficient to parameterize and use the more complex model.

The relationships represented in the two BNs do not necessarily indicate causation. The structure simply reflects the underlying understanding or hypotheses about causality arising from the research. Some explanations for variations were probably not captured in the HH survey and these could explain some of the variability in the *village* variable. Analyzing the model may give some indication of whether such understanding is warranted or implies the need to acquire more data or information.

Neither model is intended to be used as a predictive tool, but instead to explore assumptions and potentially spark discussions amongst stakeholders about interventions.

#### 7.4.4 Strategies for improving BN models

Even though BNs can readily integrate different types of data from diverse sources (Slater et al., 2013; Ticehurst et al., 2011), it would be preferable if data collection were framed or acquired based on the model structure and definition of the variables. In this research, this strategy would have required the HH survey, in particular, to be conducted after the influence diagrams were developed from the analysis of the KIIs and focus groups. It would have helped ensure the data collected was tailored to test the hypotheses about causality or correlation built into the model, as well as to provide sufficient cases to develop robust model relationships.

Such a solid data foundation would result in more robust models with the expected outcomes or outputs more useful as a discussion support tool with stakeholders. Considering that stakeholder engagement is one of the BN's strengths (Voinov & Bousquet, 2010), the models and the scenario results could also be further improved through evaluation involving farmers, policymakers and experts in different discussion venues. Such stakeholders can provide suggestions on how to improve the models, particularly on the importance of different variables and the underlying assumptions of their relationships to others. They can also help identify other potential social interventions that might improve farmers' WTC and CTC to better land uses.

However, in this study it was not possible to conduct the HH survey after the KIIs and focus groups as this would have required a third field trip after the reconnaissance trip and the primary data collection (see Figure 3.1 in Chapter 3). This was not possible within the constraints of a Ph.D. research program. The result is that some questions in the household survey were not used in the BN modelling or response categories and some of those that were used were not as informed as they might have been.

### 7.5 Conclusions

This chapter has highlighted the relevance of integrated approaches in untangling the complex decision making processes of human behaviour in land use (Hamilton et al., 2015; Jakeman and Letcher, 2003; Kelly et al., 2013). Applying the SLA framework in the BN has shown its potential for linking environmental, societal and cognitive aspects of farmers' land use decision making by integrating qualitative data from KIIs and focus groups with quantitative data from the HH survey from multiple sources that include farming households, farmer leaders, policymakers and experts. Local knowledge in the case study site can help in building the assumptions underpinning the interactions in the models. The more time that can be devoted to this process, the greater the depth of system understanding that can be gained. While the developed models are static, reflecting the time of data collection, farmers' decision making is often dynamic. Hence, they should be used with caution as tools to highlight possible outcomes (good or bad) and promote testing or

challenging existing assumptions. In the case of land use planning in watershed management, key findings should promote further discussion to develop better options and decisions.

It is important to consider the BN results within the broader understanding of the factors influencing land use decisions and actions developed in earlier chapters. This not only considers the current situation and the drivers influencing it, but also the near and far past (Chapters 4 and 5) and the future (Chapters 6 and 7). As this study considers farmers' aspirations as well as those of external stakeholders at different levels and scales (Chapter 6), the next chapter aims to draw the whole picture of land use and management in the Cabulig watershed.



# Chapter 8: Understanding the dynamics and complex web of land use and livelihoods of upland watersheds: A discussion

## 8.1 Introduction

This research has analyzed factors influencing land use and livelihood change in upland watersheds in the context of a developing country case study. It has shown that to achieve sustainable land use and watershed management, emphasis on the inclusion of both farmers and external stakeholders' aspirations is critical, as is better integration of biophysical, environmental and socio-economic aspects.

This chapter synthesizes the key messages that emerged from Chapters 4 to 7 where each investigated one of the four research questions for this thesis. These questions include:

- What are the current land use and livelihood conditions and trends? (Chapter 4)
- What factors drive land use and livelihood change? (Chapter 5)
- What future do farmers and other stakeholders want, and what are the ways they identify to achieve this future? (Chapter 6)
- Are the farmers willing to change their current land use? If they are, do they have the capacity to adopt more appropriate and sustainable land use? (Chapter 7)

Section 8.2 summarizes the main findings of each chapter, while Section 8.3 discusses five key themes and their implications in managing upland watersheds from developing countries. Section 8.4 concludes this chapter.

## 8.2 Key messages

Chapter 4 examined the current land use and livelihood conditions in the Cabulig watershed based on the proposition that land use and livelihoods would be rapidly changing even in remote and marginal parts of the upland watersheds. The key findings from this Chapter, listed in Table 8.1, highlight that the landscape is transitioning to an intensive agriculture-based system, often with land uses that are not suitable for the landscapes, with diversifying livelihoods. Economically and environmentally sustainable farming-based livelihoods are challenged by decreasing land size, economic constraints, and little effective support from external stakeholders, especially government and non-government organizations, private companies and academe among others.

**Table 8.1 Findings for Research Question 1 from Chapter 4**

| Main findings                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <ul style="list-style-type: none"> <li>• The Cabulig watershed in the southern Philippines follows the general trend for many developing countries reported in the literature on land use transition. This transition is from swidden agriculture in the forest to permanent smallholder farms, and then to extensive and intensive commercial and plantation production systems (Section 4.2).</li> <li>• In many cases, farmer land uses are not suitable for their landscape position under current management systems and most crops, even if the best management practices were being used, which is generally not the case. For example, corn is marginal or unsuitable on the slopes of gorges along the Cabulig River due to slope, rockiness, and shallow soil depth that is prone to soil erosion. This demonstrates how marginal and fragile agriculture is given the difficult biophysical conditions in the watershed (e.g. topography, slope, soil acidity) (Section 4.3).</li> <li>• Farm size is decreasing due to inheritance, and for some farmers because of land pawning and/or renting. This decrease has resulted in fragmentation of lands and heterogeneous land uses. With smaller areas, farmers prioritize cultivating agricultural cash crops to sustain daily needs over both long-term crops (e.g. trees) or production systems that integrate trees (e.g. agroforestry) (Sections 4.4.1 and 4.4.2).</li> <li>• Incomes are transitioning from mostly farming activities to more diverse livelihood activities. Most farmers now rely on off-farm and non-farm employment and maintain their farms primarily to meet consumption needs (Sections 4.4.1 and 4.4.2).</li> <li>• Many farmers have limited access to extension services, and collective actions have also declined over the years with the waning presence and activities of non-government organizations (Sections 4.4.1 and 4.4.2).</li> </ul> |

Chapter 5 analyzed the factors that drive land use and livelihood change at the watershed level, and the determinants of farmers' land use decisions and livelihood strategies at the farm level. This analysis was based on the premise that rural development has varied effects on farmers located in different areas of the Cabulig watershed, as well as on different groups within the farming community. At the farm level, it was hypothesized that farmers' response to changes is determined by their livelihood capital, particularly land, labour and finances. The key findings from this chapter are presented in Table 8.2 and emphasize that although the drivers that influence land use and livelihoods across the watersheds are similar; the changes and impacts differ based on geographic location in the watershed and also between farmer groups.

**Table 8.2 Findings for Research Question 2 from Chapter 5**

| Main findings                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <ul style="list-style-type: none"> <li>• The drivers that influence land use and livelihoods are similar across the watershed (i.e. governance, agricultural change), but the magnitude of changes and impacts differ with geographic location over time. (Section 5.2)</li> <li>• The determinants that drive farmers' land use and livelihood decisions are their lands' natural characteristics; land ownership, financial and human resources; and their values, knowledge, and aspirations. (Section 5.4.1)</li> <li>• Land use and livelihood outcomes needed and desired by farmers have changed over the years due to lifestyle preferences, increasing cost of living, and declining viability of farming livelihoods. (Part of Section 5.4.1)</li> <li>• Policies, institutions and processes influence access to and distribution of livelihood resources. (Section 5.5.1)</li> <li>• Access to and control of livelihood resources determine farmers' meaningful participation in a plantation economy. (Section 5.5.2)</li> </ul> |

Chapter 6 investigated the farming future that farmers in Cabulig watershed aspire to and whether these aspirations match the aims of external stakeholders, including policymakers and natural resource managers as informed by researchers. Based on the current land uses and livelihoods in the watershed, it proposed that there is a gap between the aims of farmers and external stakeholders and that this gap is not being addressed by the service provisions to farmers by external stakeholders. For example, while the farmers from the household (HH) survey and key informant interviews (KIIs) shared land use preferences that are agriculture-based, this differs from the external stakeholders whose land use aspiration is agroforestry and/or tree-based. The key findings of this Chapter 6 are shown in Table 8.3 and show that many of the farmers' aspirations are focused on short-term economic issues, driven by their need to survive. Their land use and crop preferences are different from those of the policymakers and researchers. Many of them are unwilling to change their land use although they can do so.

**Table 8.3 Findings for Research Question 3 from Chapter 6**

| Main findings                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <ul style="list-style-type: none"> <li>• Farmers' pursuit of survival influences their farming activities and future aspirations; economic drivers are the most influential. (Section 6.2)</li> <li>• Farmers preferred land uses and crops differ from those of external stakeholders. (Section 6.3)</li> <li>• Farmers' (un)willingness to change land use is affected by the diversity of livelihoods, ethnicity, range of skills, access to extension services, farming aspirations, the effect of typhoons and droughts, and slope. (Section 6.2.4)</li> <li>• The most significant factors influencing farmers' (in)capacity to change land use are available financial capital, education, land use values and motivations. (Section 6.3.5)</li> <li>• Many farmers unwilling to change their current land use are the ones with the financial capacity to do so. (Sections 6.2.4 and 6.3.5)</li> </ul> |

Chapter 7 investigated the farmers' willingness to change (WTC) their current land use, and their capacity to adopt more appropriate and sustainable land uses based on the proposition that many of them would be unwilling to do so and will not have the capacity because of their limited livelihood assets. The key results of this chapter are listed in Table 8.4, which emphasizes the importance and interactions of several factors from biophysical, environmental and socio-economic aspects, and cognitive processes. Methodologically, it also affirms the capacity of the Bayesian network in integrating qualitative and quantitative types of data from multiple sources, resulting in simple graphics (models) that can easily be understood and readily inform trade-off analysis.

**Table 8.4 Findings for Research Question 4 from Chapter 7**

| Main findings                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <ul style="list-style-type: none"> <li>• Livelihood assets of farmers, namely financial (current land use), cognitive processes (reasons), and social (access to extension services), influence their willingness to change (WTC); while their capacity to change (CTC) land use is affected by financial (availability of financial income) asset and cognitive processes (reasons).</li> <li>• Improving extension services to farmers increases their WTC their land use activities but the right kind of extension is needed to balance their reasonings between income and environment, thereby ensuring the adoption of sustainable land uses.</li> <li>• Providing financial assistance to farmers increases their CTC land use but the scale may be affected depending on the diversity of their livelihood activities.</li> </ul> |

## 8.3 Discussion of key themes

From Table 8.2, five main themes emerged, which are discussed in this section and related back to the literature.

### 8.3.1 Diversity in land use and livelihood capitals needs to be incorporated into planning

*Heterogeneous landscapes and livelihood capital frame the current different land uses and livelihood strategies and trends (Chapter 4):* Given its complex biophysical condition, there was a high variation of current land use activities across the landscapes of the Cabulig watershed. This was demonstrated by the differences in production systems, dominant crops, and cropping patterns by physiographic units, which were sometimes even evident within physiographic units, as influenced by landforms, position and slopes. Aside from these natural attributes, the remoteness and other socio-economic factors such as transportation, politics, community acceptance of change, and the peace and order situation were also important. However, it was also found that many of the current land uses and crops were occurring in areas of the watershed to which they were not suited with imminent negative consequences, particularly soil erosion and soil nutrient decline; not to mention the secondary, off-site effects on the wider downstream community, namely sedimentation, poor water quality, and intensified run-off increasing the risk of flooding and landslides. These impacts were compounded by limited land use options and poor farming practices as observed by Cramb (2005) around Asia.

As in many upland watersheds in China and some developed countries in Europe and Canada (Wang et al., 2016), smallholder farmers by and large comprise the farming communities in Cabulig watershed. The assessment of their current livelihood capitals (i.e. natural, financial, physical, human, social) revealed a high variation across the studied villages. This variation influenced their land use and livelihood strategies. There was heterogeneity within farming households (e.g. ethnicity, gender, age) in terms of their assets. For example, land ownership varied by ethnicity and age where lands of the Higaonon tribe were larger than migrants; and older farmers owned larger areas of land than younger ones. The actual areas being cultivated were rather small for both Higaonons and migrants, but smaller for the younger ones compared

with the older farmers. This decreasing farm size in Cabulig is evident across Asia and is putting smallholders at a disadvantage in the economy (Otsuka et al., 2016). This has moved farmers to prioritize the cultivation of crops that provide immediate cash over long-term crops like trees. Another strategy has been to rent or sell their lands, which may affect long-term land use and management because of the new landowners' lack of affinity, identity, values for the land, and different knowledge and skills for farming (Douglas, 2006). As in Africa (Vanlauwe et al., 2014), it was also found out that many farmers in Cabulig depended on off- and non-farm livelihood activities for income where many work on larger farms as daily paid labourers, while maintaining their own farms mainly for consumption (e.g. corn as staple food). This is expected with the declining farm productivity and profitability – farming is no longer economically viable so that farmers have had to diversify their livelihood activities. Farmers with diverse livelihood activities were more economically secure, another finding reported in the literature (Loison, 2015; Mahdi et al., 2009). For many farmers with limited education, skills and livelihood options in the watershed, the only alternative is to work as farm labour.

The combination of some or all these land use and livelihood capitals influenced farmers' trade-offs between livelihood security and land use sustainability, which have implications on the future development of Cabulig watershed. Development interventions from both government and the private sector should consider the heterogeneity of landscapes and farming households in designing programs and projects. A diverse landscape such as Cabulig needs various land use and management options suitable in specific areas and contexts; while varied farming households have different needs and aspirations that influence their decisions and strategies. Watershed plans, programs or projects that do not blanket the multiplicity of land uses and farmers' capacities can be a way forward, but are only be possible with robust land evaluation involving soil and watershed characterization and land suitability assessment. While this requires financial and technical investment, it can provide science-based information that can guide watershed planners and land managers, including farmers, in making better land use decisions and livelihood strategies. Notably, this diversity in land use and farmers' livelihood capitals is not only complex but also dynamic in nature as they respond to different drivers of change.

### **8.3.2 Pro-poor land use and livelihood development programs need to consider farmers' capacity to participate**

*Land use and livelihoods transformation in upland watersheds is driven largely by external socio-economic factors (Chapter 5):* The Sustainable Livelihood Approach (Chambers & Conway, 1991) was used to guide the design and analysis of the KIIs to establish the drivers of land use and livelihood change in the Cabulig watershed. This revealed that the key drivers were external socio-economic factors. These drivers included demographic changes, governance relating to policies and institutions, the impact of globalization in expanding the plantation economy that is

transforming the agricultural systems and triggering industrialization, and climate change. The growing population resulted in the intensification and expansion of agricultural production even in marginal forestlands as more land was required to cultivate food and generate income. This pattern broadly reflects the land use transition observed in Vietnam caused by the interrelated negative socio-ecological feedbacks and socio-economic dynamics where several wars depleted the country's forest resources while the increase in population resulted in the reduction in fallows, soil erosion in sloping areas and a shortage of arable lands for shifting cultivation (Lambin & Meyfroidt, 2010). Similarly, the logging operations and insurgency contributed to the forest degradation in Cabulig. Although with the insurgency, the response was different where the evacuation of communities enabled forest and land restoration with less cultivation for some years. However, the increase in population after the insurgency also resulted in shorter fallow periods (or none) and, in the absence of appropriate practices for cultivating steep areas, soil erosion leading to land degradation, and the reduction of farm productivity and income.

While legal expansion to 'new productive' lands was restricted with the enactment of forest policies, particularly in the Mt. Balatukan and Mt. Sumagaya protected areas, this has been overridden by poor enforcement under the pressure to intensify commercial agriculture by its integration into markets as part of the broader socio-economic dynamics of globalization, including the liberalization of agricultural markets and development of plantation economies. In many developing countries, globalization has triggered forest conversion into corporate plantations and mono-crops. For example in Ghana and Mexico, trade liberalization and reforms opened their agro-industrial sector, which triggered forest conversion and land degradation from unsustainable production systems (Lambin et al., 2003). Land degradation continues as a result of political and institutional issues, such as poor planning compounded by lack of reliable information, limited extension services due to lack of resources, or simply lack of political interest to improve land use and management.

Similarly, in Cabulig, recent developments seemed to prioritize economic development even on lands designated as protection and/or production forest zones. Some of these 'protected' areas are cultivated for corporate plantations to supply raw materials for pineapple, banana and tobacco as well as corn, cassava, and other agricultural mono-crops to provide for the local market. In this context, there are two emerging drivers. First is the expansion of farming by smallholders, mainly monocropping corn, vegetables, and others into more and more marginal lands, and second, the (latter) expansion of corporate plantations into some better land (possibly encouraged by the road improvements). The former is driven by population growth whereas the latter is by national and international markets.

Contrasting these two drivers is important. Even though the smallholder farmers may cause much of the land degradation, they being concentrated in more marginal lands, they may not have the

resources to address degradation. The plantation companies, on the other hand, do have the resources for good land management, and they tend to be on the more suitable land. For example, most plantations carry out liming to correct soil acidity. This can be beyond the financial resources of a smallholder farmer. Also, plantations are bringing previously cropped land that has become degraded (e.g. through acidification or nutrient decline) and unprofitable back into production. Local government units (LGUs) have the political capacity to capitalize on these companies' resources to ensure the companies minimize the associated environmental effects and socio-economic risks of their operations. However, environmental and social safeguards are often not prioritized by some LGUs that are driven predominantly by economic priorities. Not surprisingly, farmers were also driven by income and typically were using their land resources even if it would only provide short-term benefits.

This research exposed differential benefits amongst farmers from this plantation economy. It is mostly farmers with larger land areas, who either rented out their lands or themselves converted their farms into plantations, that participated and benefitted from existing arrangements. Farmers with smaller land areas or limited livelihood capitals are mostly influenced by local drivers, such as their farms' biophysical conditions, their available land, financial capital and labour, and their values, experience, knowledge and aspirations. This result highlights the importance of diversity and local contexts, which aligns with cases in Southeast Asia where farmers responded to family circumstances and to local economic opportunities to provide for their families. Although their importance vary from one situation to another, some determinants to farmers' adoption in soil and water conservation measures include concern on water and nutrient loss, invest on activities where they have available resources like land and labour, prefers gradual approach than one-off investment, invest individually than as part of a group, and learning from neighbours (Douglas, 2006). These can be intervened by quasi-political factors as local leaders.

The environmental and socio-economic effects of both external and internal factors might be mitigated by comprehensive land use and watershed management plans developed together by the farmers and external stakeholders. However, this requires more discussion and capacities to influence these drivers to help the former improve their land use and livelihoods. Participatory land use planning (PLUP) is one approach that provides negotiation support platform with the use of innovative tools and methods such as role play games, participatory 3D modelling, and participatory GIS among others. These allow farmers to explore the consequences of their land use decisions and choose between alternative future landscapes. Bourgoin et al. (2012) found this PLUP approach effective in their action research in Laos where they used an integrative communication platform that combined local and scientific knowledge. They argued that providing a venue to communicate and negotiate land use plans and development scenarios enabled participants to reach better agreements as reflected in their management plans. Some recommendations on how to improve landscape planning in the Cabulig are made in Chapter 9.

### 8.3.3 Rural development needs to understand and respond to farmers' aspirations and well-being

*Aspirations and well-being are important social determinants of land use and livelihood change and development (Chapter 6):* Understanding the well-being and aspirations of farmers and their household members is important for designing development programs that can improve farming livelihoods and encourage the uptake of sustainable land management practices. The study revealed that farmers' aspirations are mainly motivated by their wish to earn enough income to support the household basic needs of food, shelter and clothing, and recently, with the government's cash subsidy, their children's education. This result is not surprising as such financial aspiration is also common in many upland watersheds in many developing countries because of poverty. This aspiration is influenced by farmers' poor livelihood capitals (Apparudai, 2004) and has implication on farmers' decisions that may affect their land use and livelihoods.

In fact, farmers' reliance on household consumption and short-term income are already reflected in their choice to grow food crops, particularly corn and vegetables. Government, policymakers and development practitioners who want to achieve land use change and the reversal of the current unsustainable management practices in upland watersheds need to develop interventions that also improve farmers' livelihood capitals, particularly financial capital. One option is to provide strong economic incentives and rewards to appropriately modify the decisions of farmers, for example farmers' preference in southern Philippines for indirect incentives, such as continuous training and capacity building and NRM-based livelihood projects to enable adoption and investment on sustainable farming systems (Catacutan and Duque-Piñon, 2009). Such incentives and rewards may move farmers to aspire more to free themselves from the 'behavioural poverty trap', which is a situation where poverty reduces some aspects of their skills (Dalton et al., 2014). However, some farmers may want to be independent and may not accept incentives if they come with risks or consequences. As such, government, policymakers and development practitioners need to be careful in giving incentives, especially those that are short-term and usually do not lead to long-term positive changes.

Amid these land use and livelihood changes, the impacts on children and youth were significant in Cabulig. Farmers invested in their children's education: in some cases, the land was used as collateral, which under the worst scenario was subsequently foregone. This resulted in outmigration with children working in cities and abroad, and with farmer parents depending on remittances. As Sugden and Punch (2016) identified in the upland regions of Vietnam, India and China, the emphasis of farmers is on the education of their children, not on agricultural and forest development. This puts the burden on the older HH members who remain, whilst younger members go to school/college/university and then migrate to cities or overseas to work. They do not have the financial or personal capacity to invest in fully developing their farms. In the process, they are moving away from natural resource-based livelihoods, which results in the loss of



valuable traditional ecological knowledge. This may be addressed in two ways: developing farming systems that require less labour, which may affect sustainable production, or making farming viable to youth by encouraging options, such as agroforestry, that include local processing and value-adding activities of farm products. The latter may encourage rural youth to remain by diversifying incomes or capturing greater value from farm production.

The findings also revealed a gap between the land use and crop preferences of farmers and external stakeholders. Although there was a general agreement on crop preferences (e.g. corn, fruit trees), farmers generally favoured agricultural land uses, whereas external stakeholders prefer farmers to adopt and invest in agroforestry/tree-based systems (fruits, exotic, industrial trees). Although some of the farmer informants favoured agroforestry, given their knowledge of crop suitability and the role of agroforestry in watershed protection, in practice their economic need for cash crops and household food production determines their final choice. Thus, the policymakers' and experts' preference for agroforestry/tree-based systems do not correspond to farmers' land use aspirations. Reducing this discrepancy is the first step to reconciling this gap and building synergies. This requires effective extension services that provide farmers with more and better land use and crop options. The challenge is that no agency in government focuses on advocating for (or being knowledgeable about) agroforestry, and thus failing to provide suitable agroforestry extension.

### **8.3.4 Enhance farmers' willingness and capacity to adopt and invest in suitable land uses and crops**

*Improving extension service delivery and financial capital may enhance farmers' willingness and capacity to adopt and invest in better land uses and suitable crops; while considering their motivations is also as important (Chapter 7):* In this thesis, suitable crops not only refer to the ability of a given type of land to grow a particular crop but also considers the socio-economic circumstances of farmers to provide labour and farm inputs, availability of market, and other contexts. The current status of farmers' land use systems reflected their livelihood capitals' condition. There were farmers who were willing and had capacity to adopt better land use. Some were willing but were unable because they cannot do so while others can adopt appropriate land uses but were unwilling because of different livelihood aspirations. Using a Bayesian network approach, Chapter 7 aimed to understand the factors influencing farmers' (un) willingness and (in) capacity to adopt and invest in better land uses. The model structures were developed from the KII conceptual diagrams, and the significant variables identified from the regression models developed using the HH survey. The models revealed that farmers' *current land use*, *access to extension* and *skills* were important factors that informed their WTC land use. This shows that benefits, whether economic, environmental or socio-cultural, derived from a land use frames the reasonings that drive their decisions on changing the current system or not. On the other hand,

farmers' capacity to change (CTC) land use depends on the *availability of financial income, reasons and education*. Meanwhile, farmers' cognitive processes, particularly their reasoning or motivations that includes inputs, food consumption, profitability and environment, was also a considerable factor as it encompasses both WTC and CTC models. Influenced by their needs, interests, and aspirations among others, it is a critical factor that frames farmers' decisions on their land use.

The BNs developed were also used to explore the possible impacts of better access to extension services and financial capital on farmers' WTC and CTC land use, respectively. Using optimistic and pessimistic scenarios of these social interventions, the effects revealed a pattern among the study villages in Cabulig watershed. Villages with currently low access to extension have a higher probability of farmers willing to change their land use under an optimistic scenario (improved access to extension). This reflects the current extension works in the watershed where the focus is on the development of high-value agricultural crops (government on hybrid maize) supported by commercial inputs (seeds and chemical companies) and/or plantation crops (corporate plantation companies). Farmers have been exposed to these ideas but the same is not true for agroforestry extension services. This limited (or absent) extension service may explain why farmers are not inclined to switch to agroforestry. This supports the study of Lemma et al. (2016) in Ethiopia where weak extension delivery relates to farmers' generally limited access to advice, training and linkage facilitation support on market information, storage, processing and marketing of products; hence they suggested promoting innovative extension service delivery systems for market oriented agricultural development.

Improving farmers' access to financial capital was by far the most influential variable in building capacity to change in the CTC model. Increased income slightly increased farmers (modelled) motivation for environmental protection, but profitability remained the greatest concern. This reinforces the earlier suggestion on the importance of developing natural resources-based livelihoods, for example, value-added activities from current farm products like food processing, wood products, non-timber forest products and others so that, with better farm income, farmers will be motivated to allocate more time and resources to farming while adopting and/or investing more on sustainable land uses and practices.

The results of the scenario analysis are highly relevant to government and development practitioners, particularly for the role of extension on WTC. It suggested that farmers do respond to the message and support from extension activities. However, expanding current extension activities may endanger the whole integrity of the watershed if more farmers shift to agricultural land use for profit because it may entail further tree removal. It is therefore argued that it is not sufficient just to expand extension services but important to implement the right extension program. This extension program should encompass both agriculture and forestry in the same area

(i.e. agroforestry systems). Millar (2009) also provided strategies on how to adapt extension approaches in the context of Southeast Asian countries, including household aspirations and cultural sensitivity, close mentoring of extension staff, and understanding the theories and practice of extension. Specific to agroforestry extension in the Philippines, Baynes et al. (2011) identified farmers' education and knowledge, comprehension and construal of written information, ability to cope with problems as important considerations to successful delivery. They also argued that extended and targeted assistance and support are necessary for farmers with low education and social position to maximise effectiveness. Agroforestry has been widely promoted in the eastern Visayan region where this study was conducted.

To be more effective and efficient with the government's limited manpower and budget, the government may also consider consolidating these two fields and create a Municipal Agroforestry Office instead. This Office could promote agroforestry and forestry in the watershed, and facilitate the adoption and investment on this land use that can meet the twin goals of economic development and environmental protection in upland watersheds.

### **8.3.5 Integrated assessment is valuable in land use and livelihood studies**

In Chapter 3, it was argued that *integrated assessment enables broader analysis of factors influencing farmers' land use decisions and practices encompassing diverse land uses and various types of livelihood capitals and cognitive aspects*. This research used Jakeman and Letcher (2003) principles of integrated assessment (IA) as the overall framework to untangle the complex decision making processes of farmers in the context of land use decisions and livelihood strategies. There are three aspects of the methodology that need to be highlighted.

First was the method used in the HH survey. As the survey was designed to complement the soil characterization study conducted by the ACIAR Watershed Evaluation project (which used digital soil mapping), it followed a geographical sampling design that ensured all parts of the landscape were sampled. This meant that the HH survey reached those farmers living in and cultivating the remotest parts of the watershed. Some of these farmers have never been interviewed by anyone, and their information made a difference to the results of the survey by including their reflections on the current condition of land use and livelihoods in these remote and marginal areas (Chapter 4). Had the HH survey been conducted, as is usual, simply according to the main centers of population where it was convenient to sample, the survey results would have given a different picture by not including those remote farmers who have never benefitted from any government program, extension services or research. Although most literature affirmed the poor agricultural extension services in Africa and Asia, some has studied the impacts of various extension models, including training and visits, farmers' field schools, and others (Baig & Aldosari, 2013; Eicher, 2007). These studies were a purposive sampling of cases with enough funds from donors and

hence overestimated the farmers' connection to service providers. The studies did not reflect the real condition of farmers' (dis) connection to extension services in terms of reach and effectiveness.

The second aspect of the methodology was the use of the mixed-method approach, where both quantitative and qualitative data from different sources are collected and analyzed for the same study (Creswell, 1999; Small, 2011). It provided greater depth and breadth in analyzing farmers' current land use and livelihood portfolios and trends (Chapter 4), in reconciling their land use preferences with those of external stakeholders (Chapter 6), and in understanding the factors influencing their (un) willingness and (in) capacity to change land use (Chapter 7). It allowed having an informed discussion, embedding different analytical methods (i.e. land transition, MA, statistics, BN) based on the information that is produced by both quantitative and qualitative data collection strategies. It likewise enabled an exploratory staging of data gathering starting with the reconnaissance study, which consequently informed the major fieldwork on the HH survey, focus groups and KIIs. These would not have been possible with the use of a singular approach. However, the whole process was time- and resource-consuming. With the bulk of data collected, it required considerable effort to draw everything together, for example, the HH survey, focus groups, and KII results in Chapters 4, 5 and 6. Integrating these and making sense of the results was challenging (Chapters 6 and 7), particularly in remaining focused on collecting only the data needed for the study and selecting the appropriate analytical methods.

Finally, the use of the IA framework proved suitable for linking biophysical, environmental, socio-economic, cognitive and uncertainty aspects of farmers' dynamic and complex decision making and livelihood strategies involving different stakeholders at various scales (i.e. field, community, watershed) and jurisdictions (i.e. local, national, international), as well as disciplines within and between natural, biophysical or environmental and human or socio-economic sciences. IA has been widely applied in developed countries, such as in Australia's water resource management (Croke et al., 2007) and Europe's environmental (Pahl-Wostl et al., 2007) and agricultural management (Ewert et al., 2009). An integrated approach is critical in the broader context of sustainable land use and watershed planning, management and development which requires an inclusive and holistic approach. Failure to do so, by considering only either biophysical or socio-economic aspects of land use and livelihoods, has led to a divided understanding of the multiple issues these involve, and consequently to simplistic conclusions (Turner II & Meyer, 1991).

## **8.4 Conclusions**

This case study has shown that an IA framework using relevant biophysical, environmental and socio-economic data collected through mixed-methods was a suitable approach to better understand land use and livelihood transformation in upland watersheds. Methodologically, it

highlighted the importance of evaluating the options for this particularly challenging, ‘wicked’ issue on land use and livelihoods by understanding the current conditions and trends, the drivers of these trends, the desired land uses and livelihood outcomes of farmers and external stakeholders, and the farmers’ likely responses based on different scenarios. In the context of developing countries, Chapter 9 provides some recommendations on how to improve farmers' and external stakeholders’ land use decision making and livelihood strategies in upland watersheds.

# Chapter 9: Thesis synthesis and research and policy recommendations

## 9.1 Introduction

This thesis is an empirical study that aimed to contribute to the knowledge base on the need for watershed planners and land managers to integrate multiple sources of information – heterogeneous landscapes, farmers' land use, and livelihood capitals and their aspirations and well-being, as well as those of external stakeholders. Using the Cabulig watershed as the case study, it highlights the value of local farmers and external stakeholders collaborating on planning and develop a more inclusive concept of sustainable land use and management of upland watersheds. Using the meta-discipline of integrated assessment (IA) to frame the research, this thesis drew on the theories of rural development, land use transition, sustainable livelihoods, and sustainable land and watershed management discussed in Chapter 2 to:

- analyze the current land use and livelihoods conditions and trends (Chapter 4),
- investigate the drivers of land use and livelihood change (Chapter 5),
- explore the future that farmers and external stakeholders aspire to (Chapter 6), and
- examine the willingness and capacity of farmers to adopt and invest in more sustainable land use (Chapter 7).

Household (HH) surveys, key informant interviews (KII), and focus groups provided the quantitative and qualitative data used in content analysis, cognitive mapping, and regression modelling (Chapters 4 to 6) and the numerical Bayesian network modelling approach (Chapter 7). This mixed-methods approach was used to gain insight into how understanding the factors influencing land use and livelihoods in upland watersheds, and how they vary, is crucial to achieving desired environmental outcomes at the local and watershed scales and socio-economic outcomes for individual farmers and their communities (Chapter 8).

This chapter restates the key insights and conclusions from the research (Section 9.2) and recommends actions to address current issues in the management of land use and associated livelihoods in the watershed (Section 9.3). Recognizing the study's limitations, Section 9.4 proposes future research opportunities that may improve the knowledge and practice of land use and livelihood development for sustainable watershed management in Southeast Asian uplands and elsewhere in the tropical developing areas.

## 9.2 Key insights and conclusions

This thesis makes five main contributions to the fields of rural development, land use transition, and sustainable livelihoods.

### **9.2.1 The transition towards agriculture-based land use and diversified livelihoods vary by location**

The cumulative effects of long-term, land use trends – from swidden cultivation in forests to smallholder farming, and then into extensive and intensive commercial and plantation agriculture – have framed both the current land use conditions of the watershed and farmer's livelihood strategies. Across the watershed, which is largely agricultural, many current land use systems and crops are not suitable for the landscape positions where they are located; this is true under existing management systems and, for most crops, even with the best management practices (Chapter 4.3.1).

Livelihoods have diversified from subsistence or solely on-farm to a mix of on-farm, off-farm and non-farm activities. Farming alone is no longer feasible, especially in remote, marginal parcels of steep lands. This has led some farmers to work as farm labourers, venture into small-scale business or attempt to find employment in government and private companies in nearby towns and cities, or abroad. Livelihood activities also vary by location: farmers located near roads or towns have more diversified income sources, whereas those in remote areas depend largely on farming for survival.

The use of a land use transition framework (Foley et al., 2005) in landscape transformation and analysis of drivers (see Section 4.3.3) was found effective in understanding how environmental and socio-economic factors have influenced the changes in land use and livelihoods at different locations in the watershed. The demographic, land use, vegetative cover, and agriculture trends (and their interactions) were analyzed and discussed in Chapter 5. The effects of these trends on farmers varied by geographic location (i.e. village/s in mid- and upstream of the watershed) and between different groups of farmers (e.g. smallholder and large landholder, indigenous and migrants). Understanding the complexity and dynamics of this transformation should be a prompt for the government to adjust its policies and programs to assist different types of farmers with diverse capacities to develop their land use and livelihood strategies to adapt to the emerging conditions.

### **9.2.2 External and local socio-economic factors and cognitive factors drive land use and livelihood change**

The use of the Sustainable Livelihood Approach (SLA), and the land use transition framework to design data collection and structure the analyses in Chapter 5, provided important insights. The SLA helped document the importance of access and claims to resources in determining farmers' land use and livelihood strategies. Whilst farmers' decisions and strategies are determined by their farms' biophysical conditions, available land, financial capital and labour, and experience and knowledge, it was found that external factors also played a major role. Factors at the watershed level include demographic changes, governance relating to policies and institutions, and the shift

to a plantation economy. The shift to plantation economy has primarily influenced those farmers who have large areas of uncultivated land to either rent out or convert into plantations. Those with smaller areas or limited livelihood capitals are mostly influenced by local drivers.

Unintended impacts of current forest restoration projects, unplanned expansion of corporate plantations, and planned establishment of new hydropower plants are all emerging pressures on the watershed (see Section 5.5). The research suggests that national and local government institutions involved in Cabulig need to be cohesive and strengthened in terms of their resourcing and capacity to manage competing interests and priorities on how land and other resources in the watershed should be used and managed.

### **9.2.3 The disconnect between farmers and other stakeholders**

Two types of farmers emerged in the watershed based on analysis of their aspirations: ‘survivalist’ and ‘prosperous’ farmers. Most farmers who were part of the HH survey fall into the survivalist category and their aspirations are largely economic-driven. Their preference for agricultural crops reflects their reliance on household consumption of farm produce and short-term income. Downstream survivalists are vulnerable to extreme climate events (flooding) and their experience of past floods had influenced their preference for tree crops. On the other hand, the prosperous farmers are economically stable, have good social relations and whose land use and crop preference are towards tree-based systems.

Currently, there is a disconnect between farmers and external stakeholders to their land use and crop preferences. Decision-makers and expert key informants are supportive of the farmers’ crop preferences but not their preferred land use which is agriculture-based; decision-makers and experts preferred agroforestry and tree-based systems. This contradicts the current extension activities that are almost entirely focused on changing crops and not changing systems. Extension for agroforestry/tree-based farming systems is limited and if the government wants farmers to shift to agroforestry/tree-based systems, this is an obvious gap in their extension activities. The implications of this are discussed in Section 9.3.3.

### **9.2.4 Livelihood and cognitive factors influence farmers’ willingness and capacity to change land use**

Farming aspirations and slope were the most statistically significant factors influencing farmers’ willingness to adopt land uses considered more sustainable by researchers and natural resource agencies. Their capacity to do so is affected by their available financial capital, education, land use values and motivations. These results from the regression modelling together with the cognitive mapping were used to develop BN models of farmers’ willingness to change (WTC) and the capacity to change (CTC) land use. In the BN models, financial (current land use), social (access to extension), and human (skills) capitals were found to be key factors that influence



farmers' WTC land use, which is almost similar to CTC with financial capital (available financial capital), cognitive processes (reasons) and human capital (education). This difference in results can be attributed to the different analysis techniques of conventional statistical analysis and Bayesian network (BN) models, where the latter considers the interplay of interactions between and among factors.

Using a scenario of improved access to extension, the WTC model suggests that in villages which currently have poor access to extension, the probability that farmers would be willing to change their current land use to agriculture increases at the expense of agroforestry/tree-based farming. This strengthens earlier findings that the current extension is generally carried out on behalf of the Department of Agriculture and focuses on high-valued/plantation crops and practices, and without any emphasis on the benefits of agroforestry. The CTC model highlights that farmers who self-reported that they have the capacity to change land use have relatively better livelihood conditions than other farmers. However, although their capacity to change and concern for environmental protection are likely to increase with better access to financial assistance, their higher level of education is matched by a reduced likelihood of capacity to change their current land use because they rely on non-farm livelihoods.

### 9.2.5 Methodological learnings

Using the IA approach to frame this research enabled the use of mixed methods utilizing different types of data from different sources and facilitated the comprehensive integration of biophysical, environmental, socio-economic and cognitive dimensions of land use and livelihoods in upland watersheds. Methodologically, it highlighted the importance of evaluating the options for this particularly challenging 'wicked' issue on land use and livelihoods by understanding the current conditions and trends, the drivers of these trends, the desired land use and livelihood outcomes of farmers and external stakeholders, and the farmers' likely responses based on different scenarios. While the process of data collection can be complicated and the bulk of information gathered can be voluminous, IA provided a sounder, more realistic foundation for the analysis, rather than applying a single disciplinary (purely economic, technical, or social) analysis or employing one research method (purely modelling or quantitative data from the survey).

Somewhat disjoint from rigorous IA tradition, the BN model was not developed in a participatory manner with stakeholders due to the resource constraints of a PhD thesis (finances and time). Engaging farmers and external stakeholders in the process may have improved the model by iteratively allowing its development with their feedback. The model outputs could also then be used to support local management decisions and actions that are acceptable to the wider farming and stakeholder groups. Nevertheless, the BN model and its results could provide a good vehicle for future discussions with those groups.

### **9.3 Policy recommendations**

This thesis has highlighted the important implications of considering farmers' land use decisions and livelihood strategies and linking these with the external stakeholders to reconcile differing preferences and priorities, align limited resources, and catalyze available skills and resources in collaborative ways. Concerned local and national government agencies in Cabulig need to adapt and develop plans and design policies and practices in response to these realities in the field. Discussed below are some vital elements in land use and watershed planning and management.

#### **9.3.1 Integrating farmers' livelihood assets in program design and interventions**

The development of interventions in the Cabulig watershed needs to shift from the current blanket approach for watershed management that focuses on the technical aspects of land use, for example, reforestation or adoption of particular farming technology. This culture of projects addressing single issues – simply planting trees (never-ending reforestation projects) or improving farming practices for a single crop – has to end for the reasons articulated below. While such efforts serve a specific purpose, it is vital that they consider landscape heterogeneity and variation of farmers' livelihood capitals and capacities and find alternate ways to improve the latter. The availability of financial capital needs particular focus to encourage the transition to more environmentally sustainable and economically desirable cropping or agroforestry systems. For instance, increasing numbers of farmers are currently dependent on individual financiers, financing foundations, or rural banks to finance their farming production, all of which are motivated by profit and generally unwilling to share the risks inherent in farming. Hence farmers seek to minimize financial risk by minimizing borrowing or minimizing inputs. The result is a slow decline in the resource base (e.g. soil fertility, soil conservation) which simply defers the risk to a later date. An experience in Ghana showed that financial capital provided by rural banks contributed to the livelihoods development of women farmers and improvement in their farm income, access to health care, education and other social services (Akudugu, 2011). So there is a need to improve access to financial capital or subsidies for farm inputs, such as seeds and fertilizers, so that farmers have timely access to good quality inputs without increasing debit and risks for farmers.

#### **9.3.2 Investing in extension to improve the reach and quality of the service**

The limited numbers of farmers benefitting from extension services indicate the need to improve their reach and effectiveness. Government agricultural and forestry extension services need to have integrated programs to address local needs by providing more land use and livelihood options that maintain the farmers' resource base and are integrated with watershed management.

The quality of government extension services also needs to be on a par with or better than those of private seed companies and multinational companies seeking to persuade farmers to undertake particular activities. Such extension is required in terms of the number of and training of technicians, transportation support, and time spent on the technician to farmer interaction. In short, appropriate land use and watershed management interventions through effective extension service delivery are a policy imperative. Moreover, this thesis argues that it is necessary not just to improve the system of extension services, but to implement programs for restoring upland watersheds using economically viable agroforestry/tree-based systems. More balanced, holistic extension work that considers both farmers' economic progress and environmental sustainability is a first priority.

### **9.3.3 Promoting agroforestry in watersheds' production zones**

This thesis argues that the focus of current extension services should be expanded or redesigned to include agroforestry/tree-based extension that promotes those activities which restore or protect upland watersheds and provide diverse livelihood opportunities to farmers. In tropical countries, trees are valued by farming communities as they provide non-timber products harvested from trees in forest and/or managed tree farms, various products (e.g., cacao, coffee, fuelwood) and ES from agroforestry farms, and commercial products (e.g., timber, rubber) harvested from cultivated tree commodity crop (Dawson et al., 2014).

By law, watersheds are classified into agricultural and forestlands, which form the basis for specific land uses and management strategies. But this delineation is not feasible for Cabulig considering its complex biophysical condition and fragile ecosystem. On the ground, agricultural production exists even in higher elevation lands, as well on the steep slopes of the Cabulig River gorge that are designated for tree plantations or forest trees. In response, the Agriculture and Forestry departments need to work together to better react to rapid environmental, social, and economic changes. Instead of working separately, the Philippines government should consider re-structuring current institutions into one Department of Agroforestry at the national level and one Provincial or Municipal Agroforestry Office. This might allow the unification of the agricultural and forestry (agroforestry) extension service delivery programs, their implementation in a coordinated way across upland watersheds, and thus advance a more balanced and holistic agroforestry/tree-based extension approach across the landscape.

### **9.3.4 Functional Watershed Management Council**

There is a need to establish a multi-stakeholder Cabulig Watershed Management Council that will oversee all development efforts that may affect the watershed and its farming households and external stakeholders. With the current environmental, social and economic changes in Cabulig, farmers, and external stakeholders, including the local governments, lack support for achieving

their land use and livelihood priorities and mandates. Their fragmented goals and efforts provide opportunities for opportunists to fill the cracks, which in this case may mean private companies that are driven mainly by profit or farmers prioritizing their economic needs at the expense of their land resource and the environment more broadly. This Council should comprise important stakeholders from the watershed, including the farmers, indigenous peoples, private companies, non-government organizations, local and national government agencies, and others. They should work closely with the Municipal Agroforestry Offices in developing resolutions and advising actions and programs to the three municipal government units within the watershed. They should initiate the landscape planning that is required to ensure the long-term integrity of the watershed, as well as introduce management strategies. Reward systems or incentives is one strategy that encourage sustainable land use and management. In the Philippines, some LGUs provide both direct and indirect incentives for farmers to adopt and invest on sustainable farming systems (e.g. agroforestry, tree farms) and assist on reforestation activities in watersheds (Catacutan et al., 2010).

Ultimately, this thesis identifies the need for watershed planners to better integrate heterogeneous landscapes, farmers' land use, and livelihood capitals and their farming aspirations, as well as those of external stakeholders, into a more inclusive concept of sustainable land use and management of upland watersheds. Such integrated strategies will need to provide all stakeholders with a mechanism to decide on matters that are important to them all, and so will move them to act collectively. Also, with appropriate incentives to change behaviour, environment-focused programs may work.

## ***9.4 Limitations and proposed future research***

This section recognizes some limitations of the work in this thesis and further research that is necessary to validate and/or enhance its findings.

### **9.4.1 Conducting GIS-based land use mapping and analysis**

The lack of available GIS data sets (over discrete periods) for the study site prevented this thesis from developing historical maps to show trends in actual land use changes over time. The one spatial data set that was available was supplemented by qualitative information on historical land use from the KIIs and focus groups in Chapter 4. However, the new mapping of the Cabulig watershed would supplement the observations and perceptions of the respondents and validate the findings of this thesis.

### **9.4.2 Implications of declining farmer organizations**

This study recorded the institutions (for example, Figure 4.11) that aim to assist farmers in the village sites to improve their farming livelihoods, although in-depth analysis of them was not

possible within the timelines of this thesis. Similarly, the declining small number of farmers affiliated to farmer organizations undertaking collective activities was highlighted but it was not possible to analyze the factors contributing to this decline in depth. The watershed could benefit from future research that focuses on institutional and social structures in land use and livelihoods using institutional analysis, and development and network theories. This might identify institutional structures that could help use and manage common resources and map social networks where multiple stakeholders are nested (Chapter 4).

### **9.4.3 Understanding corporate land use priorities and land management strategies**

Because of their technical capacities and financial influence, the presence of mono-crop plantations operated by multinational companies has transformed the landscape and livelihoods of Cabulig watershed in the last ten years. Although this research was able to conduct initial discussions with some company staff from Dole-Philippines and Phillip Morris and Fortune Tobacco Corporation (PMFTC), as well as interview some farmers who have rented their land to them or are working for them, it was not possible to conduct the structured KIIs that were planned because of the corporations' rigid protocols around such discussions, even for research purposes. Watershed land use planning would benefit from understanding their good plantation practices, including their strategies to reduce environmental impacts, which might bridge current knowledge gaps and social perceptions of their operations. This thesis initially planned for a case study that compared the income of farmers farming their land and of those renting their land to corporations. Engagement with corporations was not able to reach a level that enabled this investigation to occur. Identification of different farming systems in different locations that achieve improved income – such that farmers modify their decision to sell or rent their land to such corporations – could guide policymakers in designing development strategies to help farmers improve their farming systems (Chapter 5).

### **9.4.4 Engaging the rural youth and private sector in sustainable agriculture and forest management**

The future of farming depends on the engagement of various stakeholders in sustainable land use and watershed management, including the younger generation and multinational companies. So it is important to understand their aspirations amid the biophysical, environmental and socio-economic changes to develop policies and programs that make farming an inviting and feasible livelihood option for the youth, which would hopefully include integration of trees and other soil and water conservation measures in large-scale plantations for multinational companies. This thesis did not focus on the private sector nor younger farmers but farmers in general. In the case of youth, the outmigration of young people to cities or abroad for employment is prevalent. Some young people who were interviewed engaged in farming mainly because they did not finish school

and there was no other livelihood option available to them except farming. As discussed in Chapter 6.2.1, parents now invest in their children's education so they can get jobs in cities or abroad, to the extent of renting out or selling their land. A study focusing on rural youth and the future of farming in Cabulig watershed is strongly recommended, as would be a study for alternative patterns of land ownership and use if the current trend of out-migration continues (Chapter 6).

#### **9.4.5 Participatory modelling to enhance social learning**

The BN models on farmers' willingness and capacity to change to more sustainable land uses, including the scenarios that were developed, have the potential to spark discussion with policymakers and development practitioners around how to achieve the dual aims of rural development and environmental sustainability, and what areas to focus on when helping farmers. Time limitations prevented the presentation of the results to the farmers and external stakeholders in order to integrate their comments and suggestions and improve the models. It is recommended that future research should include their active participation by communicating the initial results and iteratively improving the models. An added benefit from directly engaging stakeholders in the modelling process is that it helps involve them in subsequent decision making based on the results (Chapter 7).

The timing of data collection is a key consideration in an exploratory design like this study. A robust qualitative analysis in the first stage will inform the second stage of designing the HH survey questions around the conceptual model, thereby improving the strength of the BN modelling. The BN models also needed more quantitative data, particularly on CTC. The number of targeted household survey respondents should be increased with the specific information from the conceptual model for the BN model. While the use of BN modelling provided important findings on farmers' WTC and CTC to appropriate land uses, it may be useful to explore other modelling tools, for example, Fuzzy cognitive modelling, and examine which ones provide more robust findings or are more useful in a participatory modelling setting. Considering the representative cognitive maps of 'agriculture' versus 'agroforestry' farmers, such an approach could also be used as a social learning tool to expand the world view of farmers, coordinated with the improvements in extension and institutional governance.

#### **9.4.6 Exploring the potential of payments for ecosystem services to bridge farmers with their aspirations**

One of the objectives of this research was to understand potential strategies to assist and motivate farmers to adopt and invest in sustainable farming systems that would improve and/or sustain the ecosystem services (ES) that the Cabulig watershed provides, such as soil fertility management for land health, integrating trees on farm for improved hydrology and slope stabilization, as well

as carbon sequestration and biodiversity conservation and soil erosion control for stream water quality (Chapter 7). While some attempt was made to look at payments for ecosystem services (PES) as an option to watershed management, more information was needed to assess its feasibility. Potential ES buyers exist within the watershed (e.g. hydropower, plantations, tourists) and downstream (e.g. industrial factories, coal power plants) and future work is necessary to explore how ES mechanisms could benefit the smallholders in Cabulig.

#### **9.4.7 Disaster and risk management due to rapid land use change**

The combined impacts of climate change and socio-economic development in Cabulig have posed challenges not only to the farmers within the watershed but also to downstream communities. As mentioned in Chapter 7, the recent sudden shut-down of Phillip Morris and Fortune Tobacco Corp. because of reduced tobacco production due to drought are risks that affect not only the company but also its farmer-cooperators. Downstream, Minergy's hydroelectric power generation is also affected by the declining river flow. Future research should incorporate these disasters and risks into the broader context of water governance in Cabulig and examine how upstream-downstream water governance, perhaps through PES as mentioned previously, might enable farmers and other external stakeholders adapt to changing climate and socio-economic conditions. This also relates to farmers' long-term decision making on land use and livelihoods based on the risk of short-term events. This is where strategies on adaptiveness are crucial – less reactive and more proactive decisions and actions to benefit farmers and external stakeholders.

### **9.5 Summary**

Overall, this thesis supports the argument to integrate a more holistic, land use and livelihoods perspective in sustainable land use and watershed management programs, considering the heterogeneity of landscapes, the differential impacts of drivers of change in terms of location and scale, the desired farming future of farmers and external stakeholders, and the likely impacts of farmers of feasible management options. It also builds on development efforts that combine land use regulation with effective extension delivery, as well as the use of financial or other rewards to modify farmers' land use decisions and livelihood strategies based on biophysical, environmental and socio-economic realities of upland watersheds in developing countries.

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# Appendix 1: Guide questions for key informants

## Influence of stakeholders' ecological values, aspiration, and knowledge on land health and farming livelihood: a case study in an upland watershed in the Philippines

Introductory statement: The main objective of this research project is to appreciate and reconcile farmers and other stakeholders' soil ecological values, aspirations, knowledge, land uses, and actions. Understanding this helps the identification of options to manage the Cabulig watershed to achieve environmentally and socio-economically desirable outcomes. As mentioned in the letter invitation, this is voluntary, and your responses will be kept confidential. Thank you.

### Common questions for all groups: Farmers, Policymakers, Extensionists, Non-Government Organizations, Multinational companies, and Researchers<sup>88</sup>

#### A. Demographic information

Name (Optional): \_\_\_\_\_ Date: \_\_\_\_\_  
 Sitio: \_\_\_\_\_ Village: \_\_\_\_\_ Municipality: \_\_\_\_\_  
 Ethnicity: \_\_\_\_\_ Age: \_\_\_\_\_ Civil status: \_\_\_\_\_  
 Education: \_\_\_\_\_ Main occupation: \_\_\_\_\_  
 Farmer organization/s: \_\_\_\_\_  
 Code name: \_\_\_\_\_ Coordinates: \_\_\_\_\_

#### B. Preliminaries

1. How long have you been living in this village? How long have you been farming in this village? How important is farming to you?
2. Do you own the land you are farming? (Parcel/s: \_\_\_\_\_ ; Total land area: \_\_\_\_\_)
  - 2.1 If Yes, does someone owns the land with you? How did you obtain the land? Do you have plans to sell or rent out the land in the future? Why? Under what circumstances would you consider selling/renting out the land? Why?
  - 2.2 If No, do you rent the land? What is the arrangement between you and the landowner? Do you have plans to buy land in the future? Why?
3. On land renting, do you think it is important to include maintaining existing or adopting sustainable land use and management practices in the contract? Why? Do you think land ownership affects farmers' land use and management practices? Why?
4. Do you still see yourself farming in the next 10 or 20 years? Why? If you are not farming, what kind of livelihood would you be likely doing by then? Why? Would you consider working in a multinational company? Why? Would you encourage your children to work as a farmer like you, in the multinational companies, or the city? Why?
5. Do you have any other sources of income other than farming?

<sup>88</sup> Questions are reframed based on the key informants

- 5.1 If Yes, what are these? What is the benefit of having different sources of income?
- 5.2 If None, do you have any plans to diversify your livelihood? Why?

### C. Knowledge

1. What is soil?
  - 1.1 How would you describe soil? How do you know which soil is good or bad? Which areas in the village/watershed have good and bad soil? (Giller et al.)
  - 1.2 How many different types of soil do you know in your village/Cabulig? How would you describe each soil? What do you use each of these soil for? Where can you see these types of soils in the village/Cabulig?
  - 1.3 What are your indicators of soil quality? What is your most important indicator of soil quality?
2. What is soil fertility?
  - 2.1 How would you assess your land and the village/Cabulig's soil fertility in the past 5 or 10 years? What about today?
  - 2.2 How does this (increased nutrient/nutrient decline) occur?
  - 2.3 What are the effects (+/-)?
  - 2.4 What do you do to maintain/improve your land's soil fertility? What are the results so far?
  - 2.5 Which areas in the village/watershed have fertile soil? Why? (Giller et al.)
3. What is soil acidity?
  - 3.1 What are the manifestations of soil acidity?
  - 3.2 Can you tell whether Cabulig's soil is naturally acidic, neutral, or alkaline? Why?
  - 3.3 What are the causes of soil acidity? Does farming worsen soil acidity?
  - 3.4 What are the effects of soil acidity?
  - 3.5 How do you do to manage soil acidity? What are the results so far?
  - 3.6 Which areas in the village/watershed have acidic soil? Why?
4. What is soil erosion?
  - 4.1 How would you assess soil erosion in your land and the village/Cabulig's in the last 5 or 10 years? What about today?
  - 4.2 What do you think are the cause/s of this?
  - 4.3 What are the effects?
  - 4.4 What do you do to control/minimize soil erosion? What are the results so far?
  - 4.5 Which areas in the village/watershed have intense soil erosion problems? Why?
5. Does the steepness of a slope affect land use and management practices? Why?
  - 5.1 What do you specifically do in a sloping land? Why?
  - 5.2 What do you think will be the results of this action?
6. Does the presence of rocks and stones on your land affect your land use and management practices? Why?
  - 6.1 What do you specifically do on land with rocks and stones? Why?
  - 6.2 What do you think will be the results of this action?
7. Do you think your land use and management practices affect other farms and the Cabulig watershed in general? How?
8. What is the impact of poor soil management on a farm on Cabulig River?
  - 8.1 What is the impact of over clearing in Cabulig watershed?
9. Do you think agricultural intensification (e.g. mono-crops, plantation crops) has degraded land resources in your village? Why?
  - 8.1 What are the effects of agricultural intensification in your village (+/-)?



- 8.2 What are the effects of intensive upland agriculture outside Cabulig watershed (+/-)?
10. Do you think poor soil management contributes to climate vulnerability and extreme events? How? What can be done to maintain and improve soil carbon levels?

#### D. Values

1. Is your land valuable to you?
  - ☐ Very important      ☐ Important      ☐ Some importance
  - ☐ Minimal importance      ☐ Not important
2. Why is your land important to you in terms of:
  - 2.1 Social (ex)
    - ☐ It provides me the kind of lifestyle I want      ☐ I like living in farm/rural village
    - ☐ I like being a farmer      ☐ It is a great place to raise a family
    - ☐ It gives me the freedom I want      ☐ It gives me joy and fun for the family
    - ☐ Continue the family tradition of farming
    - ☐ Preserve it as property from my parents
    - ☐ Sense of pride from the compliments I received (e.g. productive, sustainable)
    - ☐ A healthy land enables me to experiment about farming and learn new things
    - ☐ Having this farm is a good break from my regular work
    - ☐ Having this farm is a good break from city life
  - 2.2 Environmental (ex)
    - ☐ Pass on the land to my children in better condition
    - ☐ My farm promotes and sustains agro-diversity
    - ☐ Sense of accomplishment that I'm contributing to the protection of Cabulig
    - ☐ It is my responsibility to take care of my land
    - ☐ I have always aspired of developing my land sustainably
  - 2.3 Economic (ex)
    - ☐ Sense of pride that it enables me to support my family financially well
    - ☐ Sense of pride that it has a good infrastructure (e.g. fencing, irrigation)
    - ☐ It is a good retirement investment
    - ☐ Sense of accomplishment from producing food/timber/meat for others
    - ☐ Integrating trees on-farm is a good long-term investment
3. Which is more important to you – a farm's productivity or sustainability? Do you see any link between the two? How?
4. What do you do to develop your farm? What are the results/gains so far?
5. What do you do to improve your farm's soil quality? What are the results/gains so far?
6. What are the values that guide your land use decisions and actions? (ex)
  - ☐ Free of conflicts on land use with fellow farmers and other users
  - ☐ Farming not just for my welfare but also for others
  - ☐ Adopting sustainable land use and management practices to protect my farm from environmental degradation and my family's livelihood
  - ☐ Adopting sustainable land use and management practices that will not negatively affect my neighbors and others' farming livelihood
  - ☐ Adopting sustainable land use and management practices to protect Cabulig
  - ☐ All community members should be equally able to access and use the land, water and forest resources to their support farming livelihoods
  - ☐ Wealthier farmers should help smallholders to improve their knowledge, use of resources, and livelihood opportunities
  - ☐ I should use my knowledge and experience to help others in my community

- ☐ I should influence my neighbours through my sustainable land use and management practices
  - ☐ I encourage others in Cabulig to balance their economic livelihood and environmental pursuits
  - ☐ Increase in income from farming mustn't harm land resources and the Cabulig River
  - ☐ Reduced production in short-term is acceptable where there are long-term benefits to the environment and future land users
7. Do you share these land values to your fellow farmers? Why do you make the effort to do that? How do you share these? What is their response? How do you feel when you do this?
  8. Do you think renting land to others is more profitable than cultivating it yourself? Why?
  9. Do you value participating in farmer organizations? Why? Does participating in these organizations improve your soil management, land use, and farming systems? How? What other benefits do you get?
  10. Is your farming family financed or you accessed farm loans? If Yes, for how long now? Can you share your experience? Which do you prefer for farm financing – individual or group loan? Why? What are the advantages and disadvantages of your preferred loan?
  11. Do you think an effective extension service system is important to improve farmers' land use and management practices? Why?
  12. Do you think a rewards-based system will encourage farmers to adopt and invest in sustainable land use and management practices? Why?
  13. Do you think a land use plan with standards developed with farmers and other land users is an acceptable way to achieve sustainable land use and management in Cabulig watershed?

#### **E. Views and aspirations on land use, land use change, and management practices**

1. What was the major land uses 10 and 20 years ago? What is the current major land uses?
2. Where did these changes occur? (*Let KI locate these changes in the watershed map*)
  - ☐ Upland                      ☐ Mid-stream    ☐ Lowland    ☐ Whole landscape
3. Do you think the current land uses are appropriate in Cabulig, profitable, and sustainable? Why?
4. Who has been active in driving these changes?
  - ☐ Policymakers                      ☐ NGOs                      ☐ Multinational companies
  - ☐ Farmers leaders                      ☐ Sectoral leaders (e.g. religion) ☐ Others, \_\_\_\_\_
5. What are the factors that drove any change?
  - ☐ Good soil                      ☐ Sufficient water                      ☐ Suitable climate
  - ☐ Degrading soil                      ☐ Water stress                      ☐ Climate variability
  - ☐ Migration                      ☐ Consumption/market demand ☐ Institutional change (e.g. NGOs)
  - ☐ New crops                      ☐ New farming technologies                      ☐ Policies
6. What are the motivations that caused these changes?
  - ☐ Profit                      ☐ Environmental                      ☐ Rural development ☐ Others, \_\_\_\_\_
7. What are the effects of these changes (+/-)?
  - ☐ Better land health                      ☐ Infertile soil
  - ☐ Improved land use                      ☐ Unsuitable land use
  - ☐ Diverse farm crops                      ☐ Poor farm productivity
  - ☐ Diverse livelihood sources                      ☐ Limited livelihood options
  - ☐ Strong social capital                      ☐ Weak social capital
8. Do you know of any farmers who benefitted from these changes? How? Do you know of any disadvantaged farmers? How?

9. What is your preferred land uses that would sustain land health and/or improve the livelihoods in Cabulig watershed? Why? (*Specify the crop/s, and locate these in the map*)  
 ( ) Natural forest ( ) Tree plantations ( ) Agroforestry  
 ( ) Agri-business plantations ( ) Agricultural commercial farms ( ) Home gardens
10. Do you think farmers can implement such preferences? Why? Would they be willing to adopt these? Why?
11. What are the levers or mechanisms that would best encourage a shift to these systems?  
 ( ) Land use policies ( ) Land management extension programs ( ) Others, \_\_\_\_  
 ( ) Land use regulations ( ) Incentives
12. What are your major considerations in deciding upon your land use and management strategies?  
 ( ) Economic values: [ ] cost-benefit [ ] flexibility to respond to market/climate condition  
 ( ) Technical reasons: [ ] Information [ ] Capital input requirements [ ] Labour  
 ( ) Environmental: [ ] Technical feasibility [ ] Effectiveness  
 ( ) Socio-cultural: [ ] Acceptability [ ] Feasibility (social) [ ] Past experience  
 ( ) Institutional: [ ] Policy support [ ] Within a plan
13. Do you consider household nutrition and health in deciding land use or crops? If Yes, are you more interested in crops that provide adequate calories and/or quality? Why?
14. Do you consider climate vulnerability and extreme events in deciding land use or crop? If Yes, what are the land uses or crops that would likely withstand these? Give example and how?
15. Who do you seek advice about soil fertility, land use, farm financing, and livelihood assistance?
16. What do you foresee the land use will be in the:  
 ➤ Short-term (next 5-10 years): \_\_\_\_\_  
 ➤ Long-term (next 11-20 years) \_\_\_\_\_

|                 | LU 5-10 years ago | Current LU | Preferred LU | How to achieve preferred LU | LU in the next 5-10 years | LU in the next 11-20 years |
|-----------------|-------------------|------------|--------------|-----------------------------|---------------------------|----------------------------|
| Upland          |                   |            |              |                             |                           |                            |
| Midstream       |                   |            |              |                             |                           |                            |
| Lowland         |                   |            |              |                             |                           |                            |
| Whole landscape |                   |            |              |                             |                           |                            |

17. What is the major issue on-farm that affect farming livelihood? How? What about the major issue in Cabulig watershed that affects your farming livelihood? How?
18. What are your aspirations on the following:  
 ➤ Land ownership: \_\_\_\_\_ Land management: \_\_\_\_\_  
 ➤ Soil management: \_\_\_\_\_ Farming livelihood: \_\_\_\_\_ Land use: \_\_\_\_\_

## F. Policy-and-planning process and stakeholders engagement

- Do you know of any policies or plans that are related to land use and watershed management in Cabulig? What are these? How are these implemented, and with what results? Do you have any suggestions to improve these?
- In your own planning of programs and activities, do you engage farmers, the local government and other stakeholders (e.g. NGAs, multinational companies, researchers)?

Why? In what way? What are the advantages and disadvantages? Are you satisfied with their contribution? Why?

3. Has your NGO participated in any policy making or planning process organized by the government? If yes, how did you participate? Are you satisfied with the process, and the policy or program output? What would have you done differently for better results? Why?
4. What policy instrument (e.g. plan, program) would you like to suggest that would protect improve soil fertility and land use, and advance the people's livelihood at the same time? Why? How would you suggest doing this?
5. What is it about being a development worker that you like the most (opportunities)? Like the least (challenges)? Do you still see yourself as a development worker in the next 10 or 20 years? Why? If you are not a development worker, what would you be doing right now as a livelihood?

### **Specific questions per group**

#### **POLICYMAKER** key informants (Village, municipal and provincial levels)

##### **A. Policy and planning process and stakeholders engagement**

1. What are the major policies/plans that the local government has on matters related to land use and watershed management? What about those that you have proposed and enacted? What made you propose these policies/programs?
2. Do you engage farmers and other stakeholders (e.g. NGAs, NGOs, multinational companies, researchers) in Cabulig on your land use decisions and land management actions? In what way? What are the advantages and disadvantages? Are you satisfied with their contribution? Why?
3. Does the local government participate in other stakeholders' any land use and management planning activity with the multinational companies, or those with the researchers from research organization, academe or national government agencies? How did you participate? Are you satisfied with the process, and the policy or program output? What would have you done differently for better results? Why?
4. Are there other ways where the local government communicates or engages the farmers and other stakeholders in your policy and planning process on matters related to land use and watershed management? How do you do this? With what results? What are the challenges and opportunities?
5. What policy/plan would you really like to enact/develop within your term that would protect improve soil fertility and land use, and advance the people's livelihood at the same time? Why? How would you do this?
6. What is it about being a policymaker that you like the most (opportunities)? Like the least (challenges)? Do you still see yourself as a policymaker in the next 10 or 20 years? Why? If you are not a policymaker, what would you be doing right now as a livelihood?

#### **EXTENSIONISTS** key informants (Local Government Unit)

##### **A. Preliminaries**

1. Please tell me about your government agency.
2. How many of you are working in Cabulig? Who do you work with closely in the area? How do you work with them?
3. What are your current major development and extension activities in Cabulig? How are these being implemented? What are the results so far?

4. As an extensionist, what is your main function? What are the knowledge and skills needed for you to work effectively? What are the supports you receive from the government to perform your job effectively? What are the challenges you encountered, and how do you overcome these? What are the opportunities?

#### **NON-GOVERNMENT ORGANIZATION** key informants

##### **A. Activities in Cabulig**

1. Please tell me about your NGO.
2. What was the main reason for including Cabulig as one of your project areas?
3. How long has your NGO been operating in Cabulig? Years: \_\_\_\_\_ # of beneficiaries: \_\_\_\_\_ Villages: \_\_\_\_\_
4. What process did you go through to start your activities? Did you ask permission from the local government or tribal council?
5. What are your major activities in Cabulig? How are these being implemented? What are the results so far? Who are your main beneficiaries? Who are not included? Why?
6. What are the support you receive from the government? What are the challenges, and how does your organization overcome these? What are the opportunities?

##### **B. Policy and planning process and stakeholders engagement**

1. Do you know of any policies or plans that are related to land use and watershed management in Cabulig? What are these? How are these implemented, and with what results? Do you have any suggestions to improve these?
2. In your own planning of programs and activities, do you engage farmers, the local government and other stakeholders (e.g. NGAs, multinational companies, researchers)? Why? In what way? What are the advantages and disadvantages? Are you satisfied with their contribution? Why?
3. Has your NGO participated in any policy making or planning process organized by the government? If yes, how did you participate? Are you satisfied with the process, and the policy or program output? What would have you done differently for better results? Why?
4. What policy instrument (e.g. plan, program) would you like to suggest that would protect improve soil fertility and land use, and advance the people's livelihood at the same time? Why? How would you suggest doing this?
5. What is it about being a development worker that you like the most (opportunities)? Like the least (challenges)? Do you still see yourself as a development worker in the next 10 or 20 years? Why? If you are not a development worker, what would you be doing right now as a livelihood?

#### **MULTINATIONAL COMPANY** key informants

##### **A. Operation**

1. What was the main reason that prompted your company to operate in Cabulig? Why?
2. How long you has your company been operating in Cabulig? Years: \_\_\_\_\_ Area covered: \_\_\_\_\_ ha; Villages: \_\_\_\_\_ # of beneficiaries: \_\_\_\_\_
3. What process did you go through to operate in Cabulig (LGU [level] and community engagement)? What were the challenges, and how did the company overcome these?
4. What are the arrangements (e.g. land buying, land renting, contract growing, etc.) with landowners? What are the major provisions and conditions of the contract (e.g. length,

- land use, land management)? Do you think it is important to include in the contract the maintenance of existing conservation measures (e.g. trees, contours) of the rented land?
5. What other benefits do landowners received? Are there any challenges encountered with landowners, and how do you overcome these?
  6. How many employees do you have at the moment? Are the majority of them locale (from the village, municipality)? Why? What position do most of them hold in the company (e.g. clerical, labour)? How much do they receive per day? What other benefits do they receive?
  7. How do you implement the company's Corporate Social Responsibility (e.g. foundation)? What are the activities involved? Who are the main beneficiaries? Why?

**B. Relationship with government and other stakeholders**

6. Do you include farmers and other stakeholders (e.g. LGUs, NGAs, researchers, etc.) in Cabulig on your land use decisions and land management actions (e.g. planning)? In what way? What are the advantages and disadvantages? Is the company satisfied with their involvement? Why?
7. Does the company participate in the local government's policy making process? How? Are you satisfied with the process, and the policy or program output? What would have you done differently for better results? Why?
8. Does the company participate in any planning process related to land use or watershed management by the government? How? Are you satisfied with the plan? What would have you done differently for better results? Why?
9. Are there other ways where the company communicates or engages the farmers and other stakeholders in your operations? How? With what results? What are the challenges and opportunities?
10. What specific policy or plan would the company like to lobby for approval and implementation by the government? Why?
11. Will your company still be operating in Cabulig 10 or 20 years from now? Why?

**RESEARCHER key informants**

**A. Activities in Cabulig**

7. Please tell me about your research organization.
8. What was the main reason for including Cabulig as one of your research areas?
9. How long has your organization been operating in Cabulig? Years: \_\_\_\_ # of cooperators: \_\_\_\_ Villages: \_\_\_\_\_
10. What process did you go through to start your activities? Did you ask permission from the local government or tribal council?
11. What are your current major activities in Cabulig? How are these being implemented? What are the results so far?
12. What are the supports you receive from the government and other stakeholders? What are the challenges, and how does your organization overcome these? What are the opportunities?

## Appendix 2: Report on the farmer group discussion in Cabulig watershed, Misamis Oriental, southern Philippines, 5-6 April 2016

### I. Introduction

This document reports the results and findings based on focus groups with farmer leaders conducted across the Cabulig watershed in Misamis Oriental, southern Philippines. During the household survey with farmers from Feb-Mar 2016, some issues influencing their soil/land management and farming livelihood were noted in discussion with the enumerators. Hence, the purpose of the focus group with farmers was to deepen understanding about these issues, including their knowledge and perceptions on soil quality, climatic, environmental, and socio-economic changes, participation in local organizations (LO) and farm financing, and their network of institutions that help improve land resources and farming livelihood.

### II. Methodology

Two focus groups were held with farmer leaders from six villages. These were conducted in the Barangay<sup>89</sup> Halls of Mat-i for middle and upper villages (i.e. Luna, Mat-i, Aposkahoy, and Malagana), and in San Nicolas for villages downstream (i.e. San Nicolas and Plaridel)<sup>90</sup>. Due to limited time and resources, the upper and middle villages were combined. An invitation letter was addressed to the village captain encouraging the participation of farmer leaders (i.e. number, gender).

**Table 1- Schedule of focus groups**

| Location            | Date       | Language | Participants        |        |
|---------------------|------------|----------|---------------------|--------|
|                     |            |          | Gender              | Number |
| Mat-i, Claveria     | 5 Apr 2016 | Visayan  | Mix (men and women) | 11     |
| San Nicolas, Jasaan | 6 Apr 2016 | Visayan  | Men only            | 9      |
| Total number        |            |          |                     | 20     |

The discussions were conducted using the local dialect, which is Visayan. Discussions lasted for six hours (Appendix 1). The methods used during the discussion include brainstorming, clustering, mapping, and group activities using worksheets among others. Guide questions were

<sup>89</sup> Barangay mean village, which is the smallest political unit in the Philippines.

<sup>90</sup> These are also the six villages where the farmers' household survey was conducted from 3Feb-18Mar 2016.

used to guide the activities and discussions about their soil knowledge, climatic, environmental, and socio-economic changes, social capital and institutions. These key topics were explored deeper based on the initial results of the farmer's household survey.

The focus groups' results and findings are highlighted throughout this report using the participants' verbatim comments when possible. These comments originated either from group discussions, which were captured by reviewing the discussions' transcription or through written worksheet exercises. Comments were translated into English and modified for better understanding.

Lunch and snacks (e.g. morning and afternoon) were provided, while the transportation cost incurred by the participants was reimbursed accordingly.

### **III. Results and Findings**

#### ***Perception of soil***

The importance of soil is recognized and valued by all participants. Soil means their survival as they consider soil as life. Most farmers perceived soil as the main source of their livelihood. They cultivate lands to support their families' basic needs. Accordingly, all people around the world depend on their livelihoods from land resources (i.e. agriculture) in direct and indirect manners. Some of them also referred to the soil as the foundation of life on earth. It is the resource that enables them to plant for people and animals to survive. It is where various crops grow, such as corn and fruit trees for people, and other crops for animal feeds. They also mentioned some environmental functions of soil, such as food production, watershed services, and source of raw materials, like timber for house construction. Soil is also where trees are planted that give people oxygen to breathe. Finally, they recognized the importance of soil for their children. As the main source of income, it enables them to educate their children to have a better future.

Participants perceived soil as:

*'Soil is the main source of my family's livelihood, which is farming...'* (Mat-i Focus group)

*'Soil is the source of life...'* (Mat-i Focus group)

*'Both rich and small farmers depend on soil because it is where fruit trees, corn, and other crops are planted for people's food, and feeds for animals...'* (San Nicolas Focus group)

*'Soil is where we plant trees to give us oxygen...'* (Mat-i Focus group)

*'Soil is important to our life for our children's better future...'* (Mat-i Focus group)

#### ***Soil indicators***

Although farmers have generally the same perceptions about soil's indicators, they have a different opinion as to the most important marker of soil quality. The most common soil quality indicators mentioned include the position, color, types of soil, soil acidity and soil fertility. Among these, the most important indicators identified are the land's position and soil fertility.



In Aposkahoy, farmers associate the sloping position of lands with soil acidity. They think that fertile topsoil on their sloping land is eroded leaving the underlying acidic soil exposed. Acidic soil contributes to farmers' poor production and income. Farmers in Luna also focused their discussion on the land's position. They believed that flatlands are the fertile soil, while rolling areas are prone to erosion. Hence, farmers in these villages suggested contouring sloping areas, applying composts to improve soil fertility, which holds/improves soil moisture through time, and integrating bamboo and/or trees on the farm. Farmers in Mat-i likewise categorized their indicators according to position such as flat, rolling, and sloping. They identified two types of soil, namely loamy and rocky. They also mentioned red soil and fertile soil, with the latter as rich in nitrogen, potassium and phosphorous. For Malagana farmers, they identified soil as either fertile or acidic. They mentioned different types of soil, such as rocky, sandy, and peat. They also distinguished soil by color like red and black and based on its position as either flat or sloping. In San Nicolas, farmers classified soil according to color as either black or red. Black soil is considered good characterized as soft, light and loose. In contrast, red soil is considered bad, which they associated with sandy, peat and rocky types of soil. They also believed that soil after burning is good for planting, which they referred to as slash-and-burn that some of them still practice. Finally, they linked the presence of earthworms to soil fertility. As for Plaridel, the farmers classified their soil indicators into good and bad soil. They characterized good soil as those that do not require the application of many fertilizers or lime. This kind of soil is black, has thick topsoil and lots of earthworms. Bad soils are the total opposite described as red, have thick topsoil, and do not have earthworms. They require the application of organic fertilizer and lime to improve soil fertility. They further discussed the decline of soil fertility over the last 30 years ago<sup>91</sup>. Accordingly, this reflects the change of soil quality over the years of cultivations.

Table 2- Farmers' indicators of soil quality in Cabulig watershed, Misamis Oriental (2016)

| Village   | Indicators                                                                                                                                                                                                                                            | Most important indicator |
|-----------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------|
| Aposkahoy | <ul style="list-style-type: none"> <li>Rolling (Requires contouring)</li> <li>Acidity (Requires organic compost to hold/improve soil moisture)</li> </ul>                                                                                             | Soil acidity             |
| Luna      | <ul style="list-style-type: none"> <li>Flat areas have fertile soil</li> <li>Rolling areas are prone to erosion and require contouring</li> <li>Sloping areas are prone to intense erosion and require contouring with bamboo and/or trees</li> </ul> | Position                 |
| Malagana  | <ul style="list-style-type: none"> <li>Soil fertility</li> <li>Soil acidity</li> <li>Position (sloping and flatlands)</li> </ul>                                                                                                                      | Soil fertility           |

<sup>91</sup> In 1985, farmers in Plaridel applied only 3 sacks of fertilizers per hectare. In 2016, they apply 30 sacks of chicken dung, 4 sacks of 14-14-14 for putting, 4 sacks for side dress, and 3 sacks of urea per hectare.

|                      |                                                                                                                                                                                                                       |                                                                                                                                                                                                                          |                |
|----------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------|
|                      | <ul style="list-style-type: none"> <li>• Color (red and black)</li> <li>• Type of soil (rocky, sandy, peat)</li> </ul>                                                                                                |                                                                                                                                                                                                                          |                |
| Mat-i                | <ul style="list-style-type: none"> <li>• Soil fertility (NPK)</li> <li>• Type of soil (soft and loose, rocky)</li> <li>• Color (reddish)</li> <li>• Position (sloping, rolling, and flatlands)</li> </ul>             |                                                                                                                                                                                                                          | Position       |
| San Nicolas (Jasaan) | <ul style="list-style-type: none"> <li>• Color (red and black)</li> <li>• Soil type (soft, loose, sticky, sandy, peat, rocky)</li> <li>• Soil fertility (light, full of minerals, burnt soil*, earthworms)</li> </ul> |                                                                                                                                                                                                                          | Soil type      |
| Plaridel (Claveria)  | Good soil                                                                                                                                                                                                             | <ul style="list-style-type: none"> <li>• Soil fertility (thick top, earthworms, does not require much fertilizer)</li> <li>• Color (black)</li> <li>• Soil acidity (does not require a lime application)</li> </ul>      | Soil fertility |
|                      | Bad soil                                                                                                                                                                                                              | <ul style="list-style-type: none"> <li>• Soil fertility (thin top, no earthworms, requires organic fertilizer)</li> <li>• Color (red)</li> <li>• Soil acidity (requires much lime according to soil analysts)</li> </ul> |                |

\*Part of practicing slash-and-burn farming system or 'sakom'

However, farmers have diverse opinions as to the most important soil quality indicator. Luna and Mat-i considered position within the landscape as the most important indicator because it can tell the general quality of the soil (i.e. fertile, unfertile) and the management practices required to either maintain or improve it. In Malagana and Plaridel, farmers considered soil fertility as the most important indicator because it helps them identify the best crops to plant, and the fertilizers to use. Knowing the type and amount of fertilizer is important as this determines if they are financially capable to plant the best crops. Aposkahoy identified soil acidity because they think this drives the farmers' decision on the type of crops to plant, inputs to use and management practices to adopt to improve the soil's condition. All participants apply lime to decrease soil acidity but with different amounts (Box 1). Finally, San Nicolas identified soil type as the most important indicator because it helps them decide in planting suitable crops.

Box 1. Common lime application in mid- and- upper Cabulig watershed

| Village   | Amount                                                 | Crops                     |
|-----------|--------------------------------------------------------|---------------------------|
| Aposkahoy | 50 bags/ha/yr;<br>100 bags/ha/yr;<br>100 bags/ha/3 yrs | Vegetables, corn, tobacco |
| Luna      | 25bags/.25ha/yr                                        | Vegetables                |
| Malagana  | 50bags/ha/cropping                                     | Corn                      |
| Mat-i     | 5bags/.25ha/cropping                                   | Vegetables, banana        |

### ***Dominant soil types and appropriate crops***

The participants mentioned red and rocky soil as the most common type of soil (Table 3). Accordingly, red soils are poor soils that require a lot of inputs (fertilizers) and proper land management to ensure production. They associate this soil with rolling and sloping areas, which are prone to erosion. Farmers can still grow crops in this soil, such as vegetables (Luna and Aposkahoy) but they have to apply additional inputs, like chicken dung, lime, and fertilizers that add up to their capital. Interestingly, the participants from Malagana said that in their village, they have red soil that can either be fertile or poor. Green onions grow well in red fertile soil, while crops like pineapple, cassava, camote, and other root crops can still thrive in Malagana's poor red soils<sup>92</sup>. Moreover, soils in between rocks are considered fertile soils as these are eroded soils. Unfortunately, growing crops in this type of soil is difficult due to the sloping terrain; hence it is more appropriate to just plant trees, like Falcata, and/or banana that require less management. Participants from Luna and Mat-i thought that red and rocky soils are the dominant type of soils in their villages while in Aposkahoy and Malagana was red soil (Figure 1). In Plaridel, sandy soil is the most common located along Cabulig River, which is the same in San Nicolas' flatlands along the riverside. They considered this good soil (eroded soil from the riverbanks).

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<sup>92</sup> In the discussion, red soil is often considered as bad soil. When the women farmers said that there are red fertile soils in their village, the other men farmers agreed that there are really cases like this.

**Table 3- Perceived soil types and their characteristics as perceived by farmers in Cabulig watershed, Misamis Oriental (2016)**

| Village     | Types of soil                                                                                                                 | Characteristics                                                                                                                                                                           | Appropriate crops                                                                                                                                                                                                  | Dominant soil       |
|-------------|-------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------|
| Aposkahoy   | 1. Fertile soil<br>2. Sandy loam<br>3. White clay soil<br>4. Red soil<br>5. Rocky<br>6. Peat<br>7. Flat<br>8. Sloping         | Sufficient nutrients<br>Soil easily dries<br>Poor growth of any crops<br>Requires compost; poor growth of any crops<br>Appropriate for trees<br>Lowlands<br>No erosion<br>Intense erosion | Any crops grow well, vegetables<br>Root crops<br>20 years Falcata – not good<br>Vegetables but with proper fertilizer<br>Falcata<br>Irrigated rice, taro, kangkong<br>Vegetables, tobacco<br>Coffee, banana, trees | Red soil            |
| Luna        | 1. Black soil<br>2. Red soil<br>3. Peat<br>4. Rocky                                                                           | Fertile soil<br>Poor production because the fertile soil has been eroded<br>Poor production; dry<br>Fertile soil in between rocks (eroded soil); difficult to manage                      | Cabbage, corn, tomato, beans<br>Garden plus chicken dung and lime<br>Any<br>Banana, lutya                                                                                                                          | Red and rocky soils |
| Malagana    | 1. Reddish soil – fertile<br>2. Reddish – poor<br>3. Pughayon<br>4. Flatlands<br>5. Reddish (sloping)<br>6. Reddish (rolling) | Fertile soil<br>Poor soil<br>Selected crops<br>Can grow any crops<br>Can be irrigated<br>Requires contour with trees                                                                      | Green onions<br>Pineapple, root crops, cassava<br>Corn, tomato<br>Rice, corn<br>Banana, rubber, falcata, fruit trees<br>Root crops like camote, banana                                                             | Red soil            |
| Mat-i       | 1. Rocky<br>2. Red soil<br>3. Peat<br>4. White clay<br>5. Fertile soil                                                        | Fertile soil; good quality of soil<br>Lack of soil nutrients; higher capital due to additional inputs<br>Good for irrigation<br>Not for planting<br>Rich in soil nutrients                | Any crop<br>Any crop but with fertilizers<br>Rice<br>Vegetables, banana, root crops                                                                                                                                | Red and rocky soils |
| San Nicolas | 1. Loamy<br>2. Sandy<br>3. White clay                                                                                         | Sloping areas, sticky soil, black and light<br>Flatlands, easily washed away by water<br>Hard, water does not infiltrate easily, whitish                                                  | Corn, banana, coconut<br>Peanuts, sweet potato, cassava<br>Timber and fruit trees (Gmelina; mango),<br>vegetables                                                                                                  | Flatlands           |
| Plaridel    | 1. Black soil<br>2. White clay                                                                                                | Fertile soil, productive<br>Dead white rocks                                                                                                                                              | Corn, cassava, coconut, banana                                                                                                                                                                                     | Sandy soil          |

| Village | Types of soil                       | Characteristics                                                                              | Appropriate crops                                                                                                                                                                                                              | Dominant soil |
|---------|-------------------------------------|----------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------|
|         | 3. Rocky<br>4. Red soil<br>5. Sandy | Located in rolling areas near the river<br><br>Unfertile, unproductive<br>Near Cabulig River | Sweet potato, vegetables, cassava grows but with rotten flesh<br>Banana, coconut, timber trees (e.g. Ipil-ipil, Gmelina, falcata, mahogany), fruit trees (mango, Lanzones, jackfruit)<br>None<br>Sweet potato, banana, coconut |               |

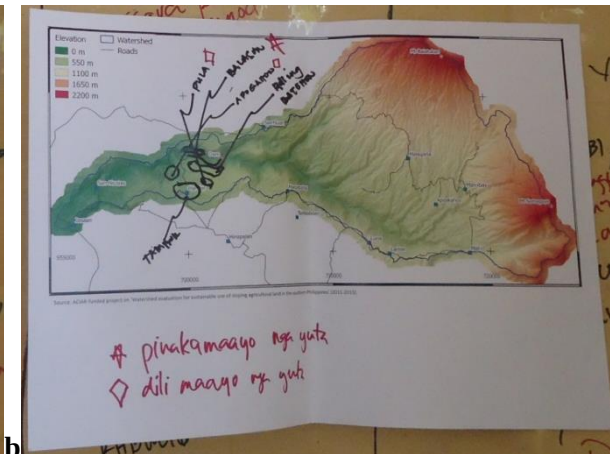
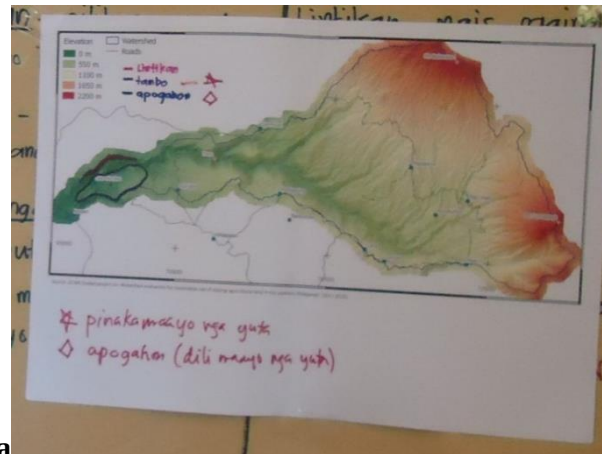


**Figure 1- Mapping dominant soil types in Cabulig watershed, Misamis Oriental (2016); a. Soil map in Plaridel; b. Farmer leader from Luna presenting their soil map to the group; and c. Soil map in San Nicolas.**

## **Perception of change**

As a plenary discussion, the participants were asked to write words or phrases in meta-cards about the major climatic, environmental, and socio-economic changes that occurred in their villages. Interestingly, only one participant in Mat-i focus group was born in Cabulig. The rest were migrants, where the earliest to arrive was in the 1960s. In San Nicolas, participants from the village were all locale while those from Plaridel were altogether migrants.

In Mat-i focus group, one major change noted was the decline of forests, which has been converted into agricultural lands. Although the logging operations have sawed most of the century-old trees from the 1960s-70s, the forest was still dense in the 1980s.

*‘...forest canopy covered the sky as I walked from Aposkahoy to Mat-i. It was always dark in the village even in the daytime... The logging trucks can only carry one log because the old trees were so huge that three people had to hold hands to gather around the base...’ (Aposkahoy farmer)*

There was no proper road during that time. They traveled from one village to another on foot. It was the logging companies that widened the trails for efficient operations. For example, the MinPlyCo developed the road from Sitio Impakibel to Sitio Quiapo in Aposkahoy (towards Mt. Balatukan). However, Typhoon Undang in 1972 damaged this, which started the different routes crossing Cabulig by public vehicles. The ‘weapon’ vehicle<sup>93</sup> transported passengers from the town of Balingasag to Malagana once a day. Those from Gingoog City were conveyed by similar vehicles<sup>94</sup>, while the Lucky Trans bus carried those from the towns of Villanueva and Jasaan passing through Natubo up to Poblacion in Claveria. In later years, the bus reached up to Luna where the Lara logging company was based. People walked from Luna to Mat-i, then to Aposkahoy and further villages.

*‘There was no ‘road’ before. We walked from Mat-i to Aposkahoy and back, underneath tall grasses and ferns. But we had fun because there were so many wild pigs and deer...’ (Aposkahoy farmer)*

The flora and fauna in the watershed were still diverse and rich. They cultivated the logged-over areas and planted these with upland rice, native corn, root crops like sweet potato, yam, taro, and many others, using the slash-and-burn farming system. The use of fertilizers and other farm inputs were unknown to them because the soil was still fertile.

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<sup>93</sup> Similar to military’s 6by6 truck; owned by ‘Labial’

<sup>94</sup> Owned by ‘Apang’

In the late 1980s, Claveria became the major producer of tomato in the region, which product was marketed as far as Manila and other major cities in the country. Agricultural production intensified and expanded replacing the forests. Other commercial crops such as hybrid corn and temperate vegetables followed.

The participants likewise mentioned changes in livelihoods. Although farming remains the main source of income in Cabulig, there are already other off-farm and non-farm alternative livelihoods. For off-farm, the most common is working as daily-paid labourers on larger farms. While for non-farm jobs, some work at government agencies or private companies while others are engaged in small-scale businesses, such as managing sari-sari store, buy-and-sell, driving public vehicles, and others.

Similarly, crops now are more diverse. They remembered that the area before was planted by tomato, followed by hybrid corn. Now, there is a mix of different annual, perennial, and tree crops. They attributed this to technology development on farming systems. The government's projects on post-harvest facilities in the villages have also helped improved the farmer's production systems. However, modern farming technologies, the attack of pest and diseases on crops, particularly vegetables, has become regular and frequent. The use of herbicides and other chemicals has also made weed management on farms problematic.

There was also a difference in the weather. It rained often and was always cold, which they attributed to the thick forests.

*'...I remembered that every day I go to school, I ran out of breath because of the fogs... it was very cold and foggy all the time... it seemed like the heaven was very close to us...' (Mat-i woman farmer)*

Although the weather now in Cabulig's upper villages is still cold as compared to others, they already complain that the weather has become hotter. In connection to this, they noticed extreme changes in climate. They have now experienced an overall decrease in rainfall but with a trend of frequent and short but heavy rainfall resulting in landslides and floods. Dry spells are also longer causing grass/forest fires, especially during summer. This unusual climate and weather have affected the farmers' livelihood.

*'... it is now difficult to distinguish wet and dry seasons, unlike before... it is confusing when to start my cropping...' (Luna farmer)*

The peace and order situation was also considered a major change in Cabulig. In the early 1980s, the New People's Army (NPA) found a stronghold in the area with mass support. They were so strong in 1983 up to 1985. At that time, the farming activities were disrupted and damaged because the area became a 'no man's land'. People left the villages down to coastal towns and neighbouring provinces leaving their farms, particularly coffee farms. Only the women and

children were allowed to stay and had to take over with their farming livelihood. Today, the NPAs are still within the watershed, while several military detachments exist.

*‘This discussion will not be complete without mentioning the peace and order situation that started in the early 1980s, because this affects us until now. Many of our neighbors did not come back in the village, especially those who evacuated in Bukidnon province and found better lands to farm...’ (Aposkahoy farmer)*

In San Nicolas focus group, the changes perceived by the participants were almost similar<sup>95</sup> except for these two are unique to downstream villages.

They noticed that although Cabulig River has never run dry, it has become shallower than before. This was attributed to the destruction of forests upstream, particularly during the logging years in the 1970s followed by the plantation companies in recent years. Landslides and soil erosion contributed to soil fertility decline.

*‘The Cabulig River became shallow because there are fewer trees that can provide water during drought-like now. There are fewer trees that also hold eroded soil, hence all soil goes downstream making the river shallow. (Plaride farmer)*

*‘The company’s canals are so big that during heavy rainfall, the overflows are so intense like river flooding. The overflows flood the cornfields of smallholder farmers, including the fertile soil. (Plaridel farmer)*

The ‘bayanihan’ spirit has also declined over the years, which is a Filipino custom of communal unity, work, and cooperation to achieve a particular goal. In farming, ‘hunglos’ or ‘pahina’ (cooperative farming) was commonly practiced before where a group of farmers works together in a farm, and then move to another until all is done within the cropping season<sup>96</sup>. It was the custom for most smallholder farmers from the 1960s-70s who lack the cash to pay for daily labour. This started to decline in the 1980s when commercial production began by landowners where working as daily paid labour became another source of income.

*‘... now, all is paid. Nothing is free... The young ones are more difficult to organize because of the gadgets. For communal activities, all they know is organizing basketball league, which does no good for the environment and community... so different from our days before...’ (San Nicolas farmer)*

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<sup>95</sup> They mentioned the decline of forest areas, declining soil fertility over time, changing climate that also changed cropping seasons, frequent and extreme weather events like flooding, population growth, and better roads.

<sup>96</sup> One family would prepare lunch and snacks on a particular day, another the next day, and so on.



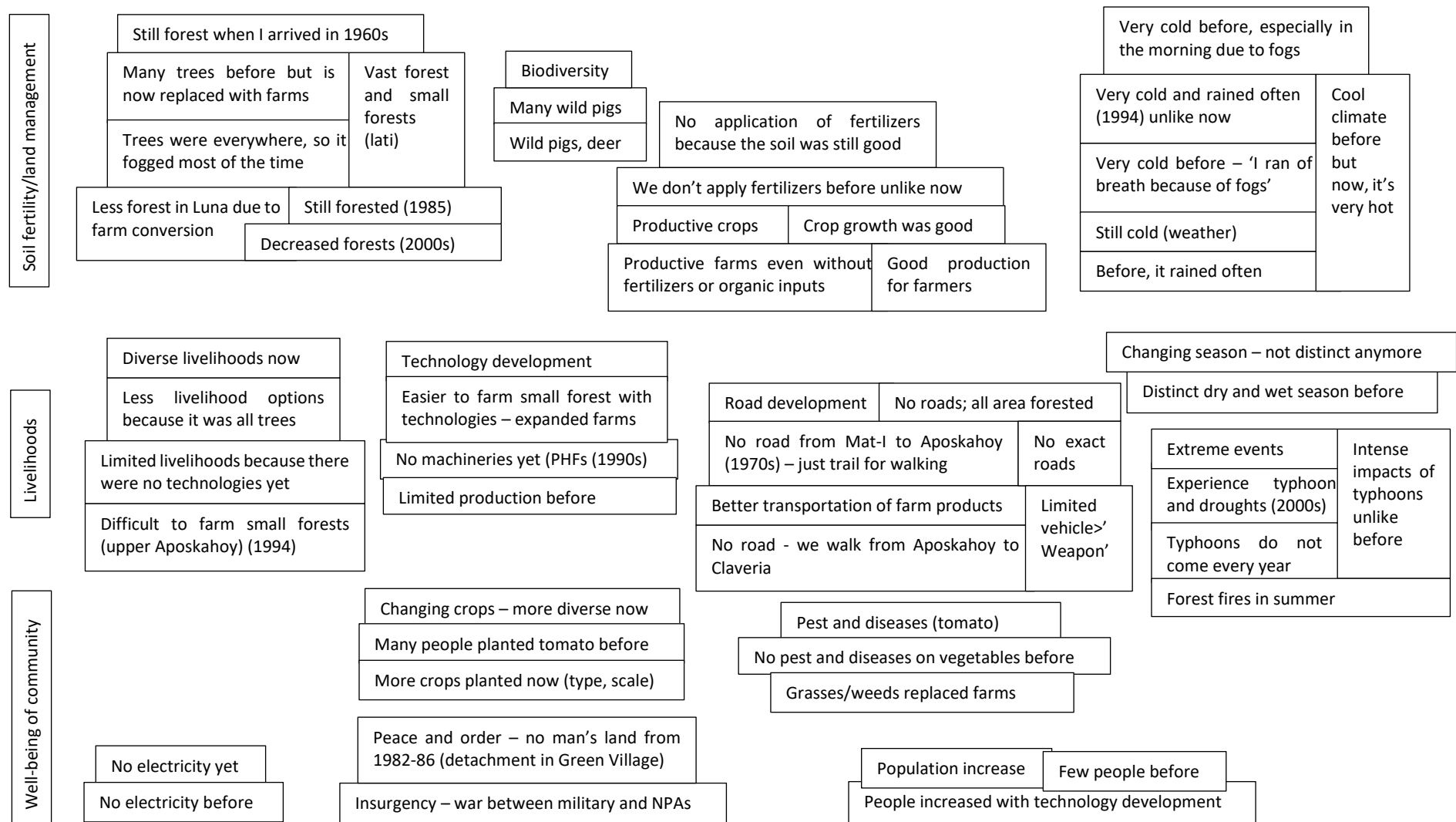


**Figure 2- Major environmental and socio-economic changes that occurred mid-and-upstream of Cabulig watershed, Misamis Oriental from 1960s-2016**

## ***Changes' effects on farming livelihood and coping and adaptation mechanisms***

From the previous historical timeline activity, the participants selected three changes that caused major effects on their farming livelihood (Table 4). In the group discussion, results revealed that farmers are already reacting to the perceived changes. The following discussion deepens certain changes and shows some of the participants' different coping and adaptation mechanisms to respond to the changes experienced.

Climate change is already perceivable in the watershed. The participants from Aposkahoy and San Nicolas shared the changing weather patterns, which already made it difficult for them to distinguish between the various seasons. They noticed that typhoons come frequently, more destructive, and no longer follow the 'typhoon season'. This affected their farming livelihood, and consequently their income. With lesser income, they suffer food shortages and unable to send children to school. In response, they are integrating trees on their farms ('plant trees'), and encouraged the government to seriously take the lead in 'restoring the environment'. Otherwise, the food shortage will intensify, and the country will depend on food importation.

*'... with more and more calamities occurring, farming is now like a gamble. It's either you get 'jackpot', which is seldom, or 'failure' that is more often...' (Aposkahoy farmer)*

*'I grew up thinking that when it is March, it is really dry. Sometimes, the rain began at the end of April, so that by May, I expect that most, if not all, have already sowed corn. And then we sow again by November... But now, it is just so different. (San Nicolas farmer)*

Land use has also changed Cabulig's landscape over the years. The participants from Luna and Mat-i narrated the pattern of land use change. In the 1990s, hybrid corn replaced most of the tomato farms that were affected by pests and diseases ('bacterial wilt'). Although the capital required was high, it gave them a good income. To minimize the cost of farm inputs, they apply an 'appropriate amount of inputs'. The correct application of inputs also reduces the impacts of land cultivation. They likewise diversify their crops to reduce the risk of climate change and fluctuating market prices. In the 2000s, the Del Monte Philippines, Inc. started their pineapple plantation in Luna. For those farmers who rented out their lands, they used the payments as start-up capital for non-farm livelihoods. Although one member per family that rented out land can be employed by the company, work is seasonal and is based on the contract. Hence, contrary to common beliefs, villages do not also fully benefit in terms of employment because pineapple plantations require limited labour. To cope, they engage in other off-farm and non-farm livelihoods. They think that if this continues, the soil will be degraded. In 2011, banana plantations began in the watershed, which based its operation in Mat-i. The banana plantation is more labour-intensive than pineapple, with a ratio of 2:1 labour per hectare, hence it provides local

employment. The company also increases the villages' Internal Revenue Allocation (tax), as well as helps maintain village roads. However, the soil becomes degraded because of monocropping. The use of too many pesticides, which poses health hazards not just to the workers but also to the communities surrounding the plantations. Since the company has to exist for years, the village government maximize their presence by implementing medical missions, tree planting activities, and many others. Otherwise, the degradation of their environment will come sooner than imagined. In 2013, Phillip Morris came and introduce tobacco in the farmers' system. Many farmers tried cultivating the new crop because of the financial and technical assistance provided. The 'soft loan' enables them to receive 60-40 payment of their weekly produce. Accordingly, the loaned capital is already recovered after the 4<sup>th</sup> harvest. The income from 5<sup>th</sup> harvest up to clearing is already the farmer's profit. However, they perceived health hazards among the workers as the main problem. Hence, they encourage the landowners to invest more on protective gear, so more labourers can use these and be protected. This should be regulated, otherwise, that believe that time will come when tobacco farmworkers will become sick. There will be more smokers, hence will intensify sickness related to smoking.

The participants from Malagana and San Nicolas experience the impacts of declining soil fertility in their livelihoods. Farm's productivity has declined over the years. Because of soil deficiency, farmers have to add more inputs like fertilizers, which expensive costs lessen their income. As such, they are unable to support their household's basic needs. To address this, they link with government agencies that provide them livelihood assistance. They also change their farming practices by incorporating organic fertilizer aimed to improve soil fertility. When able, they also change their crops into those with the assured and better market price. Otherwise, soil degradation will continue as well as poor farm's income. Since local farmers can no longer produce, the government will depend on food importation.

*'Our farm income has reduced because of soil deficiency. We need to put more inputs. We need more fertilizers to ensure production and earn a bit of profit. (Plaridel farmer)*

Interestingly, the participants from San Nicolas and Plaridel identified population growth as a major change that affected their farming livelihood. More people mean more manpower to engage in farming production. However, land ownership is concentrated on bigger farmers caused by land renting, land selling, and other forms of arrangements. Hence, they find alternative livelihoods that are often under economic livelihoods, which are low-paid and unstable. Poverty is one source of increasing crimes, such as stealing. They suggested implementing the recently

approved Reproductive Health Law<sup>97</sup>. Otherwise, people under the poverty line like farmers will rapidly increase.

*‘There are lesser economic opportunities with an increasing number of uneducated people. They end up farmers, but the land is not increasing while government support is scarce. We have to find any livelihood available just to earn income and live each day that comes...America is progressive because most of them have only two children. We should do the same.’ (Plaridel farmer)*

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<sup>97</sup> The Responsible Parenthood and Reproductive Health Act of 2012 (Republic Act No. 10354) guarantees access to methods on contraception, fertility control, sexual education, and maternal care. The passage of the legislation was controversial because of opposition, mostly based on religious, health reasons and others.

**Table 4- Perceived major changes in Cabulig watershed, and their effects on farming livelihood (2016)**

| Village   | Changes                                   | Effect on livelihood                                                                                                                            |                                                                             | Coping or adaptation strategy                                                                                                                               | Possible risks in the future                          |
|-----------|-------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------|
|           |                                           | +                                                                                                                                               | -                                                                           |                                                                                                                                                             |                                                       |
| Aposkahoy | Climate vulnerabilities & extreme events  |                                                                                                                                                 | Farming is now a gamble – sometimes jackpot but often a failure             | Plant trees to help bring back the climate, at least within the watershed                                                                                   | More calamities                                       |
|           | New farming technologies                  | Easy farming; high yield                                                                                                                        | Degraded soil due to dependence on farm inputs (e.g. pesticides, chemicals) | Be selective; adopt sustainable farming technologies (e.g. organic farming)                                                                                 | Degraded soil                                         |
|           | Transportation & communication            | Easy marketing & better access to information with cellphone & internet (though intermittent); less labour required; better quality of products | Oversupply of products; lesser income                                       | Improve cell sites; continuous improvement of roads                                                                                                         | Sickness due to emissions from vehicles (e.g. cancer) |
| Luna      | Presence and expansion of corporate crops |                                                                                                                                                 |                                                                             |                                                                                                                                                             |                                                       |
|           | Hybrid corn (1990s)                       | Good income                                                                                                                                     | High capital                                                                | Apply appropriate inputs; diversify crops                                                                                                                   | Degraded soil (inputs); lesser income                 |
|           | Pineapple (2000s)                         | Payment for land rent used for other business; company job for one family member                                                                | Limited labour for hire in the village                                      | Engage in other livelihoods                                                                                                                                 | Degraded soil                                         |
|           | Tobacco (2013)                            | Provided capital (soft loan)                                                                                                                    | Health hazard (e.g. workers, smokers)                                       | Invest and use protective gears                                                                                                                             | Sickness (e.g. workers, smokers)                      |
| Malagana  | Declining soil fertility & farm income    |                                                                                                                                                 | Unable to support basic needs                                               | Link with agencies that can provide livelihood assistance; change crop with assured & better market price; use organic fertilizer to improve soil fertility | Degraded soil; poor income                            |
|           | Lack of capital                           |                                                                                                                                                 |                                                                             | Access financial aid from agencies; loans from individuals & banks                                                                                          | Debt                                                  |

| Village     | Changes                                                    | Effect on livelihood                                                                                              |                                                                                                                                      | Coping or adaptation strategy                                                                    | Possible risks in the future                                                      |
|-------------|------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|
|             |                                                            | +                                                                                                                 | -                                                                                                                                    |                                                                                                  |                                                                                   |
|             | Poor market (when produce is abundant)                     |                                                                                                                   | Poor market price                                                                                                                    | Contract buyers (maybe institutional buyers for higher and stable price)                         | Debt                                                                              |
| Mat-i       | Road development                                           | Faster delivery of products; better quality of products; better income with quality products                      | Casualties due to road accidents (irresponsible driving)                                                                             | Prohibit drying of coffee, rice & corn on roads; enact barangay ordinance on a speed limit       | Increase cases of road accidents                                                  |
|             | Electricity                                                | Fueled village development; better access to information (e.g. weather, disaster updates) & technology            | Additional household cost (monthly dues); damaged environment (coal power plants)                                                    | Minimize & control electricity use in the household; policy advocacy – ‘no to coal power plants’ | Degraded environmental due to coal power plants                                   |
|             | Presence of multinational companies (DOLE, Phillip Morris) | Provided livelihoods (DOLE is labour-intensive; 2:1 labour per ha); maintained village roads; increased IRA (tax) | Degraded soil (too much of pesticides); health hazard; monocropping                                                                  | Capitalize on the presence of companies – medical missions, tree planting                        | Environmental degradation                                                         |
| San Nicolas | Climate change                                             |                                                                                                                   | Cannot plant on exact month; Reduced one cropping per year (before 3x/yr); hunger; lesser income (unable to send children to school) | Restore the environment                                                                          | Hunger; depend on food importation                                                |
|             | Population growth                                          |                                                                                                                   | Lesser economic opportunities - many people while the land area remains                                                              | Total implementation of birth control                                                            | Increased traffic congestion; More people below poverty line (increasing poverty) |
|             | Declining soil fertility                                   |                                                                                                                   | Increased farm inputs; lesser income                                                                                                 | Seek government support                                                                          | Depend on food importation                                                        |
| Plaridel    | Shallower Cabulig River                                    |                                                                                                                   | Lesser number and kinds of fish; lesser water quantity meant for farming                                                             | Prohibit collecting small fishes; plant trees in degraded forests                                | Hunger for farmers & others; flooding during rainy season/typhoons*               |

| Village | Changes            | Effect on livelihood            |                              | Coping or adaptation strategy                 | Possible risks in the future                |
|---------|--------------------|---------------------------------|------------------------------|-----------------------------------------------|---------------------------------------------|
|         |                    | +                               | -                            |                                               |                                             |
|         | Population growth  | More production (more manpower) | Limited employment           | Find alternative livelihoods to ensure income | Increasing crimes (e.g. stealing)           |
|         | Forest degradation |                                 | Poor agricultural production | Ban illegal logging; planting durable trees   | Worsened climate change, especially drought |

\*Fear that dam will collapse in case of an earthquake causing flashflood

## Seasonal calendar

The seasonal calendar documents regular cyclical periods and significant events that occur during a year and influence the life of a community. This includes major climatic and environmental periods and hazards. This activity allows participants to represent their understanding of the seasons, which usually differs from our understanding of seasons.

In San Nicolas focus group, there is a difference when their seasonal calendars start due to their location in the watershed. Although both villages are located downstream, Plaridel's seasonal calendar starts in June while it starts in May for San Nicolas (much lower). The dry and wet seasons have become more variable in the past years. The dry season has become longer with more intense droughts. While the rainy season has become shorter but extreme.

*'... We can no longer start cropping on exact months as before. Seasons are no longer regular because rain does not come when it should.'* (Plaridel farmer)

Water availability is a major problem in San Nicolas and Plaridel, especially with the increase of population. In San Nicolas, the usual dry period is from February to April with the driest in March. They experience water scarcity problems on these months, especially potable water for household use, which peaks in April<sup>98</sup>. Cabulig Rivers has been a source of water for various uses. However, the quality of the river water has declined over the years that households have to rely on underground water. The rainy season, on the other hand, starts in May, which tends to worsen in the last quarter of the year. Typhoons, flooding, flash flood, and landslides usually occur from October to December.

Meanwhile, farm animals' sickness has intensified in these villages over the years similar to crops' pests and diseases<sup>99</sup>. August is the month when animal farms often get sick, and pests and diseases come and damage crops. Hence, the farming income of most farmers is affected resulting in the limited food supply.

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<sup>98</sup> In one of the Village Council's regular monthly meeting during the scoping study, one of the issues that came out was how to effectively distribute potable water among its constituents.

<sup>99</sup> One of the reasons why San Nicolas valued the Municipal Agriculture's Office is their regular animal vaccination activity.



**Table 5- Seasonal calendar in San Nicolas, Cabulig watershed (2016)**

| Climatic & environmental periods & hazards | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | Jan | Feb | Mar | Apr |
|--------------------------------------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| Dry period                                 |     |     |     |     |     |     |     |     |     | **  | *** | **  |
| Rainy season                               | *   | **  | *   | *   | *   | **  | **  | *** |     |     |     |     |
| Typhoon                                    |     |     |     |     |     | **  | **  | *** |     |     |     |     |
| Flooding                                   |     |     |     | *   | *   | **  | **  | *** |     |     |     |     |
| Flashflood                                 |     |     |     |     |     | **  | **  | *** |     |     |     |     |
| Landslide                                  |     |     |     |     |     | **  | **  | *** |     |     |     |     |
| Water scarcity                             |     |     |     |     |     |     |     |     |     |     | **  | *** |
| Hunger period                              |     |     | **  | *** |     |     |     |     |     |     | **  |     |
| People's sickness                          | **  |     |     |     |     |     |     |     |     |     | *   | *** |
| Animals' sickness                          |     |     |     | *** |     |     |     |     |     |     |     | *   |
| Pest and diseases                          |     |     |     | *** |     |     |     |     |     |     |     |     |

\*\*\*very intense; \*\*intense; \*not intense

### ***Livelihood seasonal monitoring calendar***

The livelihood seasonal monitoring calendar documents through the year the important periodic livelihood activities on which farming communities depend. This identifies the production systems and income earning periods throughout the year that are most relevant to the food and livelihood security in the villages.

Although livelihood activities are more diverse in San Nicolas as compared with Plaridel, agriculture remains the main source people's livelihood in both villages. In San Nicolas, the major agricultural production systems include cash crops, perennials and fishing. For cash crops, they plant corn twice a year where they prepare land and sow seeds in May and October. After harvesting in August (first cropping) and January (second cropping), they sow mung bean<sup>100</sup>. Coconuts are also a common crop in on the riverbanks and river plains. Apart from making copra, making 'tuba'<sup>101</sup> is another source of income for the farmers. Underneath the coconuts are the bananas (e.g. Cavendish and other native varieties like señorita). These are often planted beginning May, which is the start of the rainy season. After 18 months, harvests are done every

<sup>100</sup> Locally known as 'mongos', mung bean is a nitrogen-fixing legume cultivated for its edible seeds and sprouts. This is among the cheapest source of vegetable protein, vitamins, calcium and sodium. It is a good crop for green manuring because it matures early, grows fast and produces abundant vegetative tops, hence enhances soil fertility; also commands good market price.

<sup>101</sup> Coconut red wine is the product of mixing 'barok' (a reddish color bark of mangrove tree [tungog tree]) with the coconut sap.

after two weeks. Vegetable gardening is also widespread in the village such as string beans, pechay and okra among others. These are planted in small plots at the backyard, hence are often managed by the wives including the marketing. There are still few who engage on fishing in the river, mostly between the months of July-August and October-December. As in other villages in the watershed, working as hired labour<sup>102</sup> is the most common off-farm livelihood. Demand is high for farm help in the months of May and Aug, and October and January as these are the planting and harvesting seasons. For non-farm livelihood, driving motorcycle<sup>103</sup> for transporting people and farm products from the village to Jasaan town is common.

**Table 6- Seasonal calendar of livelihoods in San Nicolas, Jasaan (2016)**

| Livelihood activity | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | Jan | Feb | Mar | Apr |
|---------------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| On-farm             |     |     |     |     |     |     |     |     |     |     |     |     |
| Corn                | p   | m   | m   | h   |     | p   | m   | m   | h   |     |     |     |
| Mung bean           |     |     |     | p   | m   | h   |     |     | p   | m   | h   |     |
| Banana              | p   | m   | m   | m   | m   | m   | m   | m   | m   | m   | m   | m   |
| Backyard gardening  | p   | m   | h   |     | p   | m   | h   |     | p   | m   | h   |     |
|                     |     |     |     |     |     |     |     |     |     |     |     |     |
| Off-farm            |     |     |     |     |     |     |     |     |     |     |     |     |
| Making coconut wine | /   | /   | /   | /   | /   | /   | /   | /   | /   | /   | /   | /   |
| Hired labour        | /   |     |     | /   |     | /   |     |     | /   |     |     |     |
| Fishing             |     | /   | /   | /   |     | /   | /   | /   |     |     |     |     |
| PVEC (Soya)         | /   | /   | /   | /   | /   | /   | /   | /   | /   | /   | /   | /   |
|                     |     |     |     |     |     |     |     |     |     |     |     |     |
| Non-farm            |     |     |     |     |     |     |     |     |     |     |     |     |
| Driving motorcycles | /   | /   | /   | /   | /   | /   | /   | /   | /   | /   | /   | /   |

p- planting; m- maintenance; h- harvesting

Combining the seasonal and livelihood calendars shows the periods when the livelihoods in San Nicolas livelihood are under pressure due to climatic and environmental periods and hazards. For example, when dry and wet seasons peak on April and December, respectively, the farmers cope by focusing on off-farm and non-farm activities, such as driving motorcycle for those who have or seek work in PVEC for contractual jobs. During summer, most of the women's backyard gardening temporarily stops, especially those located in or near the village, due to water scarcity for watering the vegetables. In fact during this time, access to potable water from their electric-

<sup>102</sup> Locally termed as 'magmoso'

<sup>103</sup> Known as 'habal-habal'

based water system is scheduled per communal point<sup>104</sup>. The village council also encourages households to collect and use this water just for drinking and cooking. However, some households also store water for washing, bathing and others because it is more convenient than going to the river. Others just buy gallons of distilled water from bigger stores in the village, but that is another extra household cost<sup>105</sup>. The village council encourages boiling water for health reasons. Meanwhile, coconut wine making is a good source of income during these periods because the buyers from other villages and in Jasaan town are already established. They just have to deliver gallons of coconut wine in these stores, while some personally collect the wine from their farms. During rainy season, particularly October to December, fishing is an alternative source of food. But it can also be dangerous because of flashfloods. Hence, the village council cautions fishing, especially when there are typhoons.

### ***Community ranking of hazard severity***

After identifying the major environmental periods and hazards and livelihoods activities using the above calendars, the participants were asked to identify the hazards that have the greatest impacts on their soil/land management and farming livelihoods. This was done using a simple radar chart. In the figure below, 1 stands for ‘has very negligible impact’ while 5 stands for ‘has a severe impact’ on farmers’ soil/land management and farming livelihood.

Different hazards affect farmers’ soil/land management and farming livelihoods, as well as the severity of their impacts. Participants attributed this to their communities’ location in the landscape (Figure 4). Mat-i and Malagana identified similar hazards. Their villages are both affected by the strong winds from December to March, which they call ‘payahan’. They are unable to plant valuable crops during these months and so they rely on off-farm and non-farm livelihoods<sup>106</sup>. The impacts of typhoon, flooding and landslides are most severe in Mat-i than in Malagana because Cabulig River traverses the former’s main village that is highly populated with riversides’ that are well cultivated. While flashflood has negligible impacts to Plaridel, it has big impacts to San Nicolas. Located downstream in the watershed, San Nicolas is more prone to flashfloods. Hence, they become extra vigilant when there is heavy rainfall. One instance that was still fresh to them was the Typhoon Senyang on December 2014 where about 30 houses were totally damaged resulting from the flashflood and flooding. Notably, Aposkahoy farmers identified peace and order that severely affects their land management and farming livelihoods.

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<sup>104</sup> Level II where the piped water with a communal water point (spring system) serves an average of 4-6 households within a 25-metre distance.

<sup>105</sup> The researcher and enumerators experienced the difficulty of water availability during the household survey. For a week, they wash and bathe in the river, and had to buy distilled water for potable water.

<sup>106</sup> During the scoping study (2015), farmers from Aposkahoy consider these as the most difficult months of the year in terms of income and food.

Although actual combats seldom happens, their farming activities, especially those located in remote areas, are limited when either of the government's military or the NPA soldiers are in the area to avoid any possible confrontation.

*'... it is difficult to be in the middle of the two fighting groups when all we want to do is farm to make a living...' (Aposkahoy farmer)*

Overall, most participants considered drought as the hazard that has severe impacts to their land resource and farming livelihood. They recounted the droughts that occurred in the past decades. Among these, the 1998 El Niño<sup>107</sup> was the long dry spell that affected them so much from the agriculture sector, as it almost caused the Cabulig River to dry up particularly in the downstream. It induced extensive destruction to already degraded watershed and grasslands because of forest fires. Needless to say, the 2015-16 droughts were current problem that farmers faced during the discussion, particularly those growing corn. Because they are rain-fed dependent, hence they feel

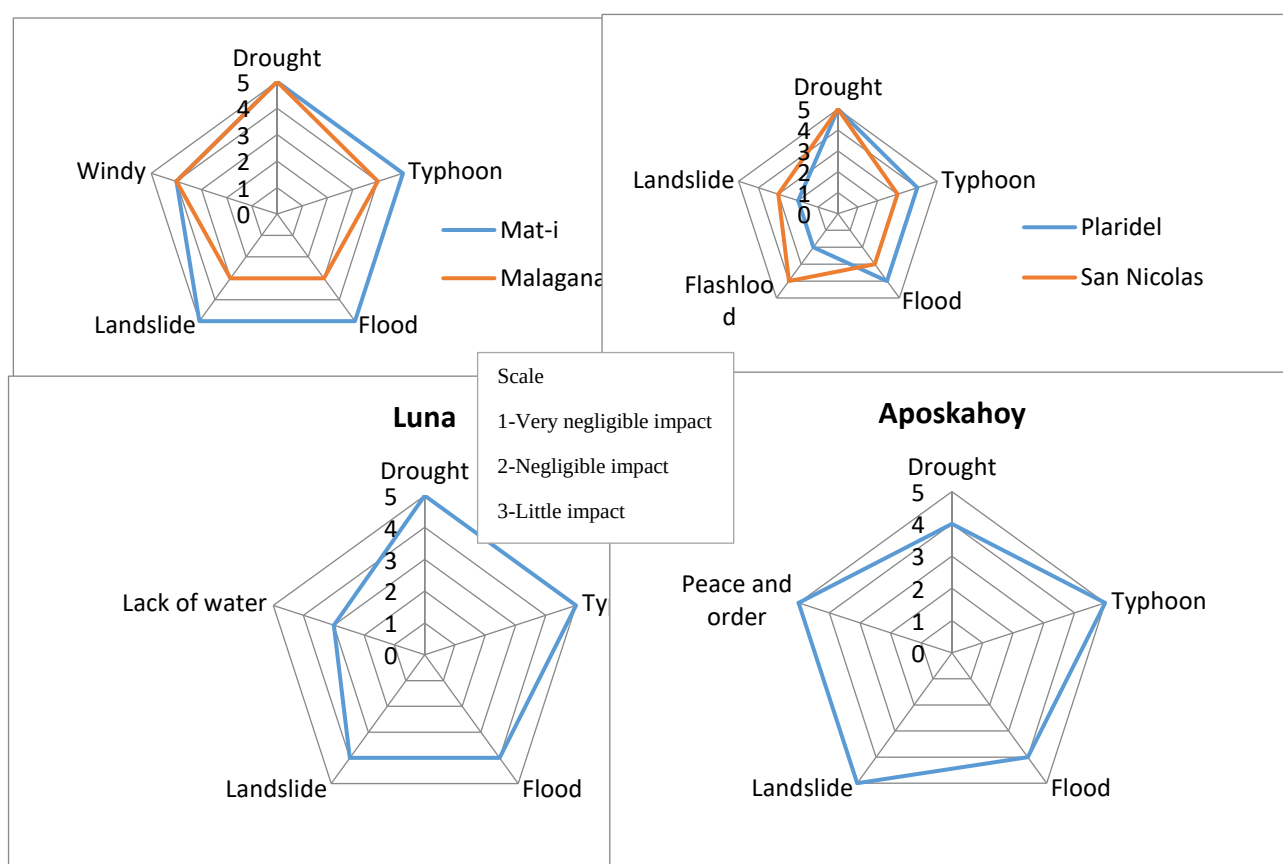


Fig3 - Radar chart for hazard severity ranking in Cabulig watershed, Misamis Oriental (2016)

<sup>107</sup> The 1998 El Niño affected 90 percent of the country with a 50 percent reduction in rainfall. More than 2 million people in 11 provinces in Mindanao were affected by the drought, which forced the government to import 640,000 tons of rice that year (Warren 2013).

In Mat-i focus group, all the participants were either leaders of farmer organizations or members of the village councils such as policymaker or office staff. In a plenary discussion, some key issues related to social capital<sup>108</sup> were discussed.

### ***Enabling conditions for successful farmer organizations***

There are several conditions that participants identified to become effective and successful farmer organizations. According to them, it is important that the organization has a clear goal as this unites them and motivates them in making decisive actions. The organization also needs to have rules and regulations ('by-laws') that are strictly implemented. This ensures smooth implementation of activities, and minimizes, if not avoid, unexpected issues from emerging. Trust to fellow members is another rider they mentioned. Effective system and management is likewise needed. Finally, they prefer God-fearing leaders who listen to members' perceptions and experts' advises.

Although there was consensus on the benefits of being part of an organization, the participants agreed that most people in their village are no longer interested on activities that involve group formation and the likes due to previous experiences. One of the main problems was transparency of transactions, where only the leaders make decisions for the whole group. The benefits, particularly financial gains, are concentrated to certain members but the whole group bears the burdens when there are already problems. This developed distrust among people. Hence, the participants preferred God-fearing leaders than those who are intelligent and smart but greedy and breaks the rules themselves.

### ***Farm financing***

Although most smallholder farmers are self-financed, some farmers in the household survey are supported financially. Surprisingly, several participants in Mat-i focus group admitted that their farming activities are likewise funded by various financiers. Some were financed by big farmers while others loaned from cooperatives. While there are advantages and disadvantages involved in farm financing (Table 7), farmers have respective reasons for deciding where to seek financing. First is accessibility. There are some big farmers in the watershed who are more accessible than those rural banks located only in the towns of Jasaan and Balingasag.

*'It is easy to get financing from individual financiers who are often just your neighbors... it is just a matter of yes or no that moment you asked for help... whereas in banks, you will have to go through a long process...' (Aposkahoy farmer)*

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<sup>108</sup> During the discussion, social capital referred to networks of relationships among people who belong in a particular farmer organization, enabling that organization to function effectively.

For example, a big farmer who specializes on financing tomato production has trusted assistant/secretary in Cagayan de Oro City where farmers go to express their financial problem. If it is the farmer's first time, the assistant/secretary evaluates their capability to pay based on some criteria that are mostly rooted on village network and trust (e.g. recommendation). If an old borrower, the assistant/secretary checks their record for any outstanding dues. The assistant/secretary then makes recommendations for the big farmer to decide. If approved, a voucher is given to the farmer to get the inputs (e.g. seeds, fertilizer) from the big farmer's agricultural supply, as well as some cash to pay for the labour cost if also needed. Interestingly, it is understandable that once a farmer get financing, he or she has to sell the produce to the financier where the whole debt is deducted every harvest until it is totally paid. If by chance the cropping failed, the big farmer will still get financing for the next season until all the money owed is paid. However, it is seldom that they get to pay their dues in just one cropping unless the production is really good or the crop's market price is very high. Accordingly, they often have a remaining balance to pay, hence they have to seek financing again, and the cycle goes on with their debt continue to soar. Some big farmers have ceiling on farmers' debt (e.g. P70,000 to 150,000 up to 500,000 for one big farmer in Malagana). Unfortunately, they were cases where land ownership or rights are taken away due to inability to pay the swelling debt. This is one bad effect of resorting to 'homely' negotiations without any contracts or clear conditions. Indeed, accessing individual financing is easy but the risks can also be high.

While the interest rate per annum for bank financing is lower, smallholder farmers find it difficult to secure financial assistance from banks. There are many documents required, and one which is land title as collateral which most smallholder farmers do not have. The process of securing approval also takes time. For example, after submitting all the requirements, the applicant has to wait for the credit investigation, where a bank representative visits and confirms all the information and documents presented. Most smallholder farmers do not have the patience and time to endure this long and costly process. Primarily because they are culturally used to trust commonly involved in one-on-one transaction.

Most of the participants were positive about securing loans from cooperatives<sup>109</sup>.

*'... [cooperatives have] lower interest rate, which diminishes over the years. I also like receiving my dividend share every year and patronage refund, hence my capital share also increases. Aside from this, I also have health insurance...' (Aposkahoy farmer)*

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<sup>109</sup> They were particularly referring to the First Community Cooperative (FICCO), Oro Integrated Cooperative, and the Cooperative Bank of Misamis Oriental.

Cooperatives also offer additional benefits such as medical assistance and livelihood training. Unlike with banks that stick to the payment agreement, cooperatives provide consideration when borrowers fail to pay their dues unlike with banks.

*‘...the penalty rate of banks is so high. Our P35,000 loan from a rural bank became P80,000 because we failed to pay the monthly dues for only 10 months...at that time, our cropping failed because of drought but banks have no considerations for cases like that...’ (Aposkahoy farmer)*

In general, they resort to these individuals and institutions, as they have nowhere to go when their production failed. They continue farming as there is limited livelihoods in the watershed, with the hope that the next cropping will be better.

**Table 7- Farmers perceived benefits and detriments of farm financing in Cabulig watershed (2016)**

|               | Financing                                                                                                                         |                                                                                                                                                                                                                                                                 |                                                                                                                                                                                                                                                                 | Loan                                                                                                                                                                         |                                                                                                                                     |
|---------------|-----------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------|
|               | Individual                                                                                                                        | Bank                                                                                                                                                                                                                                                            | Cooperative                                                                                                                                                                                                                                                     | Individual                                                                                                                                                                   | Group                                                                                                                               |
| Advantages    | <ul style="list-style-type: none"> <li>• Easy access</li> <li>• Get re-financed when cropping fail</li> </ul>                     | <ul style="list-style-type: none"> <li>• Many choices</li> <li>• Lower interest per annum</li> </ul>                                                                                                                                                            | <ul style="list-style-type: none"> <li>• Exclusive to members</li> <li>• Diminishing loan interest (annually)</li> <li>• Dividend share</li> <li>• Patronage share</li> <li>• Insurance</li> <li>• Medical assistance</li> <li>• Livelihood training</li> </ul> | <ul style="list-style-type: none"> <li>• Full responsibility in paying dues</li> <li>• Encouraged to really pay dues</li> <li>• Gets all the profit if successful</li> </ul> | <ul style="list-style-type: none"> <li>• Unity within the group in terms of goal</li> <li>• Increase livelihood projects</li> </ul> |
| Disadvantages | <ul style="list-style-type: none"> <li>• Higher interest</li> <li>• Homely negotiation (has both good and bad effects)</li> </ul> | <ul style="list-style-type: none"> <li>• Complicated process</li> <li>• Takes time (e.g. approval)</li> <li>• Requires collateral</li> <li>• Requires co-maker</li> <li>• Many requirements</li> <li>• Strict monthly payment (penalty rate applies)</li> </ul> | <ul style="list-style-type: none"> <li>• Risky for the 2 co-makers</li> <li>• Complicated and strict process</li> <li>• Strict monthly payment (1 month consideration and more assistance)</li> </ul>                                                           | <ul style="list-style-type: none"> <li>• Gets all the burden if failure</li> </ul>                                                                                           | <ul style="list-style-type: none"> <li>• Pay the dues for others who don't pay ('dili makadasig')</li> </ul>                        |

Interestingly, most participant preferred individual loan than group loan. They reasoned that in individual loan, the farmers have to do well in their activities to pay the dues. They are responsible for all their decisions and actions. When the results are good, they get all the profit or benefits. However, they also carry all the burdens when they fail.

Although they admitted that it is good to work as a team, it just does not work anymore especially when money is involved. In a group loan, sometimes they have to bear the problems of others, which they believe is unfair.

*‘Our experience with group loan is that of ‘selda-selda’, where each group has five members. We really have to help other to pay the dues. Otherwise, we also have to share in paying the penalty.’*  
(Mat-i farmer)

## **Institutions**

### ***Venn diagram on network of institutions***

A Venn diagram on institutions is used to identify the key institutions that are supporting the communities’ farming livelihood. The diagram shows organizations and groups in the villages, as well as their view of the importance of different organizations and groups. It also demonstrates who participates in these groups, and shows the institutional relationships between and among different organizations and groups.

There are three categories of institutions that support the communities’ farming livelihoods (Table 8). The participants from Plaridel identified all private organizations, such as the hydropower electric power plant, pineapple plantation and rural bank. This is in contrast to San Nicolas’ all government organizations, which were all national government agencies (NGAs). Finally, other villages had a mix of private and public organizations.

Within these villages, there is difference on the number of organizations and extent of their programs and projects. Noticeably, there are quite limited organizations in San Nicolas, which are mostly from the national and local government. This is in contrast upstream, where there are more organizations helping the communities, with activities that are also more diverse. Aposkahoy has listed the most number of organizations, which activities range from securing land tenure, forest- and agriculture-based livelihoods, irrigation, and many others. This can be attributed to the village’s massive land area with important ecosystem such as the Mt. Sumagaya and Mt. Balatukan protected areas, which are inhabited by both migrants and Higaonon indigenous community, including the religious group of Doal Nara that has international network. It is important to note that most participants recognized NGAs as the most important institution in the watershed. San Nicolas and Malagana in particular, selected the Department of Agriculture as the most institution in their villages. In the case of San Nicolas, the farmers recognize the importance of DA’s regular seed subsidy and animal vaccination projects. While in Malagana, the village has been the recipient of major post-harvest facility projects in the Municipality that have benefited most farmers. Of course, these project are channeled through the LGU’s Municipal Agriculture’s Office.



**Table 8- List of important government and non-government organizations in the village**

| Plaridel                              | San Nicolas              | Aposkahoy                                                                                                                                                                                                                                                          | Luna                                                                | Malagana                               | Mat-i                                                                                                                    |
|---------------------------------------|--------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------|----------------------------------------|--------------------------------------------------------------------------------------------------------------------------|
| Minergy*<br>DMPI<br>First Valley Bank | DENR-X<br>DA-X*<br>DTI-X | DENR (e.g. NGP)*<br>DAR (e.g. CARP)<br>LGU (e.g. MAO)<br>NIA (e.g. irrigation –<br>sentro)<br>MIC (Korea)<br>Catholic Relief<br>Services<br>Banco Balay sa<br>Mindanaw<br>Foundation<br>Tibod<br>ASA Philippines<br>DSWD (e.g. Kalahi<br>CIDSS)<br>DILG (e.g. BUB) | DA-X*<br>Phillip Morris<br>Del Monte<br>ICRAF/<br>Landcare<br>DAR-X | DA-X*<br>Phillip Morris<br>MIC (Korea) | NIA*<br>DAR (e.g.<br>CARP)<br>DOLE<br>(MLGU)<br>Kinimer/First<br>Valley Bank<br>MAO (MLGU)<br>DSWD<br>Philippine<br>Army |

\*Organization that has done most to the farmers

In terms of institutional relationships, there is variations in the way the village governments and/or farmer organizations connect, regard and behave with their partner institutions. Some relationships are formal, while others are informal. For example, the individual farmers who have accessed financial assistance from rural banks, NGOs or plantation companies have formal bond with these institutions. They conformed the generally accepted standards of accessing the funds, such as submitting application together with documents showing their eligibility, paying dues regularly as agreed, and many others. They are also sanctioned by responsibilities and conditions in case any of them defy the contract, which may include paying penalty for bank loans. Conversely, farmers' membership to the Claveria Landcare Association, particularly at the village and/or sitio levels is considered informal. While the main reason that formed these farmers together to learn and adopt soil and water conservation technologies, they can stop participating once their objective has been achieved. Some continue to expand their activities to include new commodities, marketing and others. In short, formal relationships are ruled by legal obligations and conditions, in contrast to indirect relationships' voluntary compliance.

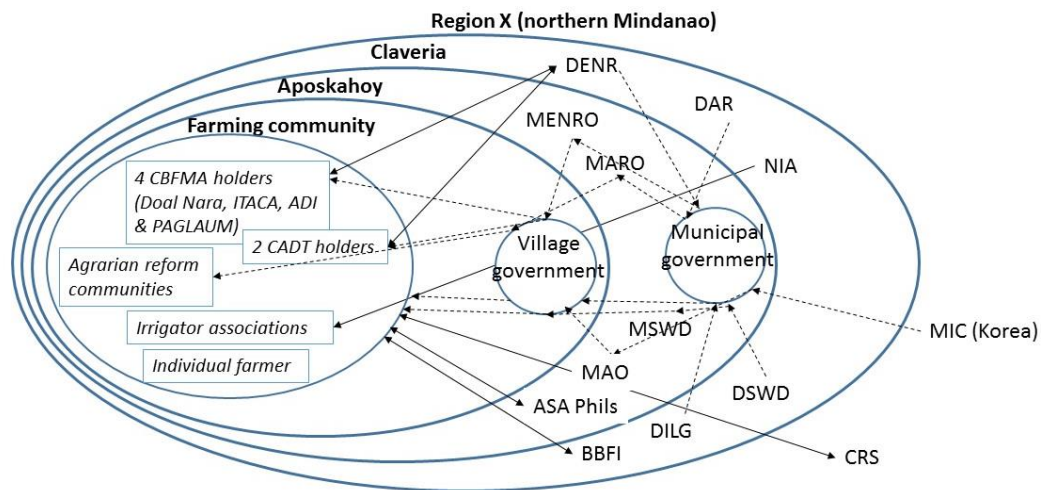


**Fig 4- Institutions that support the farming livelihood in Aposkahoy, Cabulig watershed (2016)**

Some alliances are also direct, while others are indirect. Most private institutions such as NGOs and plantation companies directly interact with the village governments and farmers, while NGAs based in the region often link first with the concerned office at the municipal government, then that office connects with the targeted village government, and finally the farmers. For instance, the technicians of the Phillip Morris Company directly assists their farmer-cooperators in managing their tobacco production as well as marketing. Whereas, the Korean NGO called MIC collaborates first with the municipal government through the Municipal Agriculture's Office. With their recommendation, the post-harvest facility project was built in Malagana with the support of the village government. Farmers not just from the village, but also the neighbouring ones benefit from the project.

Some of the institutional relationships can also be categorized as regular/recurring and special/intermittent. For example, the DA's connection with the LGUs and farmers persists because of the former's annual seed subsidy program on corn and rice among others, which is implemented at the local level by the LGUs from the municipal level down to the village to benefit all farmers. Conversely, NGOs' association with village governments and their FOs are often project-based, which means it is time limited, driven by specific objectives, and works with targeted beneficiaries among others. To illustrate, the Catholic Relief Services has worked in Cabulig watershed since 2006 with different partners to help the marginalized smallholder farmers<sup>110</sup>. Currently, they work with the Catholic Diocese in Claveria to improve food security by providing women farmers with financial assistance and support backyard gardening<sup>111</sup>. Since

<sup>110</sup> An international NGO; CRS partnered with ICRAF's Landcare Program (Phase 2) using the clustering approach.

<sup>111</sup> Women farmers bring their produce in the Diocese every Sunday during the mass for marketing. This is also the time when they pay their dues.

this project is duration bounded, they hope that the LGU's MAO will adopt the program and continue facilitating these women groups in Cabulig.

#### **IV. Conclusions**

Farmers in Cabulig watershed showed sound knowledge and deep understanding of their soil and environment. They generally value soil as they consider it as the source of life and their farming livelihood. Although there are similarities on their indicators of soil quality, namely color, position, soil fertility, soil acidity and types of soil, they identified position and soil fertility as the most important as these guide them the suitable crops to grow. They also showed familiarity where the different types of soil are found in their villages, as well as sound knowledge on the kinds of crops that grow best in these soils. This local knowledge is important on any development intervention related to land or watershed management. Instead of relying too much on external expertise on land use and management, local farmers have deeper knowledge on their soil and understanding on their environment that deserves recognition and consideration.

There are three major changes in the watershed that affected farmers' livelihoods. First is climate vulnerabilities and frequency of extreme events, particularly typhoons and droughts. The wet and dry seasons are not distinct anymore, which affected farmers' cropping patterns. The three cropping systems before is now reduced to two, and even one cropping when there is drought. Droughts are longer, while typhoons are more intense. Second is the rapid land use change, particularly in the last two decades. The logged-over forest areas have been replaced by agricultural production beginning 1970s. Tomato production dominated the upper landscape in 1980s, but was replaced by hybrid corn due to pest and diseases in 1990s. Currently, plantation crops such as pineapple, banana and tobacco are cultivated across the landscape. Notably, the key players here are the big logging companies, and big farmers who have the financial capital to support tomato and corn monocrops and the lands to rent out to plantation companies. Finally, the declining soil fertility decline has affected farms' productivity and farmers' income. They rely on applying more fertilizers to ensure production and income.

There is declining interest on farmer organizations due to not-so-good experiences in the past. Some organizations whose stakes are higher, namely land ownership, really took effort to reform and address internal issues including leadership and transparency. Current FOs are mostly reactive and driven by short-term economic goals, such as financial and livelihood assistance. Moreover, farm financing is common among farmers due to lack of financial capital. They rely mostly on individual financing, which is more convenient but with higher risks. While those who have the time and documents required prefer accessing financial assistance from cooperatives and rural banks with lesser interest rates and clearer agreements. Finally, farmers prefer individual loans than group loans due to payment problems they experienced in the past with group loans. Needless to say, there is a need to revive the value of social capital amongst farmers in Cabulig.

While there are still some NGOs that continue to facilitate their FOs, the LGU's MAO has an opportunity to revive old FOs and engage the farmers on various activities that are not just anchored on economic goals but of sustainable land resource management and development. Activating the Municipal Agriculture and Fishery Council, as well as its corresponding Barangay Agriculture and Fishery Councils can be the avenue for this. Again, this needs commitment from the LGU as facilitation requires human and financial resources. The current of Agriculture Technicians are just not enough to service the vast number of farmers effectively and efficiently. There is a mix of public and private institutions helping farmers in Cabulig. Their number and presence vary across the landscape, as well as the diversity of their projects and programs. Notably, there are more institutions working with farmers in upper villages, which can be attributed to important forest ecosystems and presence of indigenous communities and others. Despite its limitations, most farmers still recognized the Department of Agriculture through the Municipal Agriculture's Office as the most important institution. The way farmers and these institutions connect and behave vary depending on their activities, locations, funding, and rules and norms. Some institutions directly work with farmers like the plantation companies while others have to course through their activities with the LGUs such as the NGAs. Some projects come regularly to the farmers such as those from the governments, while others are project-based that have specific duration of years like special projects, which are mostly from the NGOs. Nonetheless, the farmers value relationships that are based on voluntary and willingness, transparent and open to two-way communication and learning.

These results and findings will shed light to the initial issues that came out during the household survey.

#### **Appendix 1: Focus group program and facilitator's guide questions**

|      |                                                                                                                                                                                                                                                                                                                                                                                                                                                |
|------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| I.   | <b>Preliminary:</b> 8:15-9:00                                                                                                                                                                                                                                                                                                                                                                                                                  |
|      | <ul style="list-style-type: none"> <li>• Prayer: Participant</li> <li>• Activity introduction</li> <li>• Oral consent</li> <li>• Introduction of participants</li> </ul>                                                                                                                                                                                                                                                                       |
| II.  | <b>Perception of soil:</b> 9:00-10:00 (30 mins group work; 30 mins presentation)                                                                                                                                                                                                                                                                                                                                                               |
|      | <ul style="list-style-type: none"> <li>• What is soil? (group – metacard)</li> <li>• What are the indicators of soil quality? Which is the most important indicator (1 the most important and so on?)</li> <li>• In your village, what are the different types of soil that exist? How would you describe this soil? What are the uses of this soil? Kindly locate this soil in the map. Which ones are the best and poorest soils?</li> </ul> |
| III. | <b>Perception of changes:</b> 11:00-12:00 (30 mins group work; 30 mins presentation)                                                                                                                                                                                                                                                                                                                                                           |
|      | <ul style="list-style-type: none"> <li>• What climatic and socio-economic changes have been observed by women and men over the past 10/20 years (e.g. <b>changes in rainfall, temperature, dry periods, land use</b>, biodiversity, <b>incidence of pests</b>, etc. changes in education, <b>livelihoods</b>, infrastructure, conflict, migration, policies, etc.)? (group – metacard)</li> </ul>                                              |

|      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
|------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|      | <ul style="list-style-type: none"> <li>• What are the positive and negative implications of these changes on their livelihoods (e.g. different agricultural activities, land use, animal husbandry, off-farm activities, migration patterns, etc.)?</li> <li>• What impacts do the perceived changes have on the community's overall well-being (including soil fertility, land management, livelihood and income security, health, food and water)?</li> <li>• What are the most severe changes the community is currently facing?</li> </ul>                                                                                                                                                                                                                                 |
| IV.  | <b>Lunch break:</b> 12:00-13:00                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| V.   | <b>Social capital:</b> 13:00-14:00                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
|      | <ul style="list-style-type: none"> <li>• How many in the group are members to a farmer organization? How many are not? (Group them accordingly) What are your motivations for participating in an organization? What are the benefits? What are the enabling factors? What limits you from doing so? What are the common problems in farming organizations? What are your suggestions to overcome these?</li> <li>• What community activities do you have that support soil fertility and land management improvement? How are these done?</li> <li>• Is farm financing or farm loans common in your village? What are the advantages and disadvantages?</li> <li>• Which ones do you prefer, individual or group loans? What are the advantages and disadvantages?</li> </ul> |
| VI.  | <b>Institutions:</b> 14:00-14:45                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
|      | <ul style="list-style-type: none"> <li>• What are the institutions that support your village improve soil fertility, land management and land use? How are these done?</li> <li>• What about those that help improve your livelihoods? What are the programs/projects?</li> <li>• Indicate their importance (number of stars)</li> <li>• Indicate who participates (e.g. gender, wealth, age, etc.)</li> <li>• Indicate the relationship (e.g. direct and indirect)</li> </ul>                                                                                                                                                                                                                                                                                                 |
| VII. | <b>Closing:</b> 14:45-15:00                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
|      | <ul style="list-style-type: none"> <li>• Summary of discussion results</li> <li>• Open forum and the way forward</li> <li>• Thanks</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |

# Appendix 3: Household survey form

## FARMERS' CHANGING LAND HEALTH AND LIVELIHOODS IN THE PHILIPPINE UPLAND WATERSHEDS

### CABULIG WATERSHED, MISAMIS ORIENTAL

Crop year: April 2015-March 2016

### SURVEY QUESTIONNAIRE

This study aims to enable better planning and decision making for sustainable land use and management in the Philippine upland watersheds such that land use systems can be improved and Cabulig watershed can be protected, which are the foundation to sustainable land health and better livelihoods. The study is not in any way involved in promoting mono-crop plantation or mineral exploration. We are conducting this survey to better understand farmers' values, aspirations, ecological knowledge and other factors influencing land health and livelihood changes, their current and preferred land use, and management options.

You have been randomly selected to take part in this survey. Your participation will be entirely voluntary and will not affect access to study results or participation in the later stage of the study. We will appreciate your cooperation in completing this survey for one to two hours. Your responses will be kept strictly confidential. Thank you.

Note: Introduce yourself; mention the purpose of the study; request for the farmer's voluntary participation in the survey; and provide information of Dr. Agustin R. Mercado, Jr. from ICRAF as the researcher's contact person.

Questionnaire No: \_\_\_\_\_ Coordinates: \_\_\_\_\_ Sitio: \_\_\_\_\_  
Village: (1) San Nicolas (2) Plaridel (3) Luna (4) Mat-i (5) Aposkahoy (6) Malagana  
Municipality: (1) Claveria (2) Jasaan  
Interviewer: \_\_\_\_\_ Date interviewed: \_\_\_\_\_

### 1. RESPONDENT AND HOUSEHOLD PROFILE

- 1.1 Name (Optional): \_\_\_\_\_
- 1.2 Are you the household head: (1) Yes (2) No  
If No, what is your relation to the household head?  
(1) Husband (2) Wife (3) Child (4) Relative (5) Others, \_\_\_\_\_
- 1.3 Ethnicity: Husband: \_\_\_\_\_ Wife: \_\_\_\_\_  
(1) Higaonon (2) Cebuano (3) Boholano (4) Misamisnon (6) Others, \_\_\_\_\_
- 1.4 Religion: (1) Roman Catholic (2) Baptist (3) Muslim  
(4) Protestant (5) None (6) Others, specify \_\_\_\_\_
- 1.5 Please provide information on household composition

| HH members<br>(All persons presently living in<br>the house) | Sex <sup>1/</sup> | Age | Educational<br>attainment <sup>2/</sup> | Primary<br>occupation <sup>3/</sup> | Other<br>sources of<br>income <sup>3/</sup> |
|--------------------------------------------------------------|-------------------|-----|-----------------------------------------|-------------------------------------|---------------------------------------------|
| Immediate members                                            |                   |     |                                         |                                     |                                             |
| Husband                                                      |                   |     |                                         |                                     |                                             |
| Wife                                                         |                   |     |                                         |                                     |                                             |
| Child 1                                                      |                   |     |                                         |                                     |                                             |
| Child 2                                                      |                   |     |                                         |                                     |                                             |
| Child 3                                                      |                   |     |                                         |                                     |                                             |
| Child 4                                                      |                   |     |                                         |                                     |                                             |
| Child 5                                                      |                   |     |                                         |                                     |                                             |
| Extended members                                             |                   |     |                                         |                                     |                                             |

|                  |  |  |  |  |  |
|------------------|--|--|--|--|--|
| *Relative 1      |  |  |  |  |  |
| Relative 2       |  |  |  |  |  |
| Relative 3       |  |  |  |  |  |
| **Non-relative 1 |  |  |  |  |  |
| Non-relative 2   |  |  |  |  |  |
| Non-relative 3   |  |  |  |  |  |

<sup>1/</sup> (1) Female, (2) Male

<sup>2/</sup> (1) None, (2) Elementary, (3) High school, (4) Vocational, (5) College, (6) Postgraduate

<sup>3/</sup> (1) Farmer, (2) Government, specify, (3) Private, specify, (4) Businessman/woman, specify, (5) Others, specify

\*Relative refers to parents of husband/wife, brother/sisters, grandchildren, cousins, etc.

\*\*Non-relative refers to paid house helpers, farm helpers, friends, etc.

1.6 Are you originally from this municipality? (1) Yes (2) No

If Yes, go to 2.1

If No, when did you move in this municipality? Year: 19\_\_

Which municipality/city/province are you from? \_\_\_\_\_

1.7 If No, what were your reasons for migrating to this municipality?

- (1) Soil is good for farming livelihood (4) Peaceful and quiet (change of lifestyle)  
 (2) Employment (e.g. logging, plantations) (5) Family/relative reasons  
 (3) Good environment/near the forest (6) Others, \_\_\_\_\_

1.8 What were the main land uses of this municipality when you arrived?

- (1) Dense natural forest (5) Grazing/pasture  
 (2) Degraded forest (6) Mostly cropped  
 (3) Grasslands (7) Plantations  
 (4) Agroforestry (8) Others, \_\_\_\_\_

## 2. SOIL KNOWLEDGE, VALUES, AND ASPIRATIONS

2.1 Assess your knowledge on the following:

- (1) No knowledge (2) Very little knowledge (3) Some knowledge  
 (4) Sound knowledge (5) Very sound knowledge (6) I don't know

| Knowledge                                                                                                                                                                                                                                                                                                                                                             | 1 | 2 | 3 | 4 | 5 | 6 | Comments |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---|---|---|---|---|---|----------|
| 2.1 Do you have good knowledge of different types of soil?                                                                                                                                                                                                                                                                                                            |   |   |   |   |   |   |          |
| 2.2 What is the <b>main type</b> of soil in Cabulig watershed?<br>(1) Sandy (2) Silty (3) Clayey (4) Loamy (5) Others, _____                                                                                                                                                                                                                                          |   |   |   |   |   |   |          |
| 2.3 Do you understand the causes of soil fertility decline?                                                                                                                                                                                                                                                                                                           |   |   |   |   |   |   |          |
| 2.4 Which of the following activities leads to a decline in soil fertility?<br>(1) The continual growing of crops Yes No<br>(2) Use of inorganic of fertilizers Yes No<br>(3) Not replacing soil nutrients Yes No<br>(4) Loss of nutrients due to soil erosion Yes No<br>(5) Removing/burning crop residues Yes No<br>(6) Frequent tillage (mechanical/animal) Yes No |   |   |   |   |   |   |          |
| 2.5 What is the <b>most reliable way</b> to increase soil fertility?<br>(1) Apply appropriate fertilizer/soil amendments (5) Grow ground cover<br>(2) Employ minimum/zero tillage (6) Contour sloping farms<br>(3) Integrate leguminous crops (7) Grow trees on the farm<br>(4) Retain crop residues on farm                                                          |   |   |   |   |   |   |          |
| 2.6 Can you tell whether the soil is acidic, neutral, or alkaline?                                                                                                                                                                                                                                                                                                    |   |   |   |   |   |   |          |
| 2.7 Was the soil in Cabulig watershed naturally (before farming) acidic, neutral, or alkaline?<br>(1) Acidic (2) Neutral (3) Alkaline                                                                                                                                                                                                                                 |   |   |   |   |   |   |          |
| 2.8 Does farming worsened soil acidity in Cabulig watershed? Yes No                                                                                                                                                                                                                                                                                                   |   |   |   |   |   |   |          |
| 2.9 What is the <b>most important</b> effect of soil acidity on the productivity of crops?<br>(1) Causes erosion (3) Increases weeds                                                                                                                                                                                                                                  |   |   |   |   |   |   |          |

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                     |  |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------|--|
| (2) Causes nutrient deficiencies                                                                                                                                                                                                                                                                                                                                                                                                                                                               | (4) Toxic to plants |  |
| 2.10 What is the <b>best way</b> to correct soil acidity?<br>(1) Apply crop rotation (3) Apply lime<br>(2) Appropriate management of nitrogen fertilizer (4) Retain crop residues                                                                                                                                                                                                                                                                                                              |                     |  |
| 2.11 Do you understand the causes of soil erosion?                                                                                                                                                                                                                                                                                                                                                                                                                                             |                     |  |
| 2.12 What is the <b>main driver</b> of soil erosion in Cabulig watershed that farmers can control?<br>(1) Rainfall and runoff Yes No (5) Slope length Yes No<br>(2) Wind Yes No (6) Up-down cultivation Yes No<br>(3) Soil type Yes No (7) Frequent tillage Yes No<br>(4) Lack of ground cover Yes No                                                                                                                                                                                          |                     |  |
| 2.13 What is the <b>best way</b> to reduce soil erosion?<br>(1) Apply minimum/zero tillage (4) Establish natural vegetative strips<br>(2) Retain crop residues on the farm (5) Integrate trees on the farm<br>(3) Construct contours or terraces (6) Grow ground (soil) cover                                                                                                                                                                                                                  |                     |  |
| 2.14 Do you understand what should be grown on steep land and how steep lands should be managed?                                                                                                                                                                                                                                                                                                                                                                                               |                     |  |
| 2.15 What do you suggest doing on a sloping land?<br>(1) Leave it fallow (4) Plant with trees and crops plus NVS<br>(2) Plant the whole area with trees (5) Plant with agricultural crops<br>(3) Apply SALT technology                                                                                                                                                                                                                                                                         |                     |  |
| 2.16 Do you understand the effect of rock and stones on land use and management practices?                                                                                                                                                                                                                                                                                                                                                                                                     |                     |  |
| 2.17 What should you do on land with rocks and stones?<br>(1) Leave the rocks and plant with agricultural crops (3) Plant it with trees<br>(2) Arrange the rocks and stones to utilize arable areas (4) Leave it uncultivated                                                                                                                                                                                                                                                                  |                     |  |
| 2.18 Do you understand the effect of soil degradation on Cabulig River?                                                                                                                                                                                                                                                                                                                                                                                                                        |                     |  |
| 2.19 What is the <b>major effect</b> of poor soil management on farms on the Cabulig River?<br>(1) Poor river water quality due to sediment/soil erosion<br>(2) Lack of water during the dry season<br>(3) Flooding during the wet season<br>(4) Lack of water during dry season and flooding during the wet season                                                                                                                                                                            |                     |  |
| 2.20 What is the <b>major effect</b> of over clearing across the whole Cabulig watershed?<br>(1) Poor river water quality due to sediment/soil erosion<br>(2) Lack of water during the dry season<br>(3) Flooding during the wet season<br>(4) Lack of water during dry season and flooding during the wet season                                                                                                                                                                              |                     |  |
| 2.21 How can <b>other farmers' activities</b> affect your farm?<br>(1) Worsen the impact of flooding Yes No<br>(2) Reduce the availability of water for irrigation during dry season Yes No<br>(3) Worsen water quality Yes No<br>(4) Increase soil deposition Yes No<br>(5) Increase encroachment of animals Yes No<br>(6) Increase encroachment of pests and weeds Yes No<br>(7) Reduced soil erosion due to good practices (e.g. NVS) Yes No<br>(8) Gully erosion in neighbor's farm Yes No |                     |  |

## 2.2 Rate your agreement with the following statements:

- (1) Strongly disagree (2) Disagree (3) Not sure  
(4) Agree (5) Strongly agree (6) I don't know (7) Not applicable

| Values                                                            | 1 | 2 | 3 | 4 | 5 | 6 | 7 | Comments |
|-------------------------------------------------------------------|---|---|---|---|---|---|---|----------|
| My farm's <b>sustainability is more important</b> than its income |   |   |   |   |   |   |   |          |



|                                                                                                                                                              |  |  |  |  |  |  |  |  |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------|--|--|--|--|--|--|--|--|
| I <b>prefer to use our traditional way</b> of farming                                                                                                        |  |  |  |  |  |  |  |  |
| I maintain my farm's fertile soil by <b>planting different crops</b> and implementing <b>crop rotation</b>                                                   |  |  |  |  |  |  |  |  |
| I consider the <b>diversity of plants and animals</b> on my farm to be important                                                                             |  |  |  |  |  |  |  |  |
| I <b>integrate trees on the farm</b> for long-term investment                                                                                                |  |  |  |  |  |  |  |  |
| I <b>value</b> participating in <b>local/farm organizations</b>                                                                                              |  |  |  |  |  |  |  |  |
| I <b>prefer individual loan/credit</b> than group loan/credit                                                                                                |  |  |  |  |  |  |  |  |
| <b>Renting my land</b> to others is <b>more profitable</b> than cultivating the land myself                                                                  |  |  |  |  |  |  |  |  |
| Include <b>adoption of sustainable land use</b> and farming practices in <b>land renting</b>                                                                 |  |  |  |  |  |  |  |  |
| It is important to me that I'm able to <b>support my family financially well from farming</b>                                                                |  |  |  |  |  |  |  |  |
| It is important to me that <b>my farm has good infrastructure</b> (e.g. irrigation)                                                                          |  |  |  |  |  |  |  |  |
| It is important to me that <b>people recognize and compliment me</b> on my good farming                                                                      |  |  |  |  |  |  |  |  |
| I have a <b>sense of accomplishment</b> that I'm contributing to the <b>protection of Cabulig</b>                                                            |  |  |  |  |  |  |  |  |
| Having this <b>farm is a good break from my regular work</b>                                                                                                 |  |  |  |  |  |  |  |  |
| Having this <b>farm is a good break from city life</b>                                                                                                       |  |  |  |  |  |  |  |  |
| <b>Farming is a good retirement investment</b>                                                                                                               |  |  |  |  |  |  |  |  |
| It is important to me to <b>pass on my land to my children in better condition</b>                                                                           |  |  |  |  |  |  |  |  |
| To <b>preserve the land</b> as property from my parents                                                                                                      |  |  |  |  |  |  |  |  |
| <b>Agricultural intensification has degraded land resources</b> in Cabulig                                                                                   |  |  |  |  |  |  |  |  |
| <b>Plantation crops have degraded land resources</b> in Cabulig                                                                                              |  |  |  |  |  |  |  |  |
| <b>Incentives</b> encourage farmers to adopt sustainable land use and good farming                                                                           |  |  |  |  |  |  |  |  |
| A <b>land use plan</b> with standards developed with farmers will encourage farmers to implement sustainable land use and management practices on their farm |  |  |  |  |  |  |  |  |

2.3 In farming, do these values guide your land use decisions and actions?

(1) Not at all (2) Minor influence (3) Moderate influence  
(4) Influential (5) Very influential (6) I don't know (7) Not applicable

| Values                                                                                                                                             | 1 | 2 | 3 | 4 | 5 | 6 | 7 | Comments |
|----------------------------------------------------------------------------------------------------------------------------------------------------|---|---|---|---|---|---|---|----------|
| <b>Free of conflicts</b> on land and natural resource use with neighbors and outside communities                                                   |   |   |   |   |   |   |   |          |
| Farming <b>not just for my welfare</b> but also for others in the community                                                                        |   |   |   |   |   |   |   |          |
| Adopting sustainable land use and management practices to <b>protect my farm</b> from environmental degradation and protect my family's livelihood |   |   |   |   |   |   |   |          |
| Adopting sustainable land use and management practices that will <b>not negatively affect my neighbours</b> and others' farming livelihoods        |   |   |   |   |   |   |   |          |
| Adopting sustainable land use and management practices to <b>protect the Cabulig</b>                                                               |   |   |   |   |   |   |   |          |
| All community members should be <b>equally able to access and use land and water resources</b> to support their farming livelihoods                |   |   |   |   |   |   |   |          |
| <b>Wealthier farmers should help smallholders</b> to improve their knowledge and use of resources, and provide livelihood opportunities            |   |   |   |   |   |   |   |          |

|                                                                                                                    |  |  |  |  |  |  |  |  |
|--------------------------------------------------------------------------------------------------------------------|--|--|--|--|--|--|--|--|
| I should <b><u>use my farming knowledge and experience to help others</u></b> in my community                      |  |  |  |  |  |  |  |  |
| I should <b><u>influence my neighbors</u></b> through my sustainable land use and management practices             |  |  |  |  |  |  |  |  |
| I encourage others in Cabulig to <b><u>balance their economic livelihood and environmental pursuits</u></b>        |  |  |  |  |  |  |  |  |
| Increase in income from farming mustn't <b><u>harm land resources and the Cabulig River</u></b>                    |  |  |  |  |  |  |  |  |
| <b><u>Reduced production in short-term is acceptable</u></b> where there are long-term benefits to the environment |  |  |  |  |  |  |  |  |

2.4 What are your major considerations in deciding upon your land use and management strategies?

- ( ) Economic values: [ ] cost-benefit [ ] flexibility to respond to market/climate condition  
 ( ) Technical reasons: [ ] Information [ ] Capital input requirements [ ] Labour  
 ( ) Environmental: [ ] Technical feasibility [ ] Effectiveness  
 ( ) Socio-cultural: [ ] Acceptability [ ] Feasibility (social) [ ] Past experience  
 ( ) Institutional: [ ] Policy support [ ] Within a plan  
 Others, \_\_\_\_\_

2.5 Who do you seek advice about land use and management from?

- ( ) Family/relatives ( ) Extension officers, specify \_\_\_\_\_  
 ( ) Farmer neighbours ( ) NGO facilitators, specify \_\_\_\_\_  
 ( ) Farmers in the same organizations ( ) Private company technicians, specify \_\_\_\_\_  
 ( ) Barangay officers and staff ( ) Others, specify \_\_\_\_\_

2.6 To what extent do the following issues affect your farming livelihood or the Cabulig watershed?

- (1) Extremely unimportant (2) Not important (3) Not sure  
 (4) Important (5) Very important (6) I don't know (7) Not applicable

| Issues on farms                                                             | 1 | 2 | 3 | 4 | 5 | 6 | 7 | Comments |
|-----------------------------------------------------------------------------|---|---|---|---|---|---|---|----------|
| Declining soil fertility                                                    |   |   |   |   |   |   |   |          |
| Increasing soil acidity                                                     |   |   |   |   |   |   |   |          |
| Increasing soil erosion                                                     |   |   |   |   |   |   |   |          |
| Sloping area limits crop choices                                            |   |   |   |   |   |   |   |          |
| Lots of rocks and stones                                                    |   |   |   |   |   |   |   |          |
| Increase of weeds and pest diseases                                         |   |   |   |   |   |   |   |          |
| Impact of climate variability on crop production                            |   |   |   |   |   |   |   |          |
| Limited savings (or access to loans) to invest in or improve my farm        |   |   |   |   |   |   |   |          |
| Not enough knowledge to improve the farming system                          |   |   |   |   |   |   |   |          |
| Limited labour to diversify crops and intensify farming system              |   |   |   |   |   |   |   |          |
| Expensive transport cost of farm products                                   |   |   |   |   |   |   |   |          |
| Fluctuating market price of farm products                                   |   |   |   |   |   |   |   |          |
| Issues in your village                                                      |   |   |   |   |   |   |   |          |
| Declining soil fertility                                                    |   |   |   |   |   |   |   |          |
| Increasing soil acidity                                                     |   |   |   |   |   |   |   |          |
| Increasing soil erosion                                                     |   |   |   |   |   |   |   |          |
| Insufficient water supply for crops                                         |   |   |   |   |   |   |   |          |
| Loss of important ecosystem services (e.g. land, water, biodiversity, etc.) |   |   |   |   |   |   |   |          |
| Decreasing forest cover affecting cool climate                              |   |   |   |   |   |   |   |          |
| Presence and expansion of multinational companies                           |   |   |   |   |   |   |   |          |
| Poor farming practices (e.g. monocropping, tillage)                         |   |   |   |   |   |   |   |          |
| Impacts of increasing climate variability (e.g. changes of seasons)         |   |   |   |   |   |   |   |          |
| Impacts of extreme events (e.g. typhoon, flooding)                          |   |   |   |   |   |   |   |          |

## 2.7 What are your intentions?

- (1) Very unlikely    (2) Unlikely    (3) Possible    (4) Likely    (5) Very likely  
 (6) I don't know    (7) Not applicable

| Intentions                                                                                | 1 | 2 | 3 | 4 | 5 | 6 | 7 | Comments |
|-------------------------------------------------------------------------------------------|---|---|---|---|---|---|---|----------|
| I will grow commercial crops that are more profitable                                     |   |   |   |   |   |   |   |          |
| I will grow trees on my farm                                                              |   |   |   |   |   |   |   |          |
| I will grow different crops on my farm                                                    |   |   |   |   |   |   |   |          |
| I will plant cover crops to increase the organic matter of my farm's soil                 |   |   |   |   |   |   |   |          |
| I will apply zero/minimum tillage to reduce erosion                                       |   |   |   |   |   |   |   |          |
| I will construct contour hedgerows to reduce soil erosion                                 |   |   |   |   |   |   |   |          |
| I encourage ownership of the farm to stay within the family                               |   |   |   |   |   |   |   |          |
| I will sell/lease this land in the future and migrate out of Cabulig                      |   |   |   |   |   |   |   |          |
| I will sell/lease this land in the future and work in Cabulig for a multinational company |   |   |   |   |   |   |   |          |
| I will continue farming for as long as I live                                             |   |   |   |   |   |   |   |          |
| I will purchase and/or lease lands to expand farming                                      |   |   |   |   |   |   |   |          |
| I will access loan/credit to improve and expand my farming                                |   |   |   |   |   |   |   |          |
| I will diversify my sources of income while maintaining farming                           |   |   |   |   |   |   |   |          |

## 3. FARM PROFILE, LAND USE, AND PRODUCTION

## 3.1 Please provide information on parcels owned and/or managed by land use type

| Parcel | Land use <sup>1/</sup> | Owned and cultivated: area (ha) | Owned but cultivated by others*: area (ha) | Owned but not cultivated: area (ha) | Cultivated, but owned by others**: area (ha) | Tenure <sup>2/</sup> | Total<br>Parcels | Area (ha) |
|--------|------------------------|---------------------------------|--------------------------------------------|-------------------------------------|----------------------------------------------|----------------------|------------------|-----------|
| (1)    |                        |                                 |                                            |                                     |                                              |                      |                  |           |
| (2)    |                        |                                 |                                            |                                     |                                              |                      |                  |           |
| (3)    |                        |                                 |                                            |                                     |                                              |                      |                  |           |

<sup>1/</sup> (1) Annuals crops, specify (e.g. corn, cassava, vegetables, etc.), (2) Perennials (e.g. banana, coffee, pineapple, abaca, etc.), (3) Agroforestry (combined annuals, perennials, and trees), (4) trees, specify (e.g. indigenous, exotic, fruits, rubber, oil palm, etc.), (5) fallow, (6) Others, specify

<sup>2/</sup> (1) A&D titled, (2) DAR-CLOA, (3) DENR-CBFM, (4) AD-CADC, (5) Land lease contract, (6) Others

\*Lands owned but rented-out, mortgaged or tenanted

\*\*Land cultivated through lease, tenancy, or share-cropping arrangement

## 3.2 Characteristics of farm (with the GPS point)

| Parcel # | Cultivated area (ha) | Distance from the house | Road access <sup>1/</sup> | Type of transport to market products <sup>2/</sup> | Slope <sup>3/</sup> | Irrigation used <sup>4/</sup> |
|----------|----------------------|-------------------------|---------------------------|----------------------------------------------------|---------------------|-------------------------------|
|          |                      |                         |                           |                                                    |                     |                               |

<sup>1/</sup> (1) Main road, (2) Secondary road, (3) Trail, (4) Others, specify

<sup>2/</sup> (1) Man hauling, (2) Habal-habal, (3) Draft animal with cart, (4) Jeepney, (5) Truck, (6) Others, specify

<sup>3/</sup> (1) Flat, (2) Sloping, (3) Both

<sup>4/</sup> (1) None, (2) Surface, (3) Drip, (4) Sprinkler, (5) Others, specify

## 3.3 Description of the farm's soil and fertilizer use (with the GPS point)

| Parcel # | Soil<br>Color <sup>1/</sup> | Texture <sup>2/</sup> | Type of fertilizer used <sup>3/</sup> | Fertilizer application based on soil analysis <sup>4/</sup> |
|----------|-----------------------------|-----------------------|---------------------------------------|-------------------------------------------------------------|
|          |                             |                       |                                       |                                                             |

<sup>1/</sup> (1) Black, (2) Red, (3) Yellowish, (4) Others, specify

<sup>2/</sup> (1) Sandy, (2) Silt, (3) Loamy, (4) Clayey, (5) Others, specify

<sup>3/</sup> Green manure, (3) Animal manure, (4) Inorganic, (5) Others, specify

<sup>4/</sup> (1) Yes, (2) No

### 3.4 Farm's soil fertility status (with the GPS point)

| Parcel #                                | Soil fertility       |            |                                          | Soil acidity         |            | Soil erosion           | Rocks and stones <sup>4/</sup> |
|-----------------------------------------|----------------------|------------|------------------------------------------|----------------------|------------|------------------------|--------------------------------|
|                                         | Status <sup>1/</sup> | Indicators | Trends in the past 5 years <sup>2/</sup> | Status <sup>3/</sup> | Indicators | Severity <sup>3/</sup> |                                |
|                                         |                      |            |                                          |                      |            |                        |                                |
| Measures applied to address the problem |                      |            |                                          |                      |            |                        |                                |

<sup>1/</sup> (1) Poor, (2) Moderate, (3) Good<sup>4</sup>

<sup>2/</sup> (1) Degrading, (2) Stable, (3) Improving

<sup>3/</sup> (1) Low, (2) Moderate, (3) High

<sup>4/</sup> (1) Yes, (2) None

### 3.5 Provide information on your agroforestry land use, if applicable

| Agroforestry | Total no of trees planted | The ratio of trees: crops | Tree types <sup>1/</sup> | Intercropped with     |                          |
|--------------|---------------------------|---------------------------|--------------------------|-----------------------|--------------------------|
|              |                           |                           |                          | Annuals <sup>2/</sup> | Perennials <sup>3/</sup> |
| (1)          |                           |                           |                          |                       |                          |
| (2)          |                           |                           |                          |                       |                          |
| (3)          |                           |                           |                          |                       |                          |

<sup>1/</sup> (1) Indigenous, (2) Exotic, (3) Fruits, (4) Rubber, (5) Oil palm, (6) Others, specify

<sup>2/</sup> (1) Corn, (2) Cassava, (3) Vegetables, (4) Upland rice, (5) Others, specify

<sup>3/</sup> (1) Banana, (2) Coffee, (3) Abaca, (4) Pineapple, (5) Others, specify

### 3.6 Outputs from livestock production (April 2015-March 2016)

| Animals | For cattle and goats, grazing methods <sup>1/</sup> | Number | Purpose <sup>2/</sup> | Revenue (PhP) | Production cost (PhP) | Net income (PhP) |
|---------|-----------------------------------------------------|--------|-----------------------|---------------|-----------------------|------------------|
| (1)     |                                                     |        |                       |               |                       |                  |
| (2)     |                                                     |        |                       |               |                       |                  |
| (3)     |                                                     |        |                       |               |                       |                  |

<sup>1/</sup> (1) Cut and carry, (2) Fixed grazing, (3) Rotational grazing, (4) Free grazing, (5) Others, specify

<sup>2/</sup> (1) Consumption, (2) Sale, (3) Both

**Production inputs and post-production costs of main crops in your farm with the GPS point (April 2015-March 2016)**

| Activity      | Labour                   |      |          |            |             |            |            | Inputs             |           |            |            |          |           |            |                                   |          |           |            | Others  |          |          |       |
|---------------|--------------------------|------|----------|------------|-------------|------------|------------|--------------------|-----------|------------|------------|----------|-----------|------------|-----------------------------------|----------|-----------|------------|---------|----------|----------|-------|
|               | Family labour (man-days) |      |          |            | Paid labour |            |            | Planting materials |           |            | Fertilizer |          |           |            | Herbicide, pesticide, insecticide |          |           |            | Tractor | Trucking | Thresher | Shell |
|               | Husband                  | Wife | Children | Total cost | # of days   | Daily wage | Total cost | Qty (kl)           | Unit cost | Total cost | Type       | Qty (kl) | Unit cost | Total cost | Type                              | Qty (kl) | Unit cost | Total cost |         |          |          |       |
| Crop 1: _____ |                          |      |          |            |             |            |            |                    |           |            |            |          |           |            |                                   |          |           |            |         |          |          |       |
| Crop 2: _____ |                          |      |          |            |             |            |            |                    |           |            |            |          |           |            |                                   |          |           |            |         |          |          |       |
| Crop 3: _____ |                          |      |          |            |             |            |            |                    |           |            |            |          |           |            |                                   |          |           |            |         |          |          |       |

**3.7 Production outputs of main crops**

| Crop   | Area (ha) | Qty produced (kl) | Qty consumed (kl) | Qty sold (kl) | Unit price (PhP) | Revenue (PhP) | Total cost (PhP) | Net income (PhP) |
|--------|-----------|-------------------|-------------------|---------------|------------------|---------------|------------------|------------------|
| Crop 1 |           |                   |                   |               |                  |               |                  |                  |
| Crop 2 |           |                   |                   |               |                  |               |                  |                  |
| Crop 3 |           |                   |                   |               |                  |               |                  |                  |

**3.8 Do you receive money remittance? (1) Yes (2) No**

If Yes, from whom: (1) Husband (2) Wife (3) Children (4) Relatives (5) Others, \_\_\_\_\_

Estimated amount: \_\_\_\_\_

Frequency: (1) Weekly (2) Monthly (3) Twice a year (4) Once a year (5) Others, \_\_\_\_\_

**3.9 Total farm income and others**

| Sources of income                                                                                             | Specify | Monthly income (PhP) | Annual income (PhP) |
|---------------------------------------------------------------------------------------------------------------|---------|----------------------|---------------------|
| On-farm                                                                                                       |         |                      |                     |
| Off-farm (e.g. hired farm labour)                                                                             |         |                      |                     |
| Non-farm (e.g. sari-sari store, employment, honourarium, pension, support from other household members, etc.) |         |                      |                     |

**3.10 Are you willing to change your land use? (1) Yes (2) No**

If No, why? \_\_\_\_\_

## 3.12 If Yes, what is your most preferred land use?

| Land use                      | Production system, specify | The ratio of trees: annual/perennial crops | Reason <sup>1/</sup> | Adoptable <sup>2/</sup> | If No, why? <sup>3/</sup> |
|-------------------------------|----------------------------|--------------------------------------------|----------------------|-------------------------|---------------------------|
| (1) Timber-based (indigenous) |                            |                                            |                      |                         |                           |
| (2) Timber-based (exotic)     |                            |                                            |                      |                         |                           |
| (3) Timber-based (fruits)     |                            |                                            |                      |                         |                           |
| (4) Timber-based (rubber)     |                            |                                            |                      |                         |                           |
| (5) Timber-based (oil palm)   |                            |                                            |                      |                         |                           |
| (6) Agroforestry              |                            |                                            |                      |                         |                           |
| (7) Vegetable-based           |                            |                                            |                      |                         |                           |
| (8) Banana-based              |                            |                                            |                      |                         |                           |
| (9) Cassava-based             |                            |                                            |                      |                         |                           |
| (10) Pineapple-based          |                            |                                            |                      |                         |                           |
| (11) Corn-based               |                            |                                            |                      |                         |                           |
| (12) Abaca-based              |                            |                                            |                      |                         |                           |

<sup>1/</sup> (1) Profitable, (2) Suitable to soil/environment, (3) Marketable, (4) Food consumption, (5) Watershed protection, (6) Support from government programs, (7) Cultural/spiritual reasons, (8) Source of medicine, (9) Others, specify

<sup>2/</sup> (1) Yes, (2) No

<sup>3/</sup> (1) Too costly, (2) Unreliable market, (3) Too labour-intensive, (4) No government support, (5) Not enough knowledge, (6) Others, specify

## 4. LIVELIHOOD ASSETS

4.1 Please describe and indicate the number of livelihood assets that you have currently (end of last season).

| Assets                          |                                                            | Number |                        |              | Number |
|---------------------------------|------------------------------------------------------------|--------|------------------------|--------------|--------|
| Physical                        |                                                            |        | Human capital          |              |        |
| Livestock                       | Big ruminants: Carabao<br>Cow<br>Horse                     |        | Family age composition | Dependents   |        |
|                                 | Small ruminants: Goat<br>Pig<br>Chicken                    |        |                        | Working      |        |
| Farm tools                      | Tractor<br>Thresher<br>Plow<br>Irrigation (e.g. sprinkler) |        | Education              | Literate     |        |
| Vehicles                        | Truck<br>Jeepney<br>Multicab<br>Motorcycle                 |        |                        | Non-literate |        |
| Others                          | Mobile phone                                               |        | Health                 | Healthy      |        |
| Natural                         |                                                            |        |                        | Malnourish   |        |
| Access to land                  | Quantity: ____ ha                                          |        | Skills                 |              |        |
|                                 | Quality:                                                   |        | Financial (Annual)     |              |        |
| Access to water                 | Quantity:                                                  |        | Income                 |              |        |
|                                 | Quality:                                                   |        | Savings                |              |        |
| Access to common-pool resources | Forests:<br>Grazing land:                                  |        | Debt                   |              |        |
| Social                          |                                                            |        |                        |              |        |

|                                    |           |        |                                                                                                             |
|------------------------------------|-----------|--------|-------------------------------------------------------------------------------------------------------------|
| Membership in farmer organizations | (1) Yes   | (2) No | Political connections: (1) Yes (2) No<br>Relatives nearby: (1) Yes (2) No<br>Friends nearby: (1) Yes (2) No |
|                                    | Name 3:   |        |                                                                                                             |
|                                    | (1) _____ |        |                                                                                                             |
|                                    | (2) _____ |        |                                                                                                             |
|                                    | (3) _____ |        |                                                                                                             |

4.2 How would you describe the last production year? (1) Typical (Normal) (2) Better (3) Worse

4.3 In a typical year, with all the livelihood assets that you have, are you able to:

- (1) Pay off debts Yes Some No (5) Saved certain amount Little (>10%Y) Lots (<10%Y) No
- (2) Break-even annual income Yes No (6) Employ additional staff Yes No
- (3) Invest in different land use or management Yes No (7) None
- (4) Buy more land Yes No (8) Others

4.4 In a better year, are you able to:

- (1) Pay off debts Yes Some No (5) Saved certain amount Little (>10%Y) Lots (<10%Y) No
- (2) Break-even annual income Yes No (6) Employ additional staff Yes No
- (3) Invest in different land use or management Yes No (7) None
- (4) Buy more land Yes No (8) Others

4.5 In a worse year, are you able to:

- (1) Pay off debts Yes Some No (5) Saved certain amount Little (>10%Y) Lots (<10%Y) No
- (2) Break-even annual income Yes No (6) Employ additional staff Yes No
- (3) Invest in different land use or management Yes No (7) None
- (4) Buy more land Yes No (8) Others (e.g. more debt, lost land)

## 5. CREDIT, POLICY, AND OTHER INSTITUTIONAL SUPPORT

5.1 Did you obtain any loan or credit for your crop production (April 2015-March 2016)? (1) Yes (2) No

If Yes, please provide the amount, from whom, and the benefits

|                          | Amount of loan (PhP) | Provider <sup>1/</sup> | Experienced difficulty in getting loan <sup>2/</sup> | Reason <sup>3/</sup> | Impacts            |                   | Experienced difficulty in paying loans <sup>2/</sup> | Reason <sup>6/</sup> |
|--------------------------|----------------------|------------------------|------------------------------------------------------|----------------------|--------------------|-------------------|------------------------------------------------------|----------------------|
|                          |                      |                        |                                                      |                      | Good <sup>4/</sup> | Bad <sup>5/</sup> |                                                      |                      |
| 1st cropping             |                      |                        |                                                      |                      |                    |                   |                                                      |                      |
| 2nd cropping             |                      |                        |                                                      |                      |                    |                   |                                                      |                      |
| 3 <sup>rd</sup> cropping |                      |                        |                                                      |                      |                    |                   |                                                      |                      |

<sup>1/</sup> (1) Bank, (2) Individual, (3) Cooperative, (4) Family members, (5) Others, specify

<sup>2/</sup> (1) Yes (2) No

<sup>3/</sup> (1) Lack of documents, (2) Lack of collateral, (3) Lack of connections, (4) the First-time loan, (5) Others

<sup>4/</sup> Financed cropping, (2) Better production, (3) Better income, (4) Paid debts, (5) Others, specify

<sup>5/</sup> (1) More debt due to poor production, (2) Lost property, (3) Others

<sup>6/</sup> (1) High-interest rate, (2) Poor production, (3) Natural disaster, (4) Climate variability, (5) Poor market prices, (6) Others, specify

5.2 Have you benefited from any extension activities about (1) sustainable land use and management, (2) loans or financing, and/or (3) livelihood support programs? (1) Yes

(2) No (3) Did not participate in any activity

| Provider <sup>1/</sup> | Type of support <sup>2/</sup> | Do you still use the technology <sup>3/</sup> | Reason/s <sup>4/</sup> |
|------------------------|-------------------------------|-----------------------------------------------|------------------------|
|------------------------|-------------------------------|-----------------------------------------------|------------------------|

|     |  |  |  |
|-----|--|--|--|
| (1) |  |  |  |
| (2) |  |  |  |
| (3) |  |  |  |

<sup>1/</sup> (1) LGU-MAO/MENRO, (2) Provincial Government (PAO-PENRO), (3) NGA-DA/DENR, (4) NGOs, specify (5) PO, specify (6) Academe, specify (7) Private company, specify, (8) Others, specify

<sup>2/</sup> (1) Cropping pattern, (2) Soil fertility, (3) Soil erosion and conservation, (4) Soil acidity and control measures, (5) Water conservation, (6) Fertilizer/pesticide use, (7) Farm equipment, (8) Loans/financing, (9) Livelihood projects, (10) Others, specify

<sup>3/</sup> (1) Yes (2) No

<sup>4/</sup> (1) Improves soil fertility, (2) Reduces soil erosion, (3) Improves farm income, (4) Others

### 5.3 Are you aware of any policies related to:

| Policies             | (1) Yes | (2) No | If Yes, specify |
|----------------------|---------|--------|-----------------|
| Land management      |         |        |                 |
| Water management     |         |        |                 |
| Forest management    |         |        |                 |
| Watershed protection |         |        |                 |

### 5.4 Were you consulted in the formulation of these policies or any planning process? (1) Yes (2) No

If Yes, which area/s? (1) Land (2) Water (3) Forest (4) Watershed (5) Others, \_\_\_\_\_

How? (1) Policy-making (2) Planning (3) Consultation (4) Review (5) Others, \_\_\_\_\_

Level (1) Village (2) Municipal (3) Watershed (4) Provincial (5) Others, \_\_\_\_\_

### 5.5 Did you benefit from these policies or plans? (1) Yes (2) No

If Yes, how?

- |                                                    |                                                              |
|----------------------------------------------------|--------------------------------------------------------------|
| (1) Gained access to new farming technologies      | (4) Gained access to improve market                          |
| (2) Increased farm production and income           | (5) Gained access to loans and credits                       |
| (3) Improved farm condition (e.g. reduced erosion) | (6) Improved watershed condition (e.g. better water quality) |

### 5.6 Do you think incentives are important to change your land use and management practices?

(1) Yes (2) No

If Yes, choose 3 main incentives, and rank according to importance with 1 as the most important

| Incentives                                     | Rank | Incentives                   | Rank |
|------------------------------------------------|------|------------------------------|------|
| (1) Improved extension services                |      | (5) Crop insurance           |      |
| (2) Input subsidies (e.g. livelihood projects) |      | (6) Micro-financing support  |      |
| (3) Marketing support                          |      | (4) Infrastructure support   |      |
| (4) Awards and recognition                     |      | (5) Appropriate technologies |      |

## 6. DRIVERS OF CHANGE AND RISK PERCEPTIONS TO FARMING-BASED LIVELIHOODS

### 6.1 Has your farming livelihood been affected by the following:

|               | Impacts on soil quality? <sup>1/</sup> | Adaptation/ coping strategies <sup>2/</sup> | Impacts to farming livelihood? <sup>3/</sup> | Adaptation/ coping strategies <sup>4/</sup> |
|---------------|----------------------------------------|---------------------------------------------|----------------------------------------------|---------------------------------------------|
| (1)Typhoons   |                                        |                                             |                                              |                                             |
| (2)Droughts   |                                        |                                             |                                              |                                             |
| (3)Landslides |                                        |                                             |                                              |                                             |
| (4)Flooding   |                                        |                                             |                                              |                                             |

<sup>1/</sup> (0) None, (1) Eroded farm soil, (2) Reduced soil fertility, (3) Others, specify

<sup>2/</sup> (1) Stabilized sloping areas by planting trees, (2) Contoured sloping areas [e.g. NVS, hedgerows], (3) Covered soil by planting cover crops [e.g. Arachis pintoi], (4) Established rainwater harvesting, and (5) Others

<sup>3/</sup> (0) None, (1) Damaged crops, (2) Reduced income, (3) Flooded cultivated areas, (4) Changed land use, and (5) Others



<sup>4/</sup> (1) Diversified crops on-farm, (2) Planted trees on the farm, (3) Planted crop varieties that can withstand monsoon and drought, (4) Moved to other areas not vulnerable to these extreme events, (5) Diversified sources of income, and (6) Others

6.2 Were you affected by the presence of multinational companies? (1) Yes (2) No

If Yes, how?

- (1) Rented out my land and worked in the company
- (2) Rented out my land and looked for another source of income (e.g. habal-habal, hired labour)
- (3) Reduced time farming my land and worked for the company
- (4) Fallowed my farm and worked in the company
- (5) Allowed others to cultivate the land and worked in the company
- (6) Changed land use and planted company crops on own farm (e.g. banana)
- (7) Family health affected by aerial spraying and/or chemical application among others

6.3 Were you affected by the presence of non-government organizations? (1) Yes (2) No

If Yes, how?

- (1) Introduced new land use systems
- (2) Introduced new land management practices
- (3) Improved farming and leadership skills
- (4) Increased social networks on crop production and marketing among others
- (5) Enabled to avail farm loans and livelihood assistance projects

6.4 Were you affected by Claveria-Gingoog road development? (1) Yes (2) No

If Yes, how?

- (1) Convenient transportation of farm products
- (2) Improved income due to better quality of transported farm products
- (3) Improved income due to reduced transportations cost
- (4) Expanded agricultural cultivation (e.g. vegetables)
- (5) Changed land use to make use of better roads

6.5 Were you affected by any land use or environment-related policies and/or plans? (1) Yes

(2) No If Yes, how?

- (1) Unable to farm my land
- (2) Unable to plant certain crops on my land that I would like to
- (3) I have to plant specific crops on my land
- (4) I have to apply specific land management practices on my land

**Thanks very much!!!**

## Appendix 4: Dominant crops by physiographic units on farms in Cabulig watershed (2016)

| Physiographic units and landform | Dominant crops on farms (%; n=604) |             |         |        |            |         |         |                |          |        |       |        |         |           |        | Total |
|----------------------------------|------------------------------------|-------------|---------|--------|------------|---------|---------|----------------|----------|--------|-------|--------|---------|-----------|--------|-------|
|                                  | White corn                         | Yellow corn | Cassava | Banana | Vegetables | Coconut | Tobacco | Irrigated rice | Rootcrop | Tomato | Abaca | Coffee | Flowers | Tree farm | Others |       |
| Jasaan                           |                                    |             |         |        |            |         |         |                |          |        |       |        |         |           |        |       |
| JH                               | 9                                  | 22          | 51      | 6      | 0          | 10      | 0       | 0              | 0        | 0      | 0     | 0      | 0       | 0         | 3      | 100   |
| JM                               | 10                                 | 4           | 14      | 31     | 5          | 34      | 0       | 1              | 0        | 0      | 0     | 0      | 0       | 0         | 0      | 100   |
| JL                               | 24                                 | 12          | 15      | 21     | 0          | 26      | 0       | 3              | 0        | 0      | 0     | 0      | 0       | 0         | 0      | 100   |
| All                              | 12                                 | 12          | 28      | 20     | 2          | 24      | 0       | 1              | 0        | 0      | 0     | 0      | 0       | 0         | 0      | 100   |
| Escarpment                       |                                    |             |         |        |            |         |         |                |          |        |       |        |         |           |        |       |
| EH                               | 9                                  | 27          | 0       | 18     | 18         | 0       | 5       | 0              | 0        | 5      | 14    | 5      | 0       | 0         | 0      | 100   |
| EM                               | 32                                 | 5           | 0       | 14     | 27         | 0       | 0       | 0              | 0        | 0      | 14    | 9      | 0       | 0         | 0      | 100   |
| EL                               | 33                                 | 33          | 33      | 0      | 0          | 0       | 0       | 0              | 0        | 0      | 0     | 0      | 0       | 0         | 0      | 100   |
| All                              | 21                                 | 17          | 2       | 15     | 21         | 0       | 2       | 0              | 0        | 2      | 13    | 6      | 0       | 0         | 0      | 100   |
| Sumagaya                         |                                    |             |         |        |            |         |         |                |          |        |       |        |         |           |        |       |
| SM                               | 32                                 | 0           | 0       | 12     | 21         | 0       | 0       | 3              | 12       | 12     | 6     | 0      | 0       | 3         | 0      | 100   |
| SL                               | 9                                  | 13          | 0       | 5      | 16         | 0       | 2       | 35             | 2        | 0      | 7     | 2      | 9       | 0         | 0      | 100   |
| All                              | 18                                 | 8           | 0       | 8      | 18         | 0       | 1       | 22             | 6        | 4      | 7     | 1      | 6       | 1         | 0      | 100   |
| Balatukan                        |                                    |             |         |        |            |         |         |                |          |        |       |        |         |           |        |       |
| BH                               | 50                                 | 0           | 0       | 0      | 50         | 0       | 0       | 0              | 0        | 0      | 0     | 0      | 0       | 0         | 0      | 100   |
| BM                               | 29                                 | 17          | 4       | 4      | 11         | 0       | 16      | 2              | 8        | 7      | 2     | 1      | 1       | 1         | 0      | 100   |
| BL                               | 38                                 | 8           | 0       | 0      | 8          | 0       | 23      | 0              | 8        | 8      | 0     | 8      | 0       | 0         | 0      | 100   |
| All                              | 29                                 | 17          | 3       | 3      | 11         | 0       | 15      | 2              | 8        | 6      | 1     | 1      | 1       | 0         | 0      | 100   |

## Appendix 5: Factors that influence farmers' land use decisions and management

Excerpt from KIIs of San Nicolas, Jasaan

| Factors                    | Quotations                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
|----------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Land conditions            | <ul style="list-style-type: none"> <li>• “It [soil] is gradually improving because of flooding that brings along fertile soil, that sticky top soil from the upper areas.” (Young male farmer)</li> <li>• “It was fertile before. But now, it’s still okay. It’s still good. It hasn’t changed... There is one year that I leave it idle. I leave it fallow.” (Widow caretaker/farmer)</li> <li>• “Only maize grow in my farm because it is a bit rocky. (Indigenous farmer)</li> <li>• “We only need seeds/seedlings and fertilizers because my soil is still fertile.” (Indigenous farmer)</li> <li>• “I also plant ipil-ipil. I leave them to grow because its leaves can support the soil’s nutrients, because my area rolling.” (Indigenous farmer)</li> </ul>                                                                                                                         |
| Remoteness                 | <ul style="list-style-type: none"> <li>• “They don’t call on us here because we are far. We are in a remote area.” (Young male farmer)</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| Land ownership             | <ul style="list-style-type: none"> <li>• “Yes, we bought this. This is really named after us. This is named after my parents because they are still alive. We just look after it.” (Young male farmer)</li> <li>• “My parents dreamt of a better life. So they transferred upstream when the coffee was so expensive. They bought a land in Aposkahoy. Our landlord said, ‘Do you want to go with your parents?’ I answered, ‘no’. He then said, ‘you take care of this farm’. That’s why until now, I’m still here, a caretaker.” (Widow caretaker/farmer)</li> <li>• “It’s my mother’s land, her inheritance. Then I inherited part of it. I will leave it to my grandchildren.” (Indigenous male farmer)</li> </ul>                                                                                                                                                                      |
| Farm size                  | <ul style="list-style-type: none"> <li>• “1 hectare, 1 plot”. (Young male farmer)</li> <li>• “I look after this 5 hectare land.” (Widow caretaker/farmer)</li> <li>• “It should be less than a hectare, maybe half because we’ve divided it already among us siblings.” (Indigenous farmer)</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| Sharing arrangements       | <ul style="list-style-type: none"> <li>• “My parents own this land. We are just cultivating this on their behalf... We then divide the profit into two.” (Young male farmer)</li> <li>• “We share the profit. Mine is 35%. Theirs is 65%. That is our sharing arrangement where I still have to spend all the costs, including the cost to transport the copras. They just receive their share straight away. It can be discouraging sometimes because even those crops that I’ve planted, they still get their exact share.” (Widow caretaker/farmer)</li> <li>• “That farm across the river, I had a conflict with my landlord with that because when we harvested the maize, they want to get the 25% directly without deducting all of my expenses on the seeds and fertilizers... The weeding was already free because I did the cleaning myself.” (Widow caretaker/farmer)</li> </ul> |
| Available household labour | <ul style="list-style-type: none"> <li>• “My wife also likes it here. It’s deserted here. Peaceful. Quiet. You can have peace of mind here. Unlike in the city, which is so hot, so polluted... My uncle is also here with us.” (Young male farmer)</li> <li>• “I have four children. But I am no longer with them because I’ve lived on my own now... They are all married... Then the cultivation itself is difficult as it’s only me.” (Widow caretaker/farmer)</li> <li>• “I have four children. All of them used to farm with me. But they got work in a company, at MisCor in Balingasag related to electricity, electric line. It is better that they have work other than farming. It seems that they also like it there. Let them be because it’s there occupation.” (Indigenous farmer)</li> </ul>                                                                                |
| Access to water            | <ul style="list-style-type: none"> <li>• “We always water the crops, especially now that it is drought. We take water from that river because that is already part of the river... It’s favourable here because we’re near from that river.... there are also many people washing</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |

| Factors               | Quotations                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
|-----------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                       | <i>their clothes. So we came up with this idea of making a well. It's not 100% clean but at least we can use it.</i> (Young male farmer)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| Extension services    | <ul style="list-style-type: none"> <li>• <i>"They don't call on us here because we are far. We are in a remote area. There are many farmers here, but they don't extend their services here... If we don't go there, assistance will never reach here. So we try anything possible here to do the best. That is why our farming here is all based on our own initiatives."</i> (Young male farmer)</li> <li>• <i>"The agriculture office, MAO. We really had a seminar about organic farming... They always come here and visit our garden. Maybe twice in a month... They only visit those they are assisting. Those who did not participate, they didn't visit. But it should also be okay if they also go them so they can teach them. They only go to those who have gardens."</i> (Widow caretaker/farmer)</li> <li>• <i>"They also come here. They also teach us. They taught us to make that fertilizer from decayed fish called composting."</i> (Indigenous farmer)</li> <li>• <i>"Not always. They should visit us at least every six months. When they come here, they just call us farmers to go to the barrio hall. 'You come here because our Agriculturist is here.' There we have lectures. I'm already happy with that, twice a year. What's happening now is they only come once a year. It's so long."</i> (Indigenous farmer)</li> </ul> |
| Acceptable technology | <ul style="list-style-type: none"> <li>• <i>"We can't really say that fish composting has helped. But I think fertilizer is better than that because it smells so bad. It really smells so bad because it's decayed fish. Fertilizer is better. We've tried it in madam's (Mayor) organic vegetable garden on bitter gourd. It still didn't work because of the drought. They still died."</i> (Indigenous garden)</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| Poor road system      | <ul style="list-style-type: none"> <li>• <i>"The road seems like made just for them. We don't have an access road here."</i> (Young male farmer)</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| Lack of capital       | <ul style="list-style-type: none"> <li>• <i>"Lack of fertilizer... It's really fertilizer that is insufficient."</i> (Widow caretaker/farmer)</li> <li>• <i>"My soil is poor. So I really plant ipil-ipil because it provides nutrients, considering that I cannot buy fertilizers."</i> (Indigenous farmer)</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| Access to loan        | <ul style="list-style-type: none"> <li>• <i>"We have never accessed any loan ever since."</i> (Young male farmer)</li> <li>• <i>"I've [my wife] loaned before in CARD. It was also a cash loan, financial for farming."</i> (Widow caretaker/farmer)</li> <li>• <i>"I have not accessed any loans."</i> (Indigenous farmer)</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| Land use motivations  | <ul style="list-style-type: none"> <li>• <i>"Consideration that it will benefit the environment, that's the first. Second is that you can gain profit so you can sustain the daily needs of your family. Finally, that it can benefit your whole family."</i> (Young male farmer)</li> <li>• <i>"Income and sustainable farming work together because if you are implementing sustainable farming, you will also have sustained income. There is a connection on these two aspects of farming. For example, if you are industrious in planting different crops and in finding the best system, this soil will also provide for the people's needs. If you leave the soil idle, there will also be no income."</i> (Young male farmer)</li> <li>• <i>"It will always be sustainability. I don't need that, for example they will pay me now with money – I have children. They should inherit something from me."</i> (Widow caretaker/farmer)</li> <li>• <i>"Sustainability of course. Sustainability. So we diversify our system. There is connection with income and sustainability. For example now, someone asked me, 'let me buy half sack of cassava.' We can still get income with diverse cropping."</i> (Indigenous farmer)</li> </ul>                                                                                                              |
| Aspiration            | <ul style="list-style-type: none"> <li>• <i>"I will already be in abroad... Farming is still not permanent for me. There are also opportunities abroad. For now, I'm applying."</i> (Young male farmer)</li> <li>• <i>"I would be very blessed I can own it myself in the future. But it is my hope that it will never go to another people because I've planted all those crops there. Those crops are all mine. It should always be mine. If ever I will die, I have my children who can follow and manage the farm."</i> (Widow caretaker/farmer)</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |

| Factors                 | Quotations                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
|-------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                         | <ul style="list-style-type: none"> <li>“I hope that this land I inherited from my mother will remain in the family. I want to plant more coconuts in it.” (Indigenous farmer)</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| Soil knowledge          | <ul style="list-style-type: none"> <li>“There are three kinds of soils here - sandy, lantikan, then mixed soil and lantikan (yellow). The soil is only half-metre.” (Young male farmer)</li> <li>“There are two types of soil because in that area, it has a different type of soil, ‘tambo’, sandy. This, because this is what I’ve just cultivated, this here, this has the same type. What is the name of this? ‘Lantikan’. Yes, because there, it is ‘tambo’ there. Here sandy.” (Widow caretaker/farmer)</li> <li>“Only the loam (lantikan) and sandy (tambo). Here, it is sandy. There, it is loamy there.” (Indigenous farmer)</li> </ul>                                                                                                                                                     |
| Crop preference         | <ul style="list-style-type: none"> <li>“Coconuts because it really has a good income... if you will build a house, you can use it. For other crops you cannot do this. Before you cut these, you have to plant new ones first before cutting the old trees down... If you feel thirsty, you have the coconut juice with its young flesh.” (Young male farmer)</li> <li>“It’s better to plant here maize, mung bean, squash. Cassava is not good. Mung bean is good. Trees are also okay but you can no longer plant mung bean if you have trees... Gmelina and Mahogany, Falcata, coconut. Coconut and banana should always be there.” (Widow caretaker/farmer)</li> </ul>                                                                                                                           |
| Education               | <ul style="list-style-type: none"> <li>“I’ve long enjoyed farming. Actually during my college, I took Agriculture as my course at CU. Then I shifted to another course. But I’ve always been interested on soil. I was the one who decided to that course. I just tried it. Unfortunately, I got confused at one time so shifted to Accounting. Then I shifted again to Nautical. Until in the long run, I didn’t finish any of those courses.” (Young male farmer)</li> <li>“I finished Grade VI... When I learned plowing, that’s when I started farming. I think I was 12 or 13 years old.” (Widow caretaker/farmer)</li> <li>“I finished Grade VI... I started farming when I got married. I think I was 22 then, and until now. About 40 years have passed now.” (Indigenous farmer)</li> </ul> |
| Children’s education    | <ul style="list-style-type: none"> <li>“It’s my dream that they will not follow my experiences where I really worked so hard. Sus, day and night I was working so they can go to school. I harvested coconuts before. I climbed up coconuts. At night, we roast the copras. The following day, we sell the dried copras. If only it was possible not to sleep, I will not.” (Widow caretaker/farmer)</li> <li>“Through farming, my children finished high school... They got work in a company, at MisCor in Balingasag related to electric lines. I’m happy that they have work other than farming. It seems that they also like it there.” (Indigenous male farmer)</li> </ul>                                                                                                                     |
| Diverse farm components | <ul style="list-style-type: none"> <li>“For crops alone, excluding the livestock, coconut has the highest income. As of now, we depend on coconut income... Our banana, before the Senyang flood, we earn P1k every week. But now, it’s been flooded... Our income from livestock depends on how many piglets we’ll have...” (Young male farmer)</li> <li>“There are coconuts, banana, trees like mahogany, falcata, mix, gmelina. You can really see that if you like.” (Widow caretaker/farmer)</li> <li>“I have coconuts, cassava, corn and cantong banana. I also planted gmelina and ipil-ipil... We get better income with diverse cropping.” (Indigenous farmer)</li> </ul>                                                                                                                   |
| Crops for consumption   | <ul style="list-style-type: none"> <li>“We have moringa, lemon grass. We will plant again vegetables but not now because it is still drought. We have lemon grass, moringa and five fingers.” (Young male farmer)</li> <li>“I plant string beans. I also sell them. I have squash, mung bean, moringa, patola.” (Widow caretaker/farmer)</li> <li>“In backyard maam but they died, that, what you call it, five fingers. Only that.” (Indigenous farmer)</li> </ul>                                                                                                                                                                                                                                                                                                                                  |

## Appendix 6: Factors that influence farmers' land use decisions and management on farm

Excerpt from KIIs of Aposkahoy, Claveria, Misamis Oriental

| Factors                             | Quotations                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
|-------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Land condition                      | <ul style="list-style-type: none"> <li>“If you plant without chicken dung, it will never grow well. The seedlings already need it. They will never grow well without fertilizers... For example, sweet potato, the vines don't spread so much anymore.” (Female migrant farmer)</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| Sloping lands                       | <ul style="list-style-type: none"> <li>“That is why I planted it with falcata to preserve my sloping areas from landslides. Then in planting falcata, I lined them just like contouring. They have to be a line along the contour so when their roots become matured and intertwined, the area does not easily landslide. But while they are still small, at the moment, the falcata, I planted the alley with corn because the sunlight can still get through.” (Male village councilor/farmer)</li> <li>“The areas there are not that sloping. Just relatively rolling. We still have gardens on these areas. Most of our crops are sweet potato.” (Female migrant farmer)</li> </ul>                                                                 |
| Land ownership                      | <ul style="list-style-type: none"> <li>“That area with my house going up to the mountain round down to the bridge. That is CBFM.” (Male village councilor/farmer)</li> <li>“Yes, we worked hard so we can also own lands that we can cultivate.” (Female migrant farmer)</li> <li>“You cannot plant trees because it's just rented. Rented lands are often just for gardens.” (Female migrant farmer)</li> <li>“...because no one will decide what to do with it for you. When the time comes, your activities are limited if you can only cultivate it for 1 year. Then you will have to move out. It's better when you own the land because you can harvest just anything. After harvesting, you can plant again.” (Female migrant farmer)</li> </ul> |
| Farm size                           | <ul style="list-style-type: none"> <li>“I don't know how many sacks per hectare. We don't farm by hectare. Our plots are just small. We don't have so much money to buy chicken dung and fertilizer. We only apply small amounts.” (Female migrant farmer)</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| Household labour                    | <ul style="list-style-type: none"> <li>“Only one. Six children. Only 1 son. He's the only one farming.” (Female migrant farmer)</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| Financial capital                   | <ul style="list-style-type: none"> <li>“Me, I don't plant tomato these days because it requires huge capital.” (Male village councilor/farmer)</li> <li>“We just plant sweet potato because we don't have money to buy fertilizers, chicken dung. But if we have money to buy, we plant tomato, corn. We cannot corn because we don't have money to buy fertilizer, chicken dung. It will never grow without chicken dung... We will plant many vegetables if we have sufficient capital.” (Female migrant farmer)</li> </ul>                                                                                                                                                                                                                           |
| Access to loans                     | <ul style="list-style-type: none"> <li>“Our land has been even loaned in the bank.” (Male village councilor/farmer)</li> <li>“Therein Sir ___ for tomatoes. We borrow money from him so we can buy medicines, fertilizers.” (Female migrant farmer)</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| Diverse source of income            | <ul style="list-style-type: none"> <li>“I don't have lands. I have one but I have even loaned that in a bank. What I do is raise cows... When my wife was hospitalized because of her ovary, when I arrive there in Sabal Hospital, we advised to just move out because they said, ‘how can you pay?... At that time, I had 60 cows. When our children in school need some things, when there are emergencies, I will then sell cows. That's my target.” (Male village councilor/farmer)</li> </ul>                                                                                                                                                                                                                                                     |
| Presence of multinational companies | <ul style="list-style-type: none"> <li>“Some also have employments – company driver at EKIPARCO. The others are in Dole there in Mat-i. My daughter is there but it is her husband who works in Dole.” (Female migrant farmer)</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |



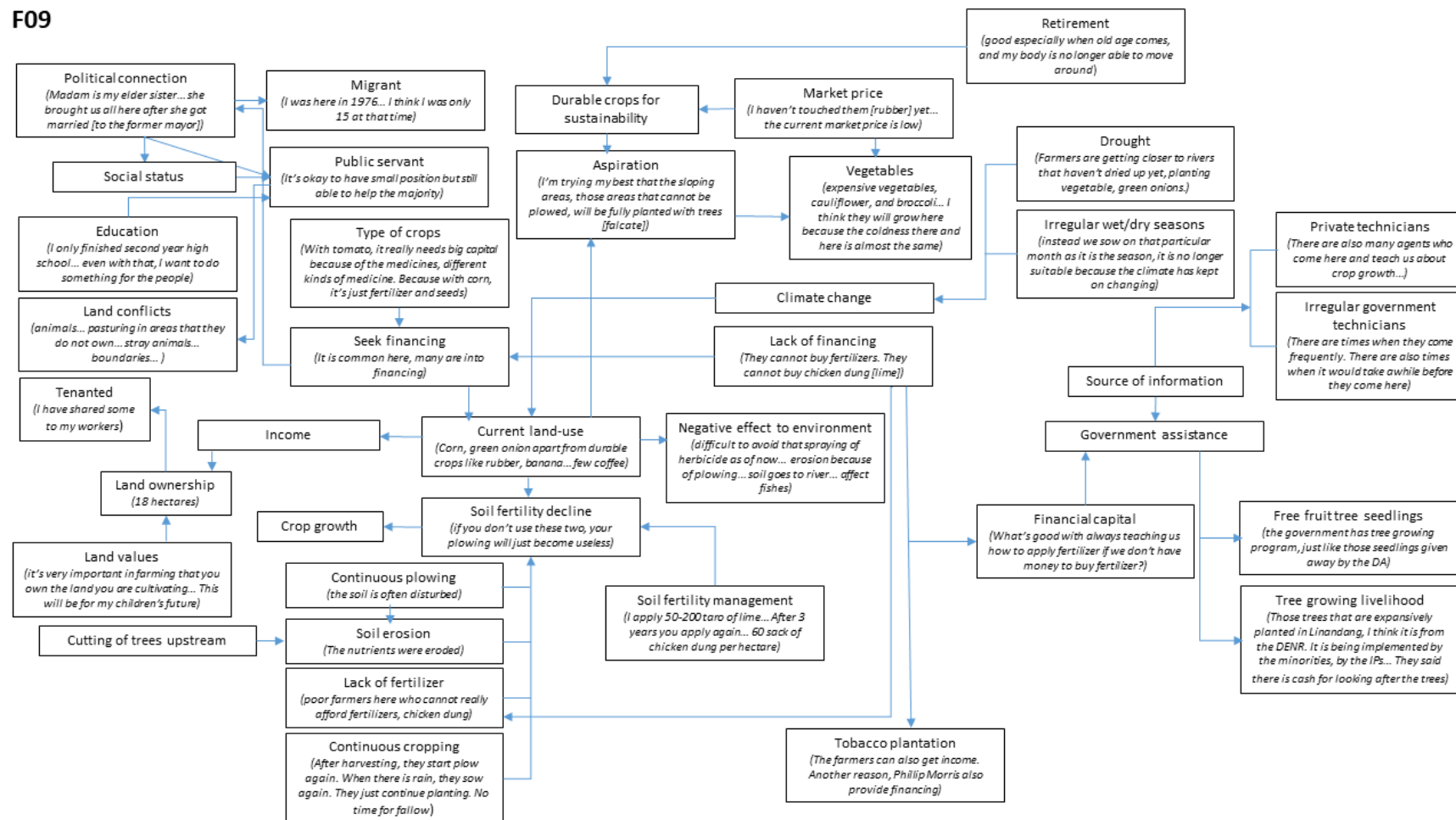
| Factors                 | Quotations                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
|-------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Extension delivery      | <ul style="list-style-type: none"> <li>“There were so many seminars at that time. I attended almost all of the seminars before. But I’ve already forgotten some of them. When we started planting, it was around 1996.” (Male village councilor/farmer)</li> <li>“They come and conduct meetings with us, those technicians of medicines, Agro. They introduce their medicines on tomato, sweet potato, corn. They conduct meetings. They often come here. That’s very important for our farming livelihood. They can help us what medicines and fertilizers to use. ... They (agricultural technicians) also come here but not always (‘permanente’). When they come, some people are already out working. Because those from Agri, they come here as scheduled.” (Female migrant farmer)</li> </ul>                                                                                                                                                                                                                                       |
| Retirement              | <ul style="list-style-type: none"> <li>“The animals that are growing each year, I allocated these for my retirement, and that they will multiply. One cow, I calculated that with just one big cow, if you manage it well, within 15 years, beginning with 15 ha, you will gain a million. 15 years. Na if you are a soldier, you will have to serve 20 years because that is an optional retirement. Na if I make it to 20 years, I will have more than a million. And then when you retire, you will also receive more than a million. It’s just the same as mine. Yes, but we’re only talking about one cow’.” (Male village councilor/farmer)</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                |
| Farmer’s identity       | <ul style="list-style-type: none"> <li>“We farm. We continue farming... I want him [son] to farm because we have no one to work on it. He has to continue farming.” (Female migrant farmer)</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| Motivation              | <ul style="list-style-type: none"> <li>“We should start a livelihood, this corn... we eat it every day. We also have a garden... Mine is beans, because these beans, it commands a higher price in the market now. It’s easy to manage because it has stakes. It also cannot negatively affect soil because when you garden, you usually apply chicken dung. Therefore, the fertile soil remains there and results in a good harvest. Because if you are also here, if you plant any crops, these crops, you always apply fertilizer, it can also harm your soil.” (Male village councilor/farmer)</li> <li>“As long as we can harvest, we can eat. We must have food to eat.” (Female migrant farmer)</li> <li>“As long as we can plant. It’s not that we have to endeavor to improve its quality. We know that in for long-term use, it is important to improve the soil but yes, what can we do.” (Female migrant farmer)</li> </ul>                                                                                                     |
| Environmental awareness | <ul style="list-style-type: none"> <li>“Because the trees control the soil that contains water. If the trees are cut, the soil dries up and the water is gone. That’s why our grandfather used to tell us before, that spring where we collect water, that spring, we call it watershed (‘sandayong’). He didn’t allow any trees around it to be cut. He even planted it with abaca because the abaca, banana, they also control soil and keep water. They ensure water availability in the soil.” (Female migrant farmer)</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| Extreme events          | <ul style="list-style-type: none"> <li>“For instance, our land there, that one near the bridge, our land is the only one there. Trees located upslopes were fell without our knowledge. When it rained, a very heavy rainfall, it was flooded with eroded soil. Trees fell out (‘nangalukat’)... It was hit by a hurricane (‘buhawi’).” (Female migrant farmer)</li> <li>“Times have changed because we are now affected by typhoons. When there are no more trees when it rains, there is flooding.” (Female migrant farmer)</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| Government program      | <ul style="list-style-type: none"> <li>“We will work on this because of the government’s program, for example, that of the NCIP now, National Greening Program, involving the planting of trees so we also plant trees. That’s what we do. We don’t, we didn’t oppose DENR’s program because if we do that, what happens is, maybe they will no longer renew our tenure.” (Male village councilor/farmer)</li> <li>“That’s really from the CBFM agreement. I’ve been here before. That’s 70-30. That’s the basis of that harvest arrangement. That’s what happened. The people, when NGP came, are a bit disappointed because if their remaining area will still have to be planted with trees, those areas that have not been planted yet with trees, what would become of their farming livelihood? What will they eat?” (Male village councilor/farmer)</li> <li>“This issue on prohibiting tree cutting... they will just pay you with your planted trees, whatever is the calculation at that time. So if they pay you, the</li> </ul> |

| Factors           | Quotations                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
|-------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                   | <p>money will easily vanish as compared to when you are cultivating the area. Your children can even benefit the land in the future. It will remain supporting your livelihood. That's the problem I see, which made me uninterested in the current process of that program. But if they can revert that and that will not happen, we'll be very thankful." (Male village councilor/farmer)</p> <ul style="list-style-type: none"> <li>• "That's why planted Falcata in sloping lands. The cleared forest areas, we also planted with Falcata... My husband has also joined that because in our farms, the boundaries of our areas, of our farms, the Falcata trees there are from the DENR." (Female migrant farmer)</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                        |
| Collective action | <ul style="list-style-type: none"> <li>• "In my experience, during my younger times before, I like joining seminars. Even if I have a low level of education and knowledge, I just really join because why? Because no matter how small, I know I will learn something. That's why before, I always joined the activities of DENR. My certificates there have already filed up..." (Male village councilor/farmer)</li> <li>• "When you are the leader and then your members are weak, you can never move productively. But if you have given your members good strategies to meet your goal, then they become active. You also become happy... Because if I will do things on my own, to improve myself, I will be the only one who will be happy. Then they will come during harvest time, 'oy do you have some spare to share'." (Male village councilor/farmer)</li> <li>• "That's what they say, what I like about seminars is I learn a lot. This one is under DAR. But in DAR, I enjoy it. Even if I don't things specifically, I can understand the general terms because... this is my ID at DENR." (Male village councilor/farmer)</li> </ul> |



## Appendix 7: Sample individual cognitive maps of farmer key informants

F09



**F10**

