The Potential of Jackfruit to Contribute to Rural Development in Leyte, Philippines

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.

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Abstract

The Filipino government is currently implementing policies in which different provinces are promoted as major producers of flagship commodities under the High Value Crops Development program. This policy approach contains social elements such as poverty alleviation. This thesis investigates the potential of jackfruit to become either a sustainable crop or a cash crop commodity in Leyte, the Philippines. It analyses jackfruits potential to contribute to rural development and as a result reduce levels of poverty and improve farmer's livelihoods.

This thesis uses a food systems and systems thinking approach to analyse cash crop commodities. By doing so it enables the whole system to be analysed in an holistic manner, hence addressing the inter-connectedness and interactions between the different components of the system. The cultural adaptation template which was developed by Newell (2011) is the key analytical framework utilised to undertake this analysis. This thesis seeks to understand what lessons can be learnt from structurally similar cash crop commodities case studies (banana and coconut) and applied to the jackfruit case study.

Findings suggest that the policy focus of agricultural intensification to reduce levels of poverty is not successfully achieving its social policy goals. Poverty statistics have not significantly changed over the years despite the consistent increase in production, prices and export levels. The approach is resulting in significant social, environmental and economic costs at the site of production. As a result the health of the ecosystem and human wellbeing is deteriorating. The policy approach is feeding into an international economic system where the bulk production of commodities is required to meet global demand. Due to the structural similarities between the three it is likely that jackfruit will develop into a cash crop commodity. As the jackfruit industry is still being developed in Leyte, interventions in the system can occur to ensure that this does not occur. Recommended points of intervention in the system include ensuring those involved in rural agriculture have a greater influence on policy, the creation of farmer cooperatives, value adding options, organic certification, collective agreements and the establishment of government taxes and payments. Ultimately, however, the Filipino government needs to have a paradigm shift in their views from agricultural intensification policies to an approach where socio-environmental degradation does not come second to the economy. Until there is this shift, jackfruit will become a cash crop commodity for farmers and will not provide them with an adequate income which would remove them from poverty.

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Chapter 1: Introduction

Food insecurity is a global problem, with an estimated 795 million people world-wide undernourished or living without adequate food (FAO *et al.*, 2015). As a result of an increasing world population, changing dietary patterns and the projected potential consequences of climate change, issues surrounding food will continue to dominate political and humanitarian debates (Godfray *et al.*, 2010; Loos *et al.*, 2014). Food insecurity is already of severe and immediate concern in developing areas such as South East Asia.

The Republic of the Philippines (The Philippines) is one of many developing nations grappling with issues of a growing population and inadequate food. From 1990 to 2008, the Filipino middle class increased by 12% (Chun, 2010). The majority of the nation's population (55%) reside in rural areas (World Bank, 2016e) and the rural poverty rate is significantly higher (39%) than the urban poverty rate (13%) (World Bank, 2016b). It is estimated that 14% of the Filipino population is undernourished (World Bank, 2016c) despite nearly 50% of rural family household expenditure being spent on food (Philippines Statistics Authority, 2016e). Approximately 31% of the population work in the agriculture sector (Philippines Statistics Authority, 2016k). This, coupled with the aforementioned concerns regarding poverty and food, highlights the need for research and policy action on food issues in the Philippines.

The South-East Asian Regional Centre for Graduate Study and Research in Agriculture (SEARCA) is the major research institution in the region. Their current approach is to create Inclusive and Sustainable Agricultural and Rural Development (ISARD) which helps in achieving the goals of food security and poverty alleviation (SEARCA, 2015). Researchers attempt to achieve this by utilising a systems oriented and inter- or trans- disciplinary approach to capacity building and research (SEARCA, 2015). Their aim is to identify recommendations that are based on best practice and lessons learnt which can be utilised on similar projects (SEARCA, 2015). This thesis is an example of this approach.

Cash crops have frequently been proposed as an aid in removing countries or regions from the poverty cycle (Khan, 1999; Bank, 1981). Currently in the Philippines, different provinces are being promoted as major producers of flagship commodities under the High Value Crops Development Program (Department of Agriculture, 2016a). For example, Jackfruit (*Artocarpus heterophyllus*) has become the flagship commodity for the province of Leyte, Eastern Visayas (Department of Agriculture, 2016a). Jackfruit

is the world's largest known edible fruit and can weigh up to 35 kilograms (Prakash *et al.*, 2009:353). It can be consumed fresh, added to curries or desserts, processed into flour or noodles and also canned in sugary syrup or frozen (Pua *et al.*, 2007:630).

This thesis focuses on jackfruit's potential to contribute to rural development and as a result reduce levels of poverty and improve farmers' livelihoods in Leyte. In order to address the above challenges, a food systems approach will be utilised to identify and integrate the links between numerous factors involved in the 'plough to plate' process (Atkins and Bowler, 2001). A food systems approach addresses the whole system and incorporates all activities, resources and people involved in the process of providing food (Chase and Grubinger, 2014). A systems thinking approach, much like a food systems' approach is an holistic way of addressing the inter-connectedness and interactions between a systems' components (Sherwood, 2002). By utilising a systems thinking approach, lessons can be drawn from structurally similar cash crop case studies in the Philippines and applied to the major case study.

The aim of this thesis can be summarised by the question "what lessons can be learnt from other cash crop commodity case studies in the Philippines and how can they be applied to the jackfruit case study?" The thesis will look at whether the government's promotion of jackfruit as a high value crop contributes to an environmentally friendly and people centred development, whilst ensuring active community and local institution participation can occur (SEARCA, 2015).

The cultural adaption template will be used to analyse jackfruit as the major case study and the associated minor case studies of bananas (*Musa sp.*) and coconuts (*Cocos nucifera*). The cultural adaptation template, which was developed by Newell (2015), is an overview systems based template, which can be utilised to understand the variables and processes operating in complex systems which results in the behaviour of the system. It aims to draw attention to the higher order variables within a social-environmental system and the processes driving change to the value of those variables. The major research question can be further broken down into the following three specific sub-research questions:

- Can the cultural adaptation template be applied to and explain cash crop commodities and the situation in the three case studies? (RQ1)
- Does jackfruit have the potential to be a profitable cash crop in Leyte, and if so, what measures are required to ensure its success? (RQ2)

- Is it likely that jackfruit will become a commodity trap for farmers and how might this be avoided? (RQ3).

This thesis adds to the growing body of literature centred around a food systems approach. Systems thinking has not been heavily applied in either the literature or by policy makers to agricultural sustainability management (Banson *et al.*, 2015). Current approaches that address problems relating to food in isolation have had limited success (Banson *et al.*, 2015) as they fail to consider cross sector linkages and result in partial and largely ineffective policy and management interventions (Newell and Siri, 2016). The analysis in this thesis attempts to address this gap.

The introductory chapter has provided an overview of this thesis. The key questions to be addressed and the scope of this study have been presented. Chapter 2 provides an overview of food security, food systems and systems thinking. The major case study of jackfruit in Leyte will also be discussed. In Chapter 3, the metabolic rift and cash crop commodities literature will be reviewed. Chapter 4 will provide an overview of the cultural adaptation template and its application in this thesis will be outlined. Chapter 5 will present a synopsis of the banana, coconut and jackfruit case studies and this data will be utilised in Chapter 6 to populate the cultural adaptation diagrams. The cultural adaptation template will be used to analyse the case studies and in doing so, will answer the first research question (RQ1) regarding its application to cash crop commodities. The key findings of the research will then be discussed, addressing whether jackfruit has the potential to be a profitable crop (RQ2) or if it will become a commodity trap for farmers (RQ3). Chapter 7 concludes with a summary of this thesis and its findings.

Chapter 2: Background

The purpose of this chapter is to provide background information for this thesis. This chapter commences with contextual information about food security, discusses its critiques and highlights why the food systems approach is used. An overview of the systems thinking approach will also be used to justify the context of this research. This is followed by an outline of the major case study on jackfruit in Leyte.

2.1 Food Security, Food Systems and Systems Thinking

A common definition of food security used in the literature is from the 1996 Food and Agriculture Organisation of the United Nations' World Food Summit. Food security is defined as a situation "when all people, at all times have physical, social and economic access to sufficient, safe, and nutritious foods that meet their dietary needs and food preferences for an active and healthy life" (FAO, 1996). This concept was extended to include the four pillars and dimensions of food security – availability, access, utilisation and stability. These definitions are displayed in Table 2.1.

Table 2.1 Four pillars of food security

Pillar	Definition (as provided by FAO, 2008)
Food availability	The availability of sufficient quantities of food of appropriate quality, supplied though domestic production or imports (including food aid).
Food access	Access by individuals to adequate resources (entitlements) for acquiring appropriate foods for a nutritious diet. Entitlements are defined as the set of all commodity bundles over which a person can establish command given the legal, political, economic and social arrangements of the community in which they live (including traditional rights such as access).
Food utilisation	Utilisation of food through adequate diet, clean water, sanitation and health care to reach a state of nutritional well-being where all physiological needs are met. This brings out the importance of non-food inputs in food security to common resources.
Food stability	To be food secure, a population, household or individual must have access to adequate food at all times. They should not risk losing access

	to food as a consequence of sudden shocks (e.g. an economic or climatic crisis) or cyclical events (e.g. seasonal food insecurity). The concept of stability can therefore refer to both the availability and access dimensions of food security.

Previously, the main approach to food security focused on food production and the knowledge that an increase in production would address food shortage issues (Ingram, 2011a). Consequently, much of the literature has focused broadly on agronometrics, such as technological advances and increasing average yields as well as economic strategies - including open markets and free trade (Ingram, 2011a). Whilst this research and the subsequent policy approach has resulted in a significant increase in food production, it has created environmental problems such as soil erosion and biodiversity loss (Ingram, 2011b). This environmental damage then degrades food production capacity, thus becoming a self-reinforcing problem (Ingram, 2011b).

A lack of food has been highlighted as a key factor contributing towards poverty. As a result, it has been emphasised that increased agricultural productivity is a key step in reducing rural poverty (von Braun *et al.*, 2004). Despite the current policy approach and research focus on agricultural production, 925 million people worldwide remained food insecure in 2010 (FAO, 2010) and 795 million people are still undernourished or living without adequate food (FAO *et al.*, 2015). However, there is currently enough food per capita to feed the world's population (Ingram, 2011a). Sen (1981) has highlighted how access to food, as opposed to availability of food, is a key component in achieving food security (Drèze and Sen, 1989).

Additionally, a range of external issues exist that surround access to food. These include problems of political and social power, insufficient or inadequate infrastructure, the lack of effective and positive international policies, difficulties accessing arable land, markets and suitable and appropriate credit surround access to food (Gregory and Ingram, 2000; Ingram, 2011b). These issues are not addressed by the current research policies that focus on agricultural production. As a result, further research on food issues in a broad and holistic manner is required, which could be provided by a food systems perspective. A food systems perspective is defined by Ericksen (2008:234-235) as being:

- "the interactions between and within biophysical and human environments, which determine a set of activities;

- the activities themselves (from production through to consumption);
- outcomes of the activities (contribution to food security, environmental security, and social welfare); and
- other determinants of food security (stemming in part from the interactions in bullet one)."

Figure 2.1 provides a visualisation of the food systems perspective and highlights the interactions between the different components of this approach. Similar to the food security literature, a food systems approach highlights the changing biophysical environment and the impact this has on food production. However, it also encompasses the social drivers within the system, such as human health and wellbeing (Ericksen *et al.*, 2009; Ericksen, 2008). Inclusion of these drivers provides a tool that allows for a greater understanding of the underlying impacts and feedbacks (Ericksen, 2008; Ericksen *et al.*, 2009). Current approaches miss cross sectoral linkages and this results in ineffective policy and management interventions (Newell and Siri, 2016). This thesis utilises a systems thinking perspective to address this theoretical and policy implementation gap.

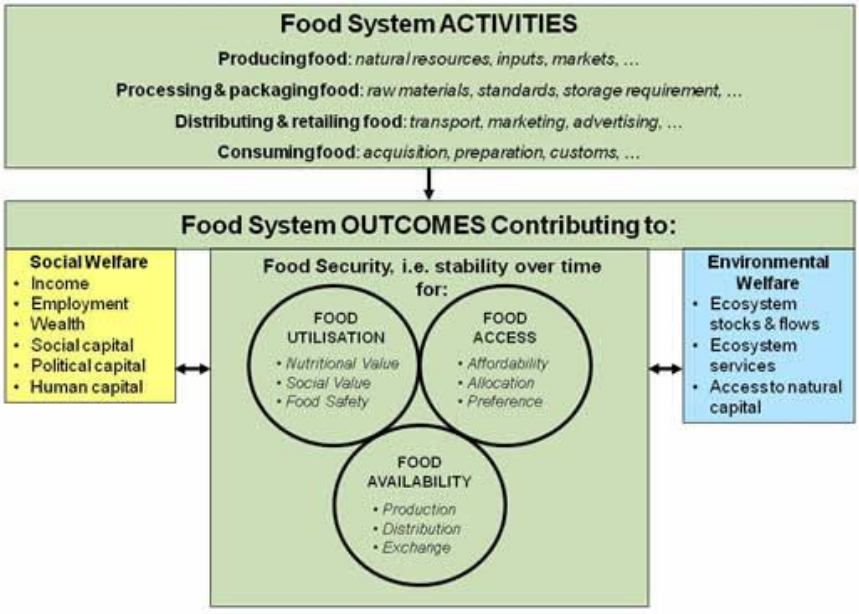

Figure 2.1 A food systems perspective (sourced from Ericksen, 2008)

A food systems approach is neither linear, nor circular (Chase and Grubinger, 2014:1). Instead it encompasses the whole process and chain of activities from 'plough to plate' (Atkins and Bowler, 2001) such as the production, processing, distribution and

consumption of food (Ericksen, 2008; Ericksen *et al.*, 2009). It does not address one aspect or part of the system, but rather analyses the system as a whole, meaning it includes individuals who may have no interaction with the original agricultural production, such as those involved in processing or those who develop and implement policies (Chase and Grubinger, 2014:1). The 'plough to plate' approach highlights the disconnect and distance occurring between the location of production and the consumption of the produce (Atkins and Bowler, 2001). This disconnect will be discussed in more detail in the following chapter when the metabolic rift literature is presented.

The systems thinking approach is an analytical tool akin to the food systems approach which is used to examine the linkages and interactions between the components that comprise the totality of a specific system (Senge, 1992). It is a method that integrates the social, environmental and economic dimensions of sustainability problems in order to achieve the challenges associated with improving both human and ecosystem well-being (Nguyen and Bosch, 2013). This thesis utilises a systems thinking approach in conjunction with the food systems approach as both address the interconnections between the components of the whole system. Examination of the whole system highlights the linkages, interactions, feedback and processes between the variables (Rwashana *et al.*, 2014). This approach is based on the principle that the elements of a system are best understood collectively as opposed to individually (Perdicoúlis, 2016). Systems thinking enables the underlying structure of the systems' connections to be studied and understood (Chase and Grubinger, 2014). Through understanding the relationship occurring between the structure and the behaviour of the system, one can better understand the workings of a system (Meadows, 2009). As a result of this understanding, points of leverage and intervention can be identified to change the system (Meadows, 2009).

However, anyone who attempts to explain and understand the behaviour of a whole system faces a complexity dilemma, as one is unable to account for all the connections within the systems due to their immense number (Newell and Proust, 2012a). The 'Complexity Dilemma?' as defined by Newell and Proust (2012a), comprises the following five parts and provides an understanding of not only how to avoid this problem, but also how to understand socio-ecological systems:

1. A feedback system compromise parts that interact to constrain behaviour.
2. The interaction of the parts is the behaviour of the system.

3. To understand the behaviour of a complex system you cannot study the parts in isolation.
4. The system needs to be studied as whole.
5. When one attempts to study the whole system they are overwhelmed by the complexity. As a result one either studies one aspect of the system and misses feedbacks or any attempt to be systemic is abandoned.

As a result of their complexity, an analytical framework is required to address the above five points. The major analytical tool used in this thesis is the cultural adaptation template, which will be used as the requisite analytical framework. An in-depth explanation of the template and its application will be discussed in Chapter 4.

The cultural adaptation template has thus far not been readily utilised in the literature to understand cash crop commodities in the Philippines, but it has been used to address issues surrounding food (Dyball, 2015). This thesis adds to the literature on systems thinking and the application of the cultural adaptation template in understanding issues surrounding food. These approaches will allow an analysis of the whole system and aid in providing a range of interventions throughout the system. A systems thinking approach enables technical and policy interventions to be developed which can contribute to environmentally friendly, people centred development, whilst ensuring active community and local institution participation can occur (SEARCA, 2015).

Current systems thinking research within the Philippines in the agricultural field has been limited. As previously highlighted, the ISARD model utilises a systems thinking approach to both capacity building and research. Systems thinking research in the Philippines has focused on soil erosion (Olabisi, 2012), conservation planning in coastal management (Larsen, 2011) and agroforestry (Gregorio *et al.*, 2015). Banson *et al.* (2015) highlighted how a systems thinking approach has not been heavily applied in either the literature or by policy makers in agricultural sustainability management. This thesis attempts to add to the growing literature on systems thinking, food systems and SEARCA's work on ISARD, through applying them to the aforementioned context of jackfruit in the Philippines.

2.2 The Philippines

The Philippines is a developing archipelagic nation in South East Asia. With approximately 31% of the population works in the agriculture sector, research into food

is very important for the Filipino livelihood (Philippines Statistics Authority, 2016o). Agricultural products are one of the country's main exports. In 2014, agricultural products, accounted for 11% of total Filipino exports (Philippines Statistics Authority, 2016o). These exports were valued at US$6,456 million of which coconut oil accounted for 18% and fresh bananas accounted for 17% (Philippines Statistics Authority, 2016o).

Nationally, it is estimated 25% of the Filipino population lives under the poverty line (World Bank, 2016b) and this figure rises to 39% of the population having an income below the poverty threshold when compared to that of Leyte (Philippines Statistics Authority, 2016a). Leyte, has seen levels of poverty increase from 37.6% in 2003 to 41.4% in 2009 (Philippines Statistics Authority, 2010). The per capita poverty threshold has also increased from 8,261.5 in 1997 to 17,516.1 in 2012 (Philippines Statistics Authority, 2016l). Leyte has the 5th largest number of impoverished people nationally with a poverty incidence of 40.5% (Asian Development Bank, 2009). Nationally, levels of extreme poverty were expected to decrease from 10.5% in 2014 to 8.2% in 2017 if high economic growth were to continue (World Bank, 2015).

Additionally, there is a correlation between vulnerable employment within the Filipino agricultural sector and poverty rates at the regional level (World Bank, 2015). Over 90% of agricultural workers have low job protection and a high level of income insecurity (World Bank, 2015). Thus a decrease in farm outputs can have a negative flow on effect, impacting a wide range of factors such as poverty and farmers' livelihoods.

The Philippines government has introduced a range of policies to address the issue of food security and poverty through increased agricultural production. For example, the Ramos Administration (1992-1998) established the Social Reform Agenda (SRA) which focused on poverty alleviation and countryside development through agrarian reform and agricultural development (Gregorio-Medel, 2002). The current primary policy mechanism is the *Agriculture and Fisheries Modernisation Act (AFMA) (1997)*, which addresses poverty alleviation and food security. This Act was expected to result in increased government investment into the agricultural sector, and resultant improvements in the sector were predicted (Aquino *et al.*, 2016). However, in 1997 agriculture accounted for 4.85% of total government expenditure which actually reduced to 4.39% in 2015 (Philippines Statistics Authority, 2016k).

The Philippines has continued to face significant food security issues despite receiving financial aid from international donors. Since 1965, the World Bank has

provided funds for agricultural projects (World Bank, 2016a; World Bank, 2016d) and the Asian Development Bank has likewise provided financial aid since 1970 (Asian Development Bank, 2016a; Asian Development Bank, 2016b). This continued promotion of agricultural development at both the international and regional level has not resolved issues surrounding food security. The Philippines did not meet the majority of their targets for the 2015 Millennium Development Goals, which focussed on eradicating extreme poverty and hunger (Philippines Statistics Authority, 2015). For example, there was an increase in prevalence of underweight children under the age of five, compared to global child growth standards (Philippines Statistics Authority, 2015). In addition, nearly 50% of rural family household expenditure is still being spent on food (Philippines Statistics Authority, 2016e). This suggests that farmers are either not sufficiently diversifying their crop production or are not receiving appropriate remuneration for their products. The above statistics suggest that the policy approach utilised over the last 50 years has not resulted in a significant reduction in poverty levels. Therefore an alternative policy approach is required in order for positive and significant changes to occur.

The above problems facing the Philippines are predicated to be exacerbated by climate change. Climate change has been highlighted as a significant challenge facing agriculture due to its potential to significantly destabilise the system (Fortier and Thi Thu Trang, 2013). Crop growth is expected to be heavily impacted by climate change with the worst impacts being anticipated in the developing world (Parry *et al.*, 2005; Parry *et al.*, 2004; Foresight, 2011; Fukuda-Parr and Orr, 2014). The rural poor will be particularly disadvantaged by climate change as they do not have the adequate capital nor access to resources to adapt and cope (Gregory and Ingram, 2000). There is particular concern over food security as a result of climate change and its affect on water availability, land cover, nitrogen cycling and temperature (Gregory and Ingram, 2000; Ingram, 2011b; Rosegrant and Cline, 2003).

2.3 The Major Case Study

The major case study in this thesis focuses on the island of Leyte in the Eastern Visayas region (Figure 2.2). Leyte was chosen as a case study site due to its remote location as this enables issues surrounding rural poverty to be demonstrated. As previously discussed there is a significant statistical difference between rates of poverty in rural and urban areas in the Philippines. The selection of a rural case study also

enables rural development and institutional issues to be discussed. The regional policy focus was another reason why Leyte was selected. These policies will be discussed in detail later on.

The island of Leyte is located in the central Philippines and is approximately 800,000 hectares in area (Nguyen *et al.*, 2012). Degraded grasslands and coconut plantations each cover approximately 40% of the island (Langenberger, 2006). Other major crops grown include corn (*Zea mays*), sweet potato (*Ipomea batatas*) and rice (*Oryza sativa*) (Navarrete *et al.*, 2013).

Figure 2.2 Map of the Philippines
Map sourced from Pike, 2016

Currently, the government is attempting to address issues surrounding food security, poverty alleviation and sustainable growth through the establishment of key regional production areas for specific crops (Department of Agriculture, 2016a). The High Value Crops Program aims to promote the production, processing, marketing and distribution of high value crops by providing both an income for farmers and contributing to the national development of agriculture (Department of Agriculture, 2016a). Jackfruit has been pinpointed by the Philippines government as a key crop and flagship commodity to be grown in Leyte (Department of Agriculture, 2016a). It is primarily grown on smallholder farms and in backyards (Department of Agriculture, 2013b).

Jackfruit is the largest edible fruit in the world and weighs up to 35 kilograms (Prakash *et al.*, 2009). It was originally a native of India (Rowe-Dutton, 1985), however it is now grown throughout Asia (Wangchu *et al.*, 2013). A jackfruit tree can grow between 10 to 15 metres in height (Prakash *et al.*, 2009). The trees normally bears fruit three to four years after being planted and it is recommended that the trees are replanted every 20 years (Morton, 1987). The long wait period is a significant limitation in jackfruit production as issues arise over what farmers live off until the trees bear fruit. Recently, the Visayas State University has developed a latex-less double rooted jackfruit tree which bears fruit two and a half to three to years after being planted (The Philippine Star, 2015).

A key challenge, and a limitation with jackfruit is the need for daily collection to maximise profit as it has a shelf life of two or three days (Pua *et al.*, 2007). Mature and unripe fruit, can be stored at 13°C for approximately three weeks (Paull and Durate, 2010:111). Jackfruit is normally consumed fresh, however, it is also preserved, canned and made into powder (Pua *et al.*, 2007). Jackfruit powder can be used in a variety of foods including snacks, baked goods, sweets and ice-cream (Pua *et al.*, 2007). The seeds can be boiled, roasted or added to flour for baking or cooked in dishes (Prakash *et al.*, 2009). The bark, roots and leaves have medicinal uses (Borines *et al.*, 2013; Prakash *et al.*, 2009). The tree has anti-inflammatory, oxidant, fungal, diabetic and bacterial effects and has high levels of potassium, calcium and carbohydrates (Prakash *et al.*, 2009). To maximise profit from jackfruit production, alternate options other than fresh consumption, require consideration.

Jackfruit is also prone to *Phytophthora palmivora* (a genus of plant-damaging moulds), which has severely damaged large areas of plantations in Eastern Visayas (Borines *et al.*, 2013:123). *P. palmivora* impairs the roots, trunks, branches and fruits (Borines *et al.*, 2013:124). It is more severe during the wet season, in orchards with poor air circulation and in areas with higher relative humidity and higher temperatures (Borines *et al.*, 2013:124). The decline in jackfruit production due to disease creates increased levels of vulnerability as it has an impact on the long-term survival of the crop and hence farmers' income (Borines *et al.*, 2013).

2.4 Conclusion

This chapter provides contextual information about food security and highlighted its major critiques. Food systems and systems thinking was presented as an alternate

approach to addressing the issue of food as it analyses and addresses the whole system. The major case study of jackfruit in Leyte, Philippines was discussed. Jackfruit has been identified as a flagship commodity to be grown extensively in Leyte. However, there are several issues with jackfruit production including limited shelf life and susceptibility to diseases. Jackfruit is being targeted for development as a crop for either domestic consumption in major Filipino cities or for overseas export markets. High levels of poverty, especially in rural areas, was a key concern raised in this chapter. The proceeds of agricultural labour (primarily financial) are not being returned to the rural areas resulting in continued high rates of poverty. In the literature, one theory for explaining this is metabolic rift, which will be discussed in the next chapter.

Chapter 3: Metabolic Rift

In this chapter, the literature on metabolic rift is outlined and analysed. The metabolic rift literature will provide an underpinning of the cash crop commodity literature. The current literature on cash crop commodities framed in systems thinking terms is presented with an emphasis on feedback loops and traps. These discussions are used to contextualise the major research question and sub research questions two and three.

3.1 Metabolic Rift

Metabolic rift was the term devised by John Bellamy Foster from Karl Marx's theory on the rupture which occurs between humans and the earth as a result of the division of production and consumption between rural towns and urban cities (Niblett, 2011:237). It has become a key aspect in the literature attempting to place agriculture into a more environmentally and socially sustainable form (Schneider and McMichael, 2010).

Karl Marx's theory was developed as a result of his consideration of the works of German agricultural chemist, Justus von Liebig (Clark and Foster, 2009; Foster, 2002; Foster, 2007; Clausen, 2008). During the 19th century, German agricultural chemists, notably Liebig, raised concerns regarding the loss of soil nutrients due to capitalist agriculture (Clark and Foster, 2009; Foster and Clark, 2004; Clausen, 2008). With nutrient rich produce being shipped to the cities to feed the growing urban population, nutrients ended up becoming waste in these cities (Moore, 2000; Foster, 2000). In traditional agriculture, these nutrients were returned to the soil thus maintaining soil fertility (Foster, 2000; Foster, 1999).

As part of the capitalist agricultural system, the concentration of land ownership in rural areas led to increased and more intense levels of agricultural production (Clausen, 2008). Increased use of fertilisers occurred in an attempt to restore the loss of nutrients (Foster, 1999). This attempt at solving the rift did not address the original problem – that of an economic system built on the requirement to provide an endless supply of a product (Clausen, 2008:27). This process lead to the creation of distance between the location of production and the consumption of crops resulting in 'delocalised' agriculture (Pelto and Pelto, 1983; Schneider and McMichael, 2010). In addition, the

proceeds of labour were not returned to the site of production and as a result producers were under compensated for their labour (Foster and Clark, 2016).

Karl Marx, in Volume 1 of Capital, implied that the separation between the site of agricultural production (i.e. rural towns) and the site of consumption (i.e. urban cities) can be expanded to the international scale through colonisation and globalisation (Clark and Foster, 2009; Foster, 2002). Similarly, it has been argued that economic development and high levels of consumption in the northern hemisphere has resulted in increased environmental degradation and lower levels of consumption in developing nations (Burns *et al.*, 2003; Chew, 2001; Frey, 2003; Hornborg, 2009; Moore, 2000; Jorgenson, 2007). This has resulted in a situation where the negative environmental and social costs from agriculture are born by the developing nations (Clark and Foster, 2009; Jorgenson, 2006; Jorgenson, 2007; Jorgenson and Burns, 2007; Jorgenson and Rice, 2007; Rice, 2007). Metabolic rift is associated with the structural dependency between the northern and southern hemispheres as the southern hemisphere relies on export-oriented monoculture and a food deficit status to supply the northern hemisphere (Niblett, 2011). This is examined in this thesis through the usage of cash crop commodities for bulk export from the Philippines.

3.2 Cash Crop Commodities and Commodity Systems

Von Braun and Kennedy (1986:1) defined cash crop as "the commercial orientation of the crop, be it a food or non-food crop, that identifies as a cash crop". On the local scale a cash crop is promoted as a tool to reduce farmers' vulnerability to food insecurity, to increase farmers' incomes and provide employment (Maxwell and Fernando, 1989; Von Braun, 1995; Von Braun, 1986; Zeller and Sharma, 2000; Jones and Gibbon, 2011). On the national level it is promoted to increase foreign exchange earnings and government revenue (Von Braun, 1986).

However, these positives do not always eventuate as many farmers fall into a commodity trap (Sawin *et al.*, 2003). A commodity trap is the built-in structural tendency of a system to trip into counter-productive behaviour and the associated difficulty this creates for farmers seeking to leave the sector as a result (Sawin *et al.*, 2003). It is a negative feedback balancing system that defies the farmer's attempts to escape it. Increased output volumes of a cash crop are commonly seen as a tool for escaping poverty. However, the price of a product per kilogram decreases with increased production, this results in a continuous cycle of increased production and

lower prices. This establishes the metabolic rift that was discussed above with consumers receiving cheap products in large quantities with no understanding of the economic and social-environmental consequences facing farmers.

Rising input costs for land and labour do not always correspond to increased output costs (Ambinakudige, 2011). The poorest farmers often do not have the capacity to feed their families hence, their nutritional status deteriorates (Effland, 2010; Von Braun, 1986). There is often substantial pressure to create commercial and export production instead of focusing on production for household consumption (Von Braun, 1995). This has created and exacerbated issues of landlessness, poverty, hunger and starvation (Effland, 2010).

Export oriented cash crops result in farmers becoming vulnerable to the global market and its price fluctuations (Fafchamps, 1992; Ambinakudige, 2011). As a result, changes in the global market, which are outside the farmer's control, have a significant consequence on the success of their crops (Ambinakudige, 2011). This has a negative impact on the farmer's economic status. In India, research has highlighted high rates of farmer suicides due to their inability to repay debts arising from the production of cash crops (Kennedy and King, 2014). This demonstrates the impact cash crop failure has on the general wellbeing of those involved.

Research has also highlighted how food utilisation and access is worse off in households when a greater quantity of cash crops are grown, and the control of income is coordinated by the male in the household (Anderman *et al.*, 2014; Due and Gladwin, 1991; Hoddinott and Haddad, 1995; Kennedy and Peters, 1992). A link to a decrease in levels of nutrition within the household has also been shown (Anderman *et al.*, 2014; Due and Gladwin, 1991; Hoddinott and Haddad, 1995; Kennedy and Peters, 1992).

Cash crops have resulted in significant land use changes due to the drive to meet market demands (Cockburn, 2014; Fox and Vogler, 2005; Gibreel *et al.*, 2014). This impacts ecosystem services and results in significant environmental degradation (Dong *et al.*, 2013; Yi *et al.*, 2014). Su *et al.* (2014) have shown that cash crops can result in modified land patterns and can have negative ecological impacts. Other issues include deforestation, which radically alters the landscape, changes to the nutrient cycles and increased soil erosion (Niblett, 2011). The introduction of commercial inputs such as fertilisers and pesticides is another contributing factor to the deterioration of the environment (Montefrio, 2012). The increased usage of fertilisers was highlighted in the metabolic rift literature as an attempt to address loss of soil nutrients (Foster, 1999).

It was argued that their usage did not solve the original problems arising from an economic system which is based on the need for an endless supply of a product (Clausen, 2008). The requirement to meet the global demand for a commodity results in a significant socio-environmental cost at the location of production (Ambinakudige, 2011). This cost is continually being reinforced as the commodity system does not change.

The commodity system results in the characteristics of a bulk commodity becoming standardised rather than individual producers having characteristics which distinguishes their produce (Sawin *et al.*, 2003). This leads to a given volume of produce being indistinguishable no matter its location of origin, as the only information beyond a greater quality grade recorded, is the price (Sawin *et al.*, 2003). This approach allows buyers and sellers to move a commodity worldwide as part of the mass commodity system (Sawin *et al.*, 2003), where the principle of metabolic rift ensures that it is economically powerful global buyers who dominate. Streamlined and standardised processes (i.e. economically 'efficient') remove the ecological and social context of a commodity. The result is a commodity only having an economic value assigned to it i.e. its price per kilogram. Producers are thus denied a means to promote their commodity as they are attempting to sell it for the lowest price (Sawin *et al.*, 2003). In addition, due to the large numbers of producers, the producer with the lowest price makes the sale (Sawin *et al.*, 2003). The streamlined and standardised nature of the market, means that this is the only way a competitive advantage can occur for a producer (Sawin *et al.*, 2003). Over time this has resulted in the growing dominance in the commodity system of a small number of economically powerful global retailers (Sawin *et al.*, 2003). Small producers and farming communities are unable to compete due to lower prices and higher levels of production (Sawin *et al.*, 2003). While this outcome is not desirable, its occurrence is due to the lack of mechanisms which slow the cycle of higher production, declining prices or the creation of any interventions within the system (Sawin *et al.*, 2003). The two behaviours of a commodity system are then the continued production of goods and lower prices.

These two behaviours result in three feedback loops occurring within the commodity system – the capital growth loop (Figure 3.1), the efficiency boosting loop (Figure 3.2) and the demand growth loop (Figure 3.3) as highlighted by work by the Sustainability Institute (Sawin *et al.*, 2003).

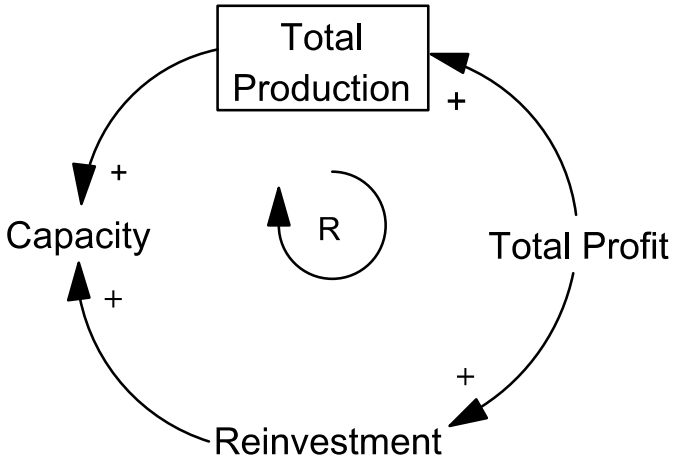

Figure 3.1 Capital Growth Loop

The capital growth loop occurs when an increase in production (with everything else in the system remaining constant) results in a rise in total profits. This often results in these profits being reinvested in productive capacity, which in turn increases total production and subsequently profits. This creates a reinforcing loop.

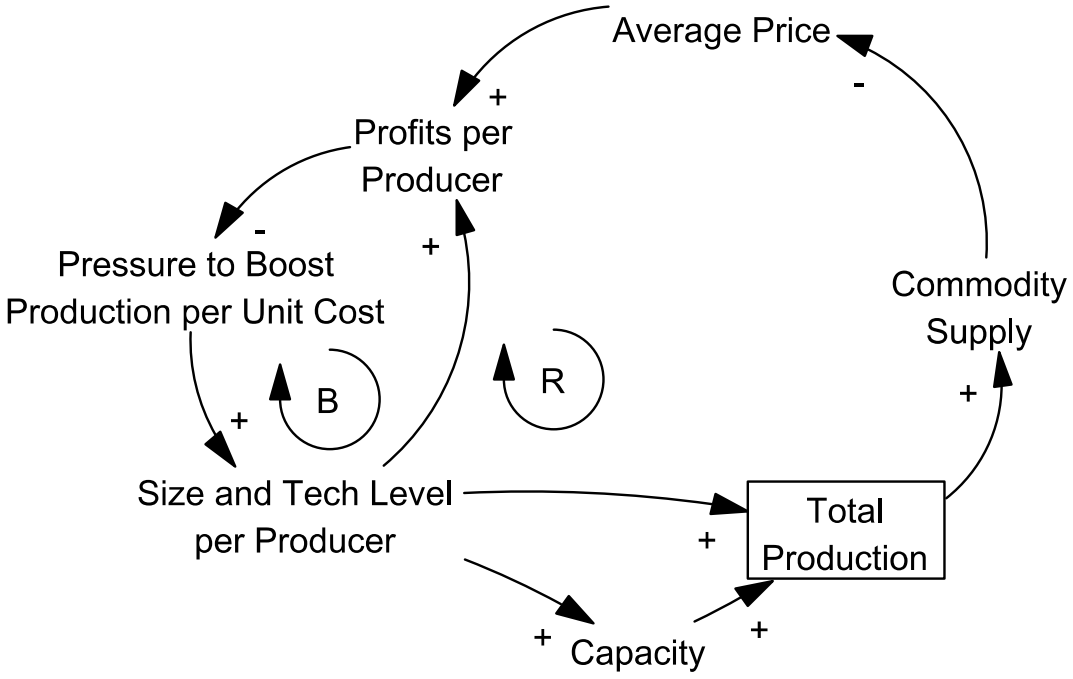

Figure 3.2 Efficiency Boosting Loop

The efficiency boosting loop occurs when an increase in total production results in a fall in prices and a reduction in profits per producer. In this situation a producer either reduces costs or increases production and this

creates more pressure to boost production per unit cost. The size and technology level per producer increases in an attempt to increase profits per producer. This creates a balancing feedback loop. The increase in size and technology levels per producer increases total production creating a reinforcing loop, which then creates a cycle of increased production and reduced profits.

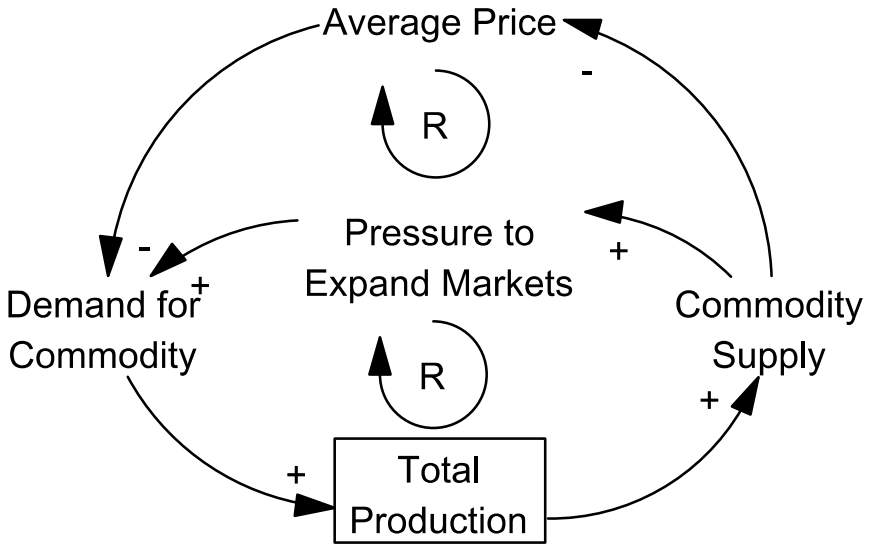

Figure 3.3 Demand Growth Loop

The demand growth loop occurs when an increase in production increases the supply to the markets resulting in lower prices. This then creates a reinforcing loop of increased demand and total production of a commodity. There is then a large supply of a commodity which results in pressure to expand the markets which creates a reinforcing loop.

Sawin *et al.* (2003) have identified three commodity system traps which can occur from these feedback loops. Firstly, resource depletion occurs when the systems' harvesting capacity is greater than the sustainable yield of the resource. Secondly, environmental pollution occurs when a system generates too much waste and it exceeds the rate at which it can be absorbed by the system. Finally, community decline occurs when the income which producers receive is too low for a family or community to survive on. This results in the creation of a commodity trap as producers are unable to leave. As a result, interventions are required for the commodity trap to be broken. These trap breakers can be utilised to change the structure of the system. This thesis aims to develop on the literature by Sawin *et al.* (2003) on understanding cash crop

commodities from the perspective of systems thinking. It will utilise two systems (bananas and coconuts) to compare it to the developing system of jackfruit. These traps and the feedback loop information can be utilised to answer research question two regarding whether jackfruit has the potential to be a profitable cash crop and if so what measures are required for its success. It can also be used to answer research question three regarding the likelihood of jackfruit becoming a commodity trap for farmers. Avoidance of jackfruit becoming a commodity trap will ensure that environmental, social and economic damaged is limited.

Chapter 4: Research Design

The purpose of this section is to provide an overview of the research design. An explanation of the cultural adaptation template and its application to the case studies of jackfruit, banana and coconut in Leyte will be explained. This section aims to demonstrate the link between the methods and the research questions.

4.1 Cultural Adaptation Template

A key challenge when understanding issues surrounding cash crops is having a means to capture the processes occurring between the location of its production and its consumption. By utilising a systems thinking approach, leverage points within a system can be identified thus enabling a greater understanding of how the system's behaviour can be changed (Meadows, 2009; Seto *et al.*, 2012). By studying aspects of the system in isolation, agricultural production feedback processes between the different elements of the system are missed (Banson *et al.*, 2015). Similarly, such an approach will not assist in enhancing an understanding of how different parts of a system may constrain the behaviour of other parts of the system (Banson *et al.*, 2015).

The cultural adaptation template which was developed by Newell is one such example which studies the whole system (Dyball and Newell, 2015). It is a powerful generic framework which highlights the higher order variables which are present in social environmental systems. The template draws the reader's attention to the numerous feedback processes which are occurring between the variables.

The basic cultural adaptation template which is shown in Figure 4.1 comprises of four subsections: – state of cultural paradigms, state of the community, state of human health and wellbeing and state of the ecosystems. These are key variables which are present in all social-environmental systems. They are named in a manner which labels what is being quantified and how much is currently present. A change in a variable refers to the change in the quantity which is present at a point in time. This is different from changing the structure of a system which occurs when interventions introduce or remove variables creating a new system with a different structure to the old one. As we are dealing with a feedback system, when the value of a variable changes other variables will change as a result. The way in which these variables change over time reflects the structure of the system.

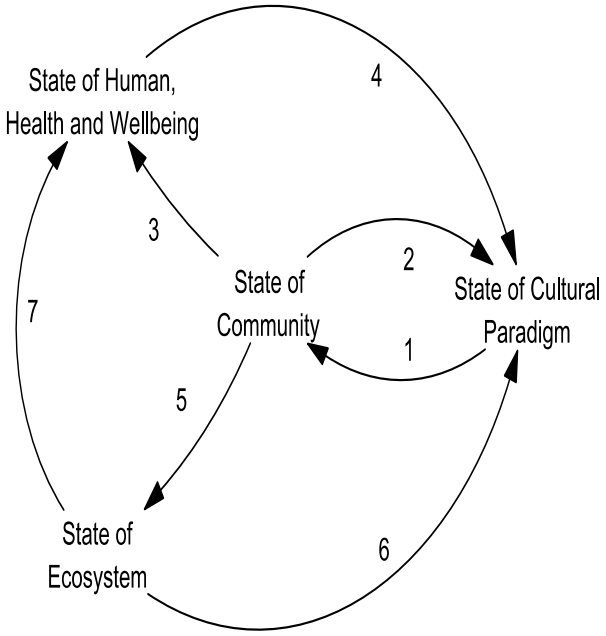

Figure 4.1 Cultural Adaptation Template (adapted from Dyball and Newell, 2015)

The four variables of the cultural adaptation template are named in terms that can be presented in greater or lesser amounts. The 'State of Cultural Paradigms' refers to the "shared mental models, world views, knowledge, beliefs, assumptions and priorities that hold sway in a given community" (Dyball and Newell, 2015:124). These cultural paradigms have a large influence on a community's actions because they influence the creation of institutions that will give effect to whatever it is that the paradigm judges to be prudent, or a 'good idea' in the circumstances. By challenging this paradigm there is the possibility for a change to occur in the behaviour of a system. The 'State of the Community' refers to the economic, social and political institutions that govern collective behaviour. These can refer to both formal and informal arrangements such as government legislation and world views. The 'State of Human Health and Wellbeing' refers to both the physiological and psychological health of a community. Examples include the individual members' happiness, comfort and security and access to clean air and water. Practical examples of this variable include disease, mental health and sense of security. The 'State of the Ecosystem' refers to elements of the natural environment such as flora, fauna, atmosphere and oceans. It also includes infrastructure and demographic variables such as buildings, roads and vehicles.

The arrows between the four elements are processes which are driving change in the variables. Over time the affecting variable (tail end of the arrow) will create a change in the affected variable (head end of the arrow). In the application of the

template, a positive arrow (+) means an increase (or decrease) in the first variable resulting in an increase (or decrease) in the second variable and *vice versa* – a decrease will mean a decrease: they drive change in the same direction. These are positive or 'reinforcing' causal links. A negative arrow (-) means an increase (or decrease) in the first variable results in a decrease (or increase) in the second and *vice versa*. That is, they drive change in the opposite direction. These are negative or 'balancing' causal links.

The links numbered one, three and five are individual or human activities. The variable which the arrow points to is directly affected by human activity, practice or behaviour by the community. Links two, four and six are all learning activities and refer to an observational change in the variable they point away from. All three links points to the state of cultural paradigms, which indicates the possibility of a change occurring in the dominant paradigm. Link seven demonstrates how human health is impacted directly by environmental conditions.

In the application of the template, feedback loops will be included. A positive or reinforcing feedback loop is displayed by an "R" inside an arrow and has an even number of positive causal links. It is a reinforcing loop as the direction of change in the variables feeds back to reinforce further change in the same direction. These loops can push the system towards some limit. A negative or balancing feedback loop is displayed by a "B" inside an arrow and has an odd number of negative causal links. It refers to a situation where the direction of change in any output process is fed back to the variable in the opposite direction. This has a stabilising or balancing effect on the system.

4.2 Application of the Template

For the cultural adaptation template to be applied to a specific issue of concern it must be created into a 'problem-space diagram' (Newell and Proust, 2012b). A problem-space diagram provides a more concentrated view of a feedback structure. The variables in the template are reworded to focus on the particular situation or issue. In Figure 4.2 the variables have been reworded to be applicable to cash crop commodities with the links explained in Table 4.1.

By using multiple systems which are structurally similar an insight into the relationship between system structure and system behaviour can be developed (Meadows, 2009; Sterman, 2000). This enables the processes within the system which

are driving or inhibiting change to be identified. The processes can then be utilised to highlight intervention points which change the structure of the system and may thus be applied to other structurally similar case studies. In this thesis the banana and coconut case studies will highlight how areas of intervention can be applied to the jackfruit case study to change the structure of the system and hence provide recommendations on measures to ensure its success.

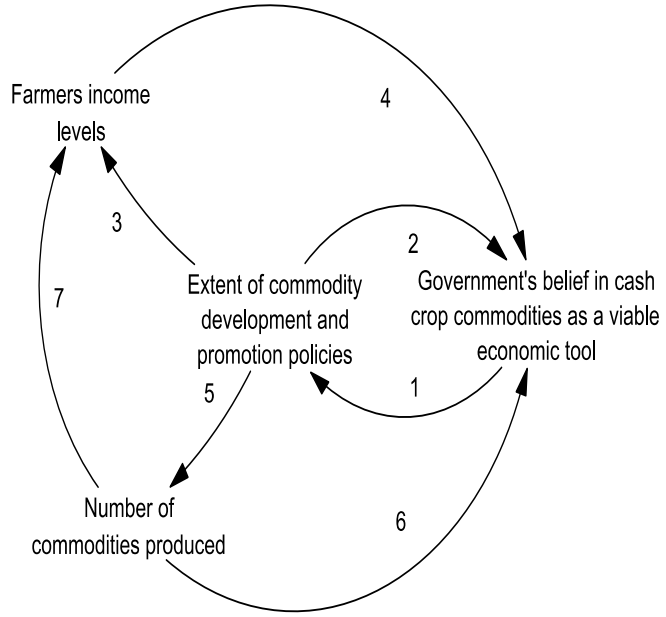

Figure 4.2 The Cultural Adaptation Template (Figure 4.1) translated into a cash crop commodity 'problem space' (adapted from Dyball and Newell, 2015)

Table 4.1 Influence links for the cash crop commodity problem space (Figure 4.2)

Link	Action/processes/mechanisms represented in Figure 4.2
1	The government's belief in cash crop commodities as a viable economic tool leads to decision makers establishing policies to promote agricultural intensification. This belief results in the establishment of free trade agreements which guarantees access to overseas markets.
2	The extent of commodity development and promotion policies demonstrates the government's belief in cash crop commodities as a viable economic tool. There is little concern for the impacts of these policy choices. There is no pressure to change the policy approach.
3	The extent of commodity development and promotion policies is driven by the government's policy belief. The needs to meet overseas demand rather than

	increasing farmer's income levels drives production. As a result Filipino farmers compete in international commodity markets, which drive down terms of trade (Sawin *et al.*, 2003).
4	An increase in income levels should reinforce the governments' belief in cash crop commodities as a viable economic tool (Von Braun, 1986).
5	The development and promotion of policies which increase commodity production results in an increase in the number of a commodity being produced.
6	The number of commodities produced reinforces the government's belief in cash crop commodities. As they are primarily produced for the export market, there is a significant disconnect between the location of production and consumption (Von Braun, 1995). In addition, the proceeds of labour are not being returned to the site of production resulting in a rift occurring (Foster and Clark, 2016).
7	An increase in the number of commodities produced should, from the government's perspective, increase the levels of farmer's income. Ambinakudige (2011) highlighted how input costs do not always equal outputs costs.

This problem space can then be applied to the three 'specific system of interest' (Newell and Proust, 2012); banana, coconut and jackfruit. The problem space enables the case studies to be compared to show the generic structures and highlight what processes are driving or inhibiting change. A table explaining the links within the system is provided for all diagrams. Vensim® Software will be used to create these diagrams. For an understanding of how to read and comprehend the diagrams in greater detail *Constructing Influence Diagrams and Causal Loop Diagrams Guidelines* (Proust and Newell, 2014) should be consulted.

This step aims to answer research question one by demonstrating if the cultural adaptation template can be applied to explain generic structural problems endemic to cash crop commodity systems. Secondary data on case studies will be analysed to highlight basic information about the crop, prices and relevant policies. Data will be primarily sourced from international, national and local references and aims to highlight the structural similarities of the three case studies. Analysis will explore if cash crop systems are generically structured as undesirable balancing feedback systems where efforts to increase farmers' incomes through increased production results in the opposite

occurring and farmers' income is then balanced and 'locked in' at a lower level. The analysis will contain a list of interventions in the systems aimed at enhancing the likelihood of jackfruit becoming a successful cash crop commodity. This will answer research question two regarding jackfruit's potential profitability as a cash crop and question three regarding if it will become a commodity trap for famers. Possible measures to prevent this occurring will also be considered.

4.3 Conclusion

In conclusion, this section has provided an overview of my research design. The link between the research design and questions was highlighted. An explanation of the cultural adaptation template and its application to the three cash crop case studies utilised in this thesis was discussed. This has established a foundation for the following chapters where the template will be applied to aid in understanding and determining the potential for jackfruit to be a successful cash crop in Leyte.

Chapter 5: Results

This chapter presents an overview of the banana, coconut and jackfruit case studies. Data from international, national and local sources will be presented and this will be utilised in the next chapter to populate the cultural adaptation diagrams. The banana and coconut case studies are intended to highlight the structural similarities within their relevant systems. Banana and coconut were selected for analysis in this thesis as they are the Philippines' top two agricultural exports and are supported by a wide range of international, national and local data sources. In the next chapter this information will be utilised to highlight interventions to enable jackfruit to be a successful commodity and how a commodity trap can be avoided.

5.1 Bananas

Bananas (*Musa sp.*) are a tropical fruit cultivated mainly by developing nations (Dodo, 2014). They grow in tropical humid regions and produce fruit all year round (Dodo, 2014). In Leyte, the major species grown are – Cavendish, Latundan, Lakatan and Saba. The fruit stalk or bunch is the primary part of the tree that is cultivated for food purposes. Bananas are primarily produced for fresh consumption, however they can also be pureed, candied, preserved, powered and produced into chips (Department of Agriculture, 2010). The peel can be utilised as a fertiliser or as food for cattle and is also produced into sheets of paper and paperboard (Department of Agriculture, 2010). Banana extract is used in the manufacturing of catsup, vinegar and wine (Department of Agriculture, 2010). Bananas also have numerous health benefits and are high in potassium, magnesium, fibre and vitamins C and B6 (Dodo, 2014).

5.1.1 Policies and Statistics

The Filipino government has pursued numerous policies which promote maximum commodity production. Examples include the high value crops development program, which was discussed in the background section and the setting of production targets for banana plantations on a per hectare basis. The *National Research Centre for Banana Act* (2016) aims to educate and train key stakeholders, undertake research on bananas, develop a marketing system, improve farming systems, establish national and international linkages and upgrade the skills of those involved in the banana industry. The Priority Commodities Investment Plan promote the production of bananas to

improve farmers' livelihoods and promote sustainable agricultural development (Department of Agriculture, 2015a).

These policies, which have promoted maximum commodity production have led to an increase in plantations. Figure 5.1 displays the area in hectares of bananas planted/harvested from 2000-2015. From 2000-2013 there was a 7% increase in the number of bananas planted and harvested in Leyte. This increase continued until Typhoon Haiyan devastated numerous plantations in November 2013 and resulted in a 23% reduction. Raw data is included in Appendix A: Area of Banana Planted/Harvested.

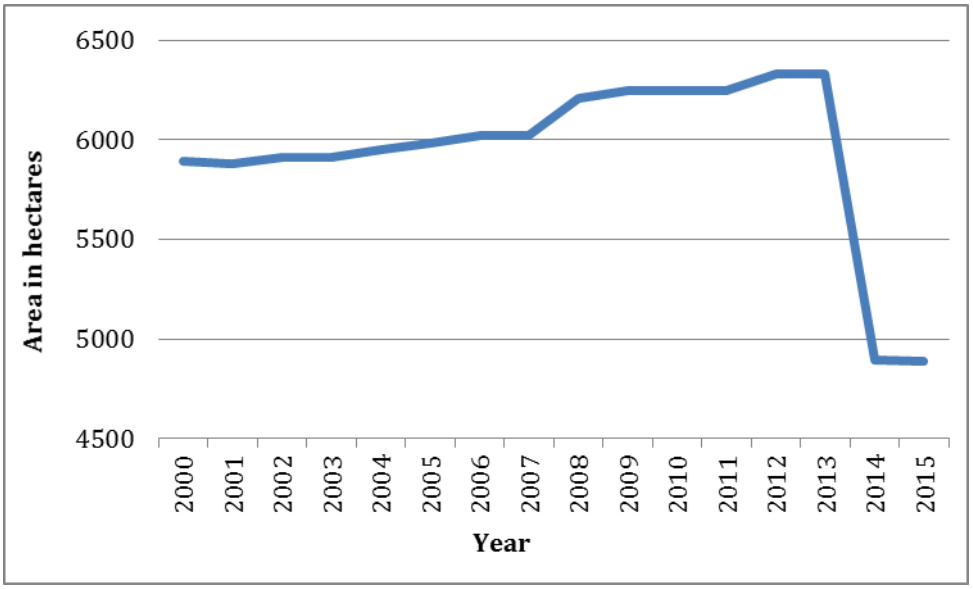

Figure 5.1 Area in hectares of bananas planted/harvested in Leyte from 2000-2015 (data sourced from Philippines Statistics Authority, 2016m)

Figure 5.2 displays the area in hectares of bananas by species planted/harvested in Leyte from 2002-2015. From 2002-2013, there was an increase of 127%, 10% and 13% in hectares planted and harvested for cavendish, lakatan and saba, respectively. This reduced by 24%, 23% and 24%, respectively for each species after Typhoon Haiyan. Raw data is included in Appendix B: Area of Banana by Species Planted/Harvested.

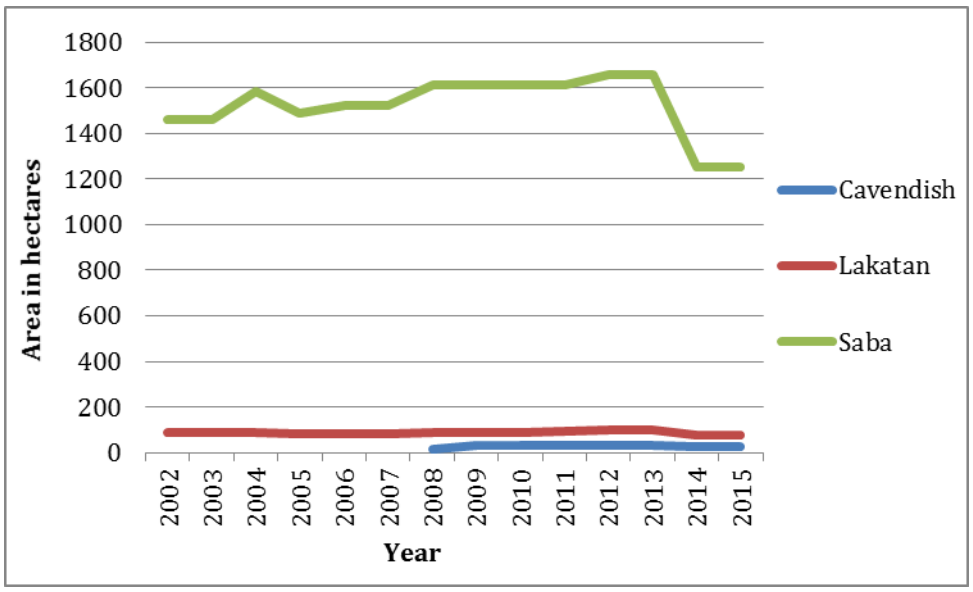

Figure 5.2 Area in hectares of bananas by species planted/harvested in Leyte from 2002-2015 (data sourced from Philippines Statistics Authority, 2016m)

In 2013, the Philippines was the third largest producer of bananas in the world behind India and China (FAO, 2016a). They produced 8,645,749 tonnes which is approximately 8.1% of global production (FAO, 2016a). In 2015, the Philippines consumed 5,029,209 tonnes of bananas (Philippines Statistics Authority, 2016i). The average yield of bananas in 2013 was 19.39 metric tonnes/hectare (Espino and Espino, 2015). Figure 5.3 shows Filipino banana exports levels from 2000-2013 which have increased by 104% over this time. Raw data is displayed in Appendix C: Banana Exports.

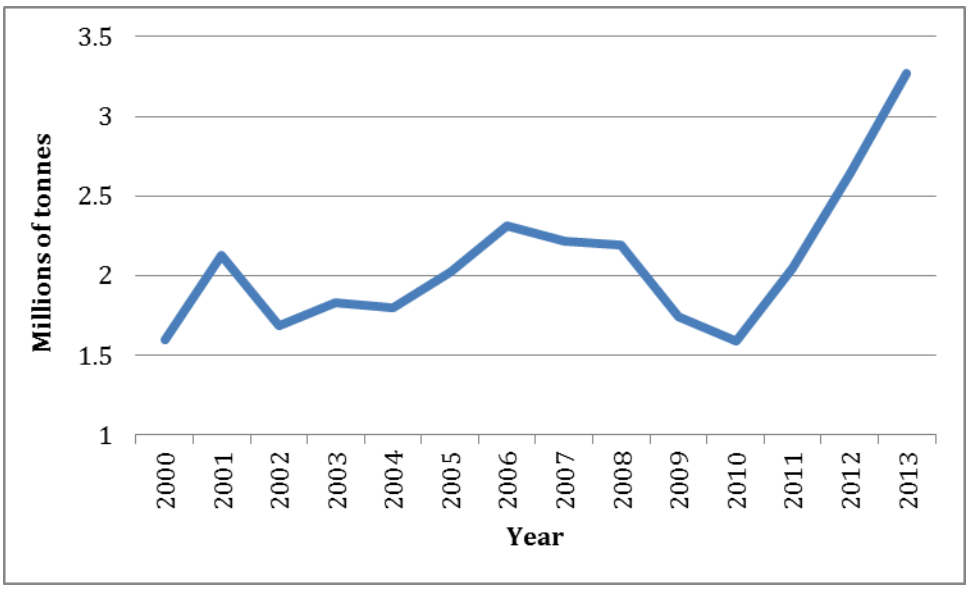

Figure 5.3 Banana Exports from the Philippines (data sourced from (FAO, 2016b)

The Philippines main importers of fresh bananas are Japan, South Korea and China (Department of Agriculture, 2013a). The main importers of Filipino banana chips are Vietnam, China and the United States (Department of Agriculture, 2013a). The Philippines government has pursued numerous export policies, which promote bulk banana production. These include ASEAN-free trade agreements with China (July 2005) (Asia Regional Integration Centre, 2015b) and South Korea (June 2007) (Asia Regional Integration Centre, 2015a). The Filipino government is in discussions with the European Union to develop a free trade agreement (Asia Regional Integration Centre, 2015d). The Philippines exports a large quantity of bananas to Japan however there are significant issues regarding tariffs. It has been highlighted that zero tariff rates should be pursued by the Filipino Government in all future renegotiated trade agreements (Perez, 2016) as current tariff rates change throughout the year (Asia Regional Integration Centre, 2015c).

5.1.2 Farmer Inputs and Market Structures

Table 5.1 summaries the key inputs and functions of farmers in banana plantations. The key constraints are also discussed. Information in this section is sourced from the following unless otherwise stated (Department of Agriculture, 2014b; Calderon and Rola, 2003; Department of Agriculture, 2015g; Department of Agriculture, 2015e).

Table 5.1 Key inputs and functions of farmers in banana plantations	
Key inputs	Constraints and problems
Planting materials • Materials are often sourced from own or neighbours farms. • This contributes to the spread of diseases and pests.	• There is a lack of supply of good quality disease free planting materials. Material sourced from farms rather than nurseries are not always of a high quality resulting in low quality fruit. • There is a lack of tissue culture laboratories. • Tissue cultured planting materials can significantly improve yields. • Farmers have a lack of awareness of the benefits of tissue cultured plantings. • Tissue cultured planting materials are often expensive resulting in farmers not purchasing them. • The above issues result in lower farm productivity.
Land preparation • All stumps, weeds and bushes should be removed before planting. • Each hole should be fertilised with complete fertiliser.	• Fertilisers are expensive resulting in little to no usage on small scale farms. • Organic fertiliser is not readily available commercially. • Farmers do not have an understanding of the proper and effective use of fertilisers. • Bananas remove a significant amount of nutrients from the soil. • There are significant environmental concerns with the use of fertiliser and pesticides which may enter river systems and irrigation water (Bajet and Tejada, 1995:433). This has the potential to impact flora and fauna downstream (Calderon and Rola, 2003:14). • Health impacts include, but are not limited to - headaches, skin rashes, blurred vision (Wilson and Otsuki, 2004) cancer and

	reproductive problems (Merlo and Bolognesi, 2011).
Maintenance • Weed control through commercial products such as Glamoxine or Karmex sprays. • In times of long dry periods, irrigation is required. This should occur by overhead sprinkler, furrow irrigation or drip or trickle irrigation. • Fertiliser should be applied at three month intervals until the tree becomes fruit bearing.	• Fertiliser and pesticide use has been discussed previously. • There is a lack of access and use of low cost technologies which have the potential to improve farm productivity. A greater availability and knowledge of these could improve the industry. • Good Agricultural Practices (GAP) are often not used by farmers. These practices increase yield rates which can increase farmers' income levels. Farmers require training and on-farm mentoring and monitoring.
Pest and disease control • Extra suckers should be removed to reduce the competition for soil nutrition. • Leaves should be removed regularly to reduce leaf diseases such as Sigatoka. • Other diseases and pests include moko, banana corm weevil, bugtok and bunchy top.	• Fertiliser and pesticide usage which has previously been discussed. • Limited access to technologies which has previously been addressed.
Harvesting • Saba – 15 to 16 months • Cavendish – 6 to 8 months • Latundan – 12 months • Lakatan – 12 months (dela Cruz *et al.*, 2008). • Harvesting requires two people.	• Fruit damage due to poor packaging and handling results in the banana becoming bruised or scratched. This results in harvest losses of between 10%-20% of the original crop. • Reducing harvest losses is crucial in increasing productivity and improving the industry.

The banana, jackfruit and coconut case studies all have a similar market structure and hence will be discussed together rather than separately. Produce are either collected weekly from farmers or farmers take their produce to wholesalers where they are sold. If the produce are intended for the urban or export market, they are either taken to buying stations or collected from farmers. From here, assemblers coordinate with the buying stations and agents and collect the produce. They and then sold to consignees residing in the urban areas. The produce are then sold to wholesalers who distribute them to wet markets and supermarkets.

As many farmers do not have access to adequate infrastructure, issues such as poor roads from farms to markets heavily impacts the marketing process. Finance has been provided by the Filipino government to expand and improve rural roads. This issue is the same for the coconut and jackfruit case studies.

5.1.3 Economics

Bananas are primarily consumed fresh, however they can be processed into banana chips. This occurs at processing factories in urban areas. There is thus limited value adding that farmers can undertake to increase their income levels. The lack of banana processing facilities for farmers is a key value adding opportunity warranting further investigation (Aurore *et al.*, 2009).

Leyte farmgate price data is displayed in Figure 5.4, the retail price diagram is shown in Figure 5.5 and the wholesale price for the Philippines is shown in Figure 5.6. There is no data for the wholesale price for either Leyte or Eastern Visayas. Raw data are shown in Appendix D: Farmgate Prices for Banana, Appendix E: Retail Prices for Banana and Appendix F: Wholesale Prices for Banana.

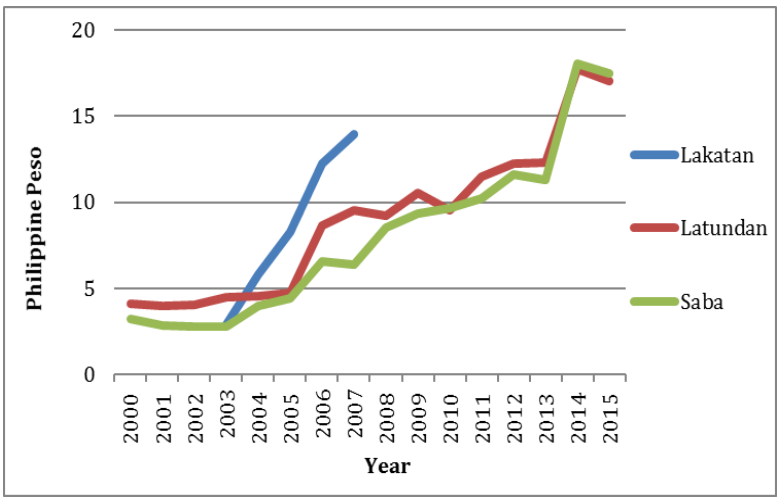

Figure 5.4 Farmgate price of banana species for Leyte in Philippine Peso (data sourced from Philippines Statistics Authority, 2016g)

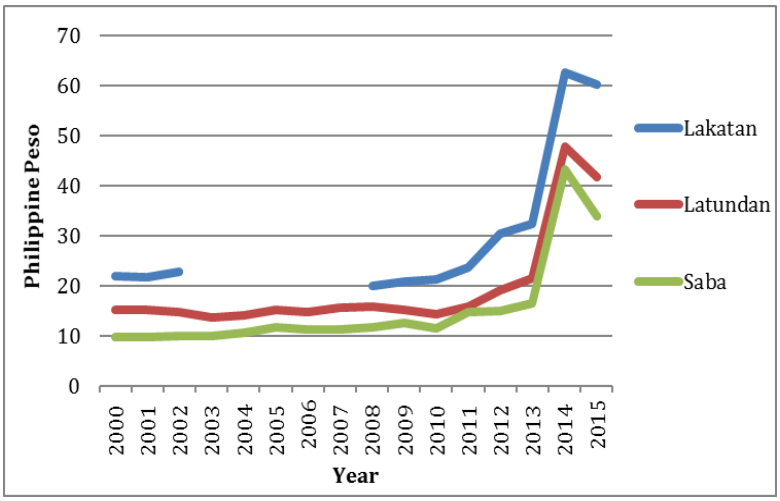

Figure 5.5 Retail price of banana species for Leyte in Philippine Peso (data sourced from Philippines Statistics Authority, 2016h)

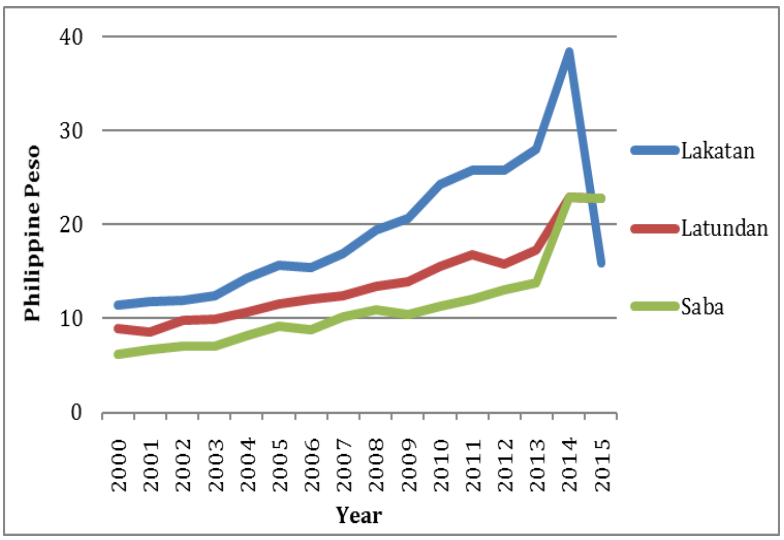

Figure 5.6 Wholesale price of banana species in the Philippines in Philippine Peso (data sourced from Philippines Statistics Authority, 2016j)

The price data highlights how the farmgate price is significantly lower than the retail or wholesale price. For example, in Leyte in 2013, there was a 73% and 45% difference respectively, for Lakatan and saba between the farmgate and retail price. Lakatan bananas on average have the highest price out of the three species and are commonly produced for domestic consumption. Saba bananas are the most common species planted and harvested in Leyte and between 2000-2013 there was a 13% increase in plantings and harvestings. This species is commonly processed into banana chip. It should be noted that the prices received for Saba bananas is the lowest across all three species despite the quantity and continued increase in plantations.

Table 5.2 shows the average wage of a farm worker in the Philippines and Eastern Visayas in Filipino pesos. This data also applies for jackfruit.

Table 5.2 Average yearly income (data sourced from Philippines Statistics Authority, 2016a)

	2009		2012	
	Daily	Year	Daily	Year
Philippines	₱169.88	₱62,006.20	₱166.63	₱60,819.95
Eastern Visayas	₱144.78	₱52,844.70	₱138.10	₱50,406.50

Table 5.3 shows the income deciles for the Philippines in 2009 and 2012 in Filipino pesos. Data was sourced from Philippines Statistics Authority, 2013.

Table 5.3 Income deciles

	2009	2012
	Income	Income
1	₱62,000	₱69,000
2	₱83,000	₱92,000
3	₱96,000	₱108,000
4	₱113,000	₱130,000
5	₱136,000	₱153,000
6	₱163,000	₱182,000
7	₱198,000	₱229,000

8	₱251,000	₱286,000
9	₱338,000	₱381,000
10	₱639,000	₱715,000

These tables highlight that the average farmer in Eastern Visayas has a lower income than the national average. For example, in 2012 the average income of a farm work is ₱50,406.5. This is 17% less than the national farm worker average of ₱60,819.95. This means a farmworker is in the lowest income decile.

Table 5.4 displays a basic estimated cost of production and return for one hectare. The table does not include value-adding activities which as previously highlighted does not occur by farmers. Data was sourced from Department of Agriculture 2013a.

Table 5.4 Cost of production

Item	Cost
Maintenance – labour, water, research and development and communication	₱1.1/kg
Fertilisation	₱0.75/kg
Pest control	₱0.18/kg
Harvesting	₱0.18/kg
Transport	₱0.39/kg
Miscellaneous other costs	₱0.41/kg
Cost to produce a kilogram	₱3.21/kg
Average farmgate price per kilogram from 2000-2015	Saba – ₱8.07
Profit per kilogram	₱4.86

5.2 Coconuts

Coconut (*Cocous nicifera*) is a tropical tree often referred to as the tree of life due to the crops' numerous uses and other associated products from the tree (Department of

Agriculture, 2016b). The nuts are the primary part of the tree that is cultivated for food purposes. The major products of the coconut which are discussed in this thesis are:

- Desiccated coconut – pure white, dried and dehydrated shredded meat of the coconut. It is used in confectionary, frozen foods and bakery products.
- Copra – dried coconut meat. It is obtained by removing the meat from the shell which is then dried.
- Coconut oil – is extracted from either the fresh coconut meat or copra. It is used in foods for cooking, frying, margarine and confectionary purposes. Coconut oil is also used in soaps and as a diesel oil substitutes.
- Coconut coir – is derived from coconut husks. The coir can be used for example to make cushions, carpets, brushes and yarn (Department of Agriculture, 2016b).

The leaves of the tree can be woven into clothing and furnishings (Duke, 1983). The wood can be used as a building material (trunk wood), carving for ornaments (outer wood) and the logs can be used to make rafts and canoes (Duke, 1983).

5.2.1 Policies and Statistics

Coconut is the only crop discussed in this thesis which has its own Filipino management authority designed to regulate the produce. The Philippine Coconut Authority aims to develop the industry to its full potential and ensures that it is globally competitive. Key policies and programs which the Authority promotes include

- National coconut planting/replanting;
- Maintenance of coconut seed farms and seed gardens to promote long term planting and replanting;
- Kasaganahan Sa Niyugan ay Kaunlaran ng Bayan (KAANIB) which promotes coconut based farming activities as a financially viable agribusiness;
- Market development services which promote trade and investment; and
- Research and development which address breeding, pest management and value adding (Philippine Coconut Authority, 2016b).

The Authority does not regulate the market by creating either a minimum price or regulating production to ensure the market does not exceed demand.

Coconut is the only produce out of the three case studies where legislation on the crop has been promulgated through the national Filipino legislature. Under the 17th Congress which commenced in July 2016, a number of Acts have been passed including the *Coconut Farmers Development Act* (2016) aimed at revitalising the coconut industry and the *Coconut Industry Development Act* (2016). At the regional level, programs include nursery management and operations training which is run in conjunction with the Food and Agriculture Organisation of the United Nations (Department of Agriculture, 2015b). This program is aimed at providing training on crop nursery management and agricultural operations such as land preparation and seedling management (Department of Agriculture, 2015b).

A key long term problem in the coconut industry is the coconut levy fund which was established during the Marcos Government in the early 1970's (Warr, 2002). It was an export tax, which resulted in lowering domestic prices and reduced the income of coconut producers (Warr, 2002). These producers were predominantly low income, small holders (Warr, 2002). The scheme was associated with corruption and misuse of funds (Intal and Power, 1990, 1991). The tax was abolished in 1985 (Warr, 2002). New president Rodrigo Duterte has stated that the coconut levy funds will be invested into the coconut industry (Simeon, 2016).

Figure 5.7 shows an increase of 12% of coconut plantations and harvesting from 2000-2012 for Leyte. Typhoon Haiyan devastated the region in 2013, which explains the 44% reduction between 2013-2014. Raw data is in Appendix G: Area of Coconut Planted/Harvested.

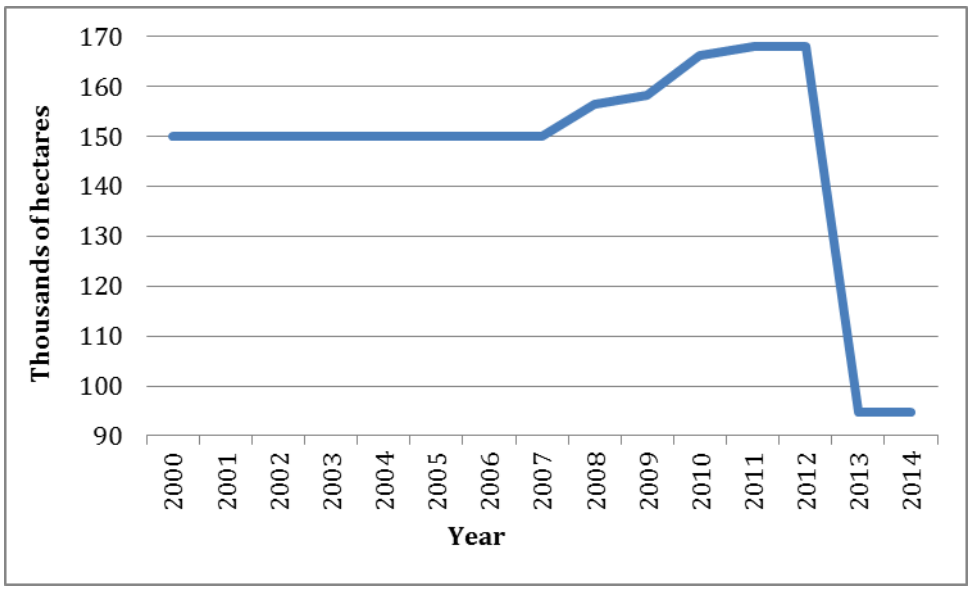

Figure 5.7 Area in hectare of coconut planted/harvested in Leyte from 2000-2014 (data sourced from Philippines Statistics Authority, 2016m)

In 2013, the Philippines was the second largest producers of coconuts producing 15,353,200 tonnes which is approximately 24% of global production. In 2015, the Philippines consumed 735,316 tonnes of coconuts. The average yield hectare/tonnes in 2009 for the Philippines was 4.61 (Department of Agriculture, 2016c).

The Philippines export rate of coconuts between 2000-2013 is shown in Figure 5.8. Similarly to the banana case study, coconuts exports increased 24% between 2000-2013. There was a significant increase in 2011 due to a massive spike in global demand. This is an example of how the levels of export demand maybe influenced by external market factors, which are outside farmers' control. Raw data is shown in Appendix H: Coconut Exports.

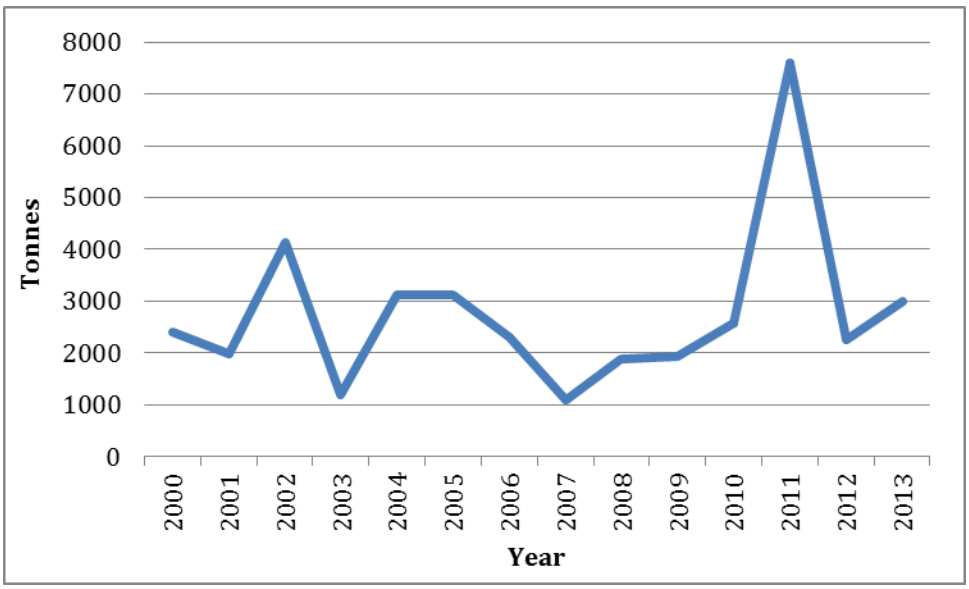

Figure 5.8 Coconut Exports from the Philippines (data sourced from FAO, 2016b)

The Philippines exports coconut produce to the European Union, India, the United States of America, South Korea, China, Vietnam and Japan (UCAP, 2016b; Department of Agriculture, 2016b; UCAP, 2016a). In a similar fashion to the banana case study, the free trade agreement with the European Union is vital for improving export conditions and financial returns to Filipino coconut farmers. Tariffs are low or non-existent for all other coconut produce except for the agreement with India (WTO, 2016).The Indian agreement uses the most favoured nations' tariffs which are significantly higher (10% or 15%) (WTO, 2016). A key aspect of the ASEAN-India free trade agreement is the reduction in tariffs over time (WTO, 2016). This has not occurred for coconut products exported to India with subsequent disadvantages for all those involved in the Philippines coconut industry (WTO, 2016). Other agreements with Japan, South Korea and China favour the Philippines.

5.2.2 Farmer Inputs

Table 5.5 summaries the key inputs and functions of farmers for coconut plantations. The key constraints are also discussed. Information is sourced from the following Department of Agriculture sources unless otherwise stated (Department of Agriculture, 2014a; Department of Agriculture, 2015e; Department of Agriculture, 2015d; Department of Agriculture, 2015h; Department of Agriculture, 2015k; Department of Agriculture, 2015i; Department of Agriculture, 2015c; Department of

Agriculture, 2015f; Department of Agriculture, 2015j; Department of Agriculture, 2016b; Department of Agriculture, 2016c).

Table 5.5 Key inputs and functions of farmers in coconut plantations

Item	Constraints and problems
Planting materials • Sourced from the PCA through seedling programs, local nurseries or other coconut farmers. • Sourced from existing coconut farms.	• The PCA programs are not always widespread. • Coconut trees are ageing or not bearing fruit. These trees need to be identified and replanted. • The selection of planting materials has an impact on productivity. Farmers' choices on what they utilise is due to accessibility and affordability. Addressing this would improve yields. This is similar to the banana case study.
Land preparation • All stumps, weeds and bushes should be removed before planting. • Fertiliser should be applied.	• Fertiliser and pesticide use has been discussed previously in the banana case study.
Maintenance • Removal of weeds. • Desuckering or pruning of plants. • Salt is the key fertiliser used.	• Distribution of salt through the PCA is limited and cannot cover all coconut farmers. • To achieve maximum productivity and to increase the average yield, access to fertilisers and good management practices are crucial.
Pest and disease control • Monitor for pests and diseases and spray pesticides if required. • Remove infected branches or leaves. • Pests and diseases include – rhinoceros	• Greater control and eradication of pests and diseases needs to occur. • Fertiliser and pesticide use has been discussed previously in the banana case study.

beetles, coconut leaf beetle, leafy spots, Socorro wilt and phytophtora (Philippine Coconut Authority, 2016a).	
Harvesting • Coconut trees planted in healthy and productive soils bear fruit five - six years after planting, however, in general it is normally closer to seven - nine years before fruit production. • They become full bearing in 12 - 13 years. • Coconut trees can survive for between 40-90 years. • For copra and desiccated coconut, nuts are harvested when they are ripe. • For coir, they are harvested one month before maturity (Duke, 1983). • Harvesting generally occurs every three - four months.	• The FAO has highlighted how the long time period between planting and harvesting of coconuts (up to 13 years) can have significant affect on farmers' income (FAO, 2014). • As a result mixed cropping is recommended to ensure that farmers have income whilst the coconut trees grow.

5.2.3 Economics

The major value adding option for farmers is producing copra. The price data below highlights how this provides a greater income level for farmers. Some farmers have limited knowledge on copra production (Department of Agriculture, 2015k). This is a significant limitation in its production. Increasing farmers' knowledge by providing training can improve this. Other value adding activities such as creating coconut oil are performed predominantly in the urban areas by processing factories.

Leyte farmgate price data is displayed in Figure 5.9, the retail price is displayed in Figure 5.10 and wholesale price for the Philippines in Figure 5.11. Raw data is in Appendix I: Farmgate Prices for Coconut, Appendix J: Retail Prices for Coconut and Appendix K: Wholesale Prices for Coconut.

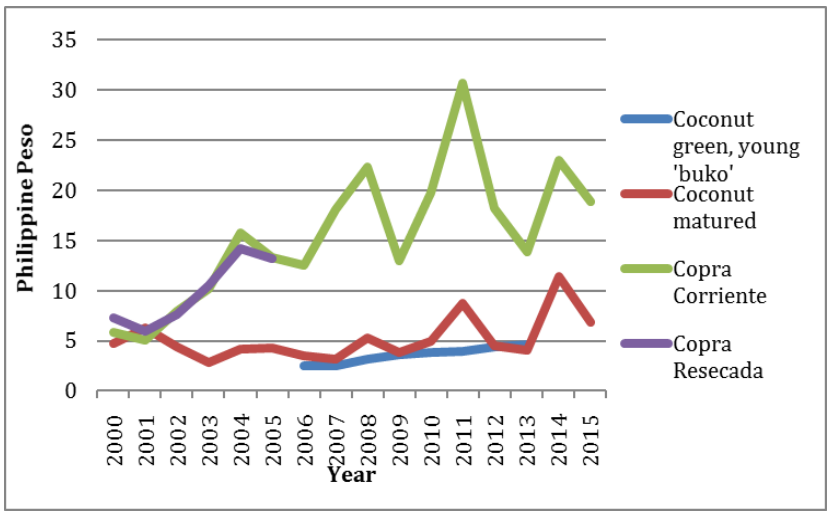

Figure 5.9 Farmgate price of coconut for Leyte in Philippines Peso (data sourced from Philippines Statistic Authority, 2016b)

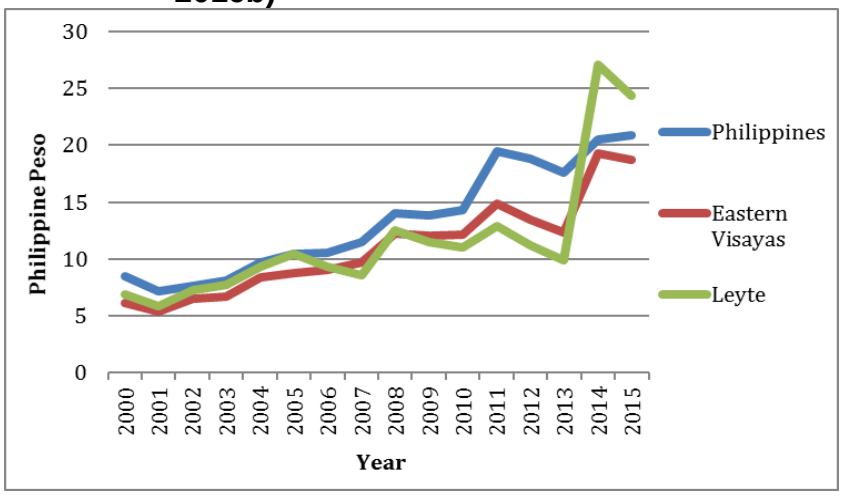

Figure 5.10 Retail price of coconut mature by location in Philippine Peso (data sourced from Philippines Statistics Authority, 2016c)

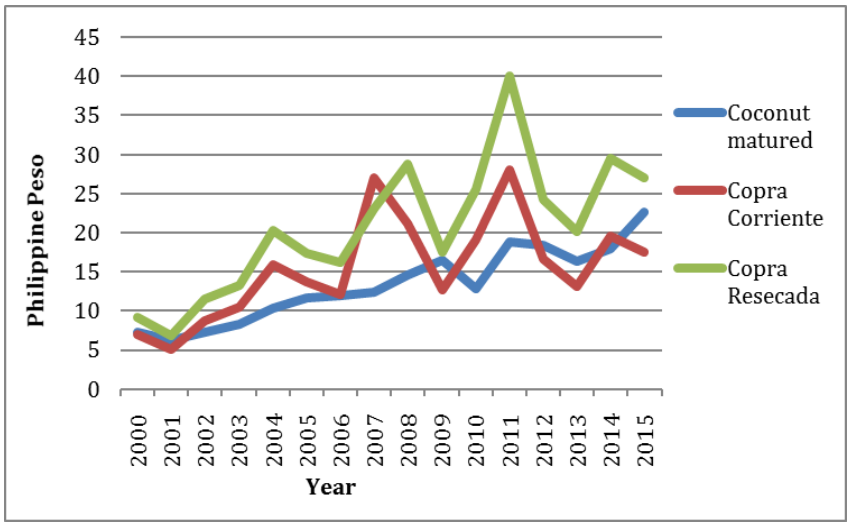

Figure 5.11 Wholesale price for coconut in the Philippines in Philippine Peso (data sourced from Philippines Statistics Authority, 2016d)

In general, prices for both mature and green coconuts are lower than copra prices. For example, in 2015 the retail price for mature coconuts in the Philippines was ₱6.46 compared to ₱21.28 for *C. corriente* and ₱24.04 for *C. resecada*. This suggests that value added products are in greater demand and will attract higher prices. The farmgate price for green and mature coconut is significantly lower than the wholesale and retail price. For example, in Leyte in 2013, there was a 111% price difference for coconut mature between the farmgate and wholesale price.

Table 5.6 shows the average wage of a coconut worker in the Philippines and Eastern Visayas in Philippines Pesos.

Table 5.6 Average yearly income (data sourced from Philippines Statistics Authority, 2016a)

	2009		2012	
Philippines	₱158.92	₱58,005.80	₱161.90	₱59,093.50
Eastern Visayas	₱138.80	₱50,662.00	₱148.53	₱54,213.44

Similarly to statistics discussed in the banana section, a coconut farmer in Eastern Visayas has a lower income than the national average. For example in 2012 the average income of a coconut worker in Eastern Visayas was ₱54,213.45. This is 9% lower than the national average, however it is 7% higher than the average farm worker in Eastern Visayas. A coconut farm worker in Eastern Visayas has an average yearly income in the lowest deciles.

Table 5.7 displays a basic estimated cost of production and return for one hectare. The table does not include value-adding activities. Data sourced from (Department of Agriculture, 2014a; Department of Agriculture, 2015k; Department of Agriculture, 2015j).

Table 5.7 Cost of production

Item	Coconut costs	Copra costs
Maintenance – labour, water, research and development and	₱1.2/kg	

communication		
Fertilisation	₱0.37/kg	
Pest control	₱0.25/kg	
Harvesting	₱0.35/kg	
Copra making		₱0.50/a kg
Transport	₱0.20/kg	
Miscellaneous other costs	₱0.85/kg	₱2.50/kg
Cost to produce a kilogram	₱3.22/kg	₱5.37
Average farmgate price from 2000-2015	Coconut matured – ₱5.20	Copra corriente ₱15.52
Profit per kilogram	₱1.98	₱10.32

5.3 Jackfruit

A description of jackfruit is provided in Chapter 2 of this thesis. There are numerous Filipino policies, which promote the agricultural production and exportation of jackfruit. The Bureau of Agricultural Eastern Visayas Research Centre has developed a jackfruit variety called EVIARC Sweet jackfruit which has resulted in an 82% increase in production in one town in the region (Dagooc, 2013; Gonzales, 2013). The program provides training for farmers in pruning, pesticide use and bagging of fruit (Dagooc, 2013; Gonzales, 2013). The federally funded program has also established a jackfruit nursery in the region (Dagooc, 2013; Gonzales, 2013). Numerous forums have been held by the Department of Agriculture Regional Field Unit 8 to highlight the potential for jackfruit. For example in 2012, a forum was held under the auspices of the Agribusiness and Marketing Assistance Division to highlight jackfruit's investment prospects (Department of Agriculture, 2013c). It highlighted who and where the markets were, what produce is in demand, the quantity required by the market and investment opportunities such as vacuum fired jackfruit (Department of Agriculture, 2013c).

The production data utilised in this thesis was sourced from the Food and Fertiliser Technology Centre (FFTC) and the Philippine Council for Agriculture, Aquatic and Natural Resources Research and Development (PCAARRD). Figure 5.12 shows the national increase in the volume of production in hectares planted for the Philippines.

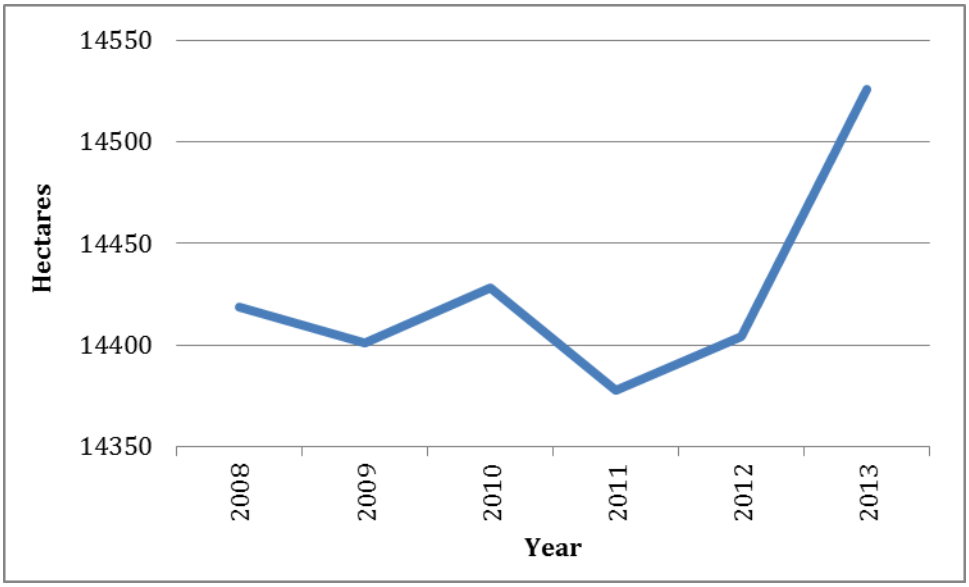

Figure 5.12 Area in hectares of jackfruit planted in the Philippines from 2008-2013 (data sourced from Espino and Espino, 2015)

Figure 5.13 shows the volume of jackfruit production in metric tonnes for Leyte. This has increased by 4% between 2008-2013. However, one town in Leyte has increased its jackfruit yield by 82% (Dagooc, 2013; Gonzales, 2013). Data is shown in Appendix L: Area of Jackfruit Planted.

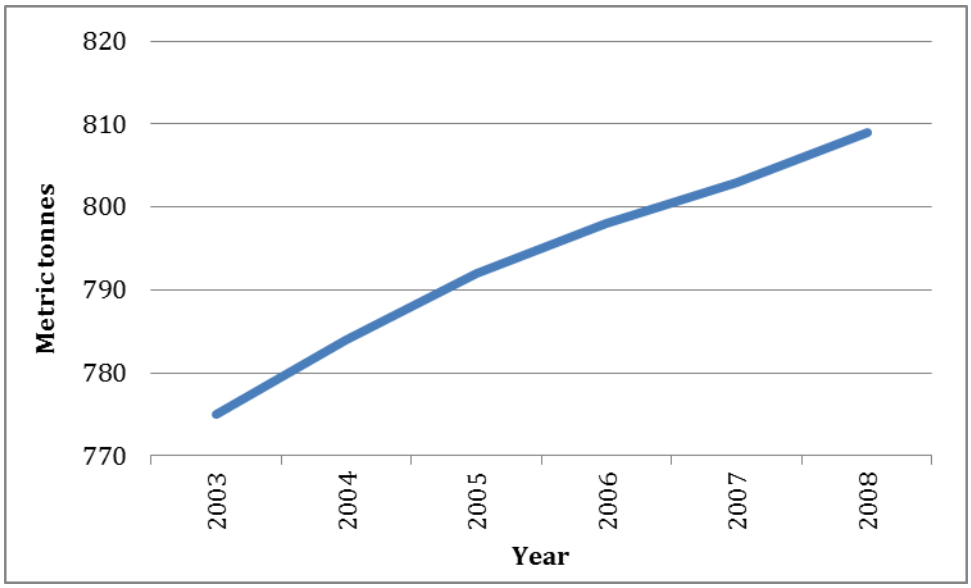

Figure 5.13 Metric tonnes of jackfruit produced in Leyte from 2003-2008 (data sourced from PCAARRD, 2009)

In, 2015, the Philippines produced 43,666 tonnes of jackfruit whilst consuming 41,054 tonnes of jackfruit (Philippines Statistics Authority, 2016i). The average yield in 2013 was 3.17 metric tonnes/hectares (Espino and Espino, 2015).

In 2015, the Philippines exported only 14 tonnes of fresh jackfruit (Philippines Statistics Authority, 2016i). The Philippines primarily exports processed jackfruit products to India, Japan, the United States of America, Canada, Saudi Arabia, Hong Kong and South Korea (Department of Agriculture, 2013b). The tariffs on jackfruit products entering India reduces over time however, the tariffs for mixed nuts or fruit which do not reduce over time (WTO, 2016). The agreement with the European Union has no tariffs on fresh and dried jackfruit, however preserved and mixed dried fruit are subjected to tariffs (European Commission, 2012). This hinders international growth and the export potential of the processing industry. To promote local produce and hence support the local industry this needs to be addressed through policy changes.

5.3.1 Farmer Inputs

Table 5.8 summaries the key inputs and functions of farmers for jackfruit plantations. The key constraints are also discussed. Information is sourced from the following Department of Agriculture sources unless otherwise stated (PCAARRD, 2016; Department of Agriculture, 2013b).

Table 5.8 Key inputs and functions of farmers in coconut plantations

Item	Constraints and problems
Planting materials • Sourced from nurseries or through government seedling programs.	• Similarly to the banana and coconut case studies there is the need to source planting materials from nurseries to ensure diseases do not spread.
Land preparation • All stumps, weeds and bushes should be removed. • Each hole should be fertilised	• Fertiliser issues were discussed in the banana inputs table.
Maintenance • Ring weeding and under bushing should	• Fertiliser and pesticide issues were discussed in the banana

occur every three months. • Fruit thinning – during the first year of planting to maintain a maximum of three fruit. This should increase to eight by the seventh year and 20 by the 15th year. • Remove unwanted, unproductive and diseased branches. • Desuckering or pruning - prune tree at two years of age and apply fungicide. • Fertiliser - apply one month after planting, six months after planting, at the start of the rainy season, at the end of the rainy season and when the tree starts to bear fruit.	inputs table. • Fruit thinning significantly reduces the number of fruits produced in the early years. • Similarly to the other two case studies there is a lack of utilisation of low cost technologies which could increase productivity.
Pest and disease control • Fruit should be covered when they are young so they cannot be attacked by insects. • Diseased parts of the tree should be removed and burned. • Trees should be sprayed with Sevin.	• Fertiliser and pesticide issues were discussed in the banana inputs table. • Limited access to technologies which has previously been addressed • As highlighted in the background section, diseased jackfruits are a significant issue in Eastern Visayas.
Harvesting • Fruit should be harvested three to four years after planting. • Harvesting should occur between mid-morning and late afternoon to reduce latex flow within the fruit. • This results in the fruit not being stained which reduces the marketability of the fruit.	• The long wait time is a significantly limitation of the fruit, however it is not as long as coconut. The requirement to ensure fruit is of a high standard is a significant constraint.

5.3.2 Economics

The farmgate price data for jackfruit in Leyte is shown in Figure 5.14 and the wholesale price is shown in Figure 5.15. Raw data is included in Appendix M: Farmgate Prices for Jackfruit and Appendix N: Wholesale Prices of Jackfruit.

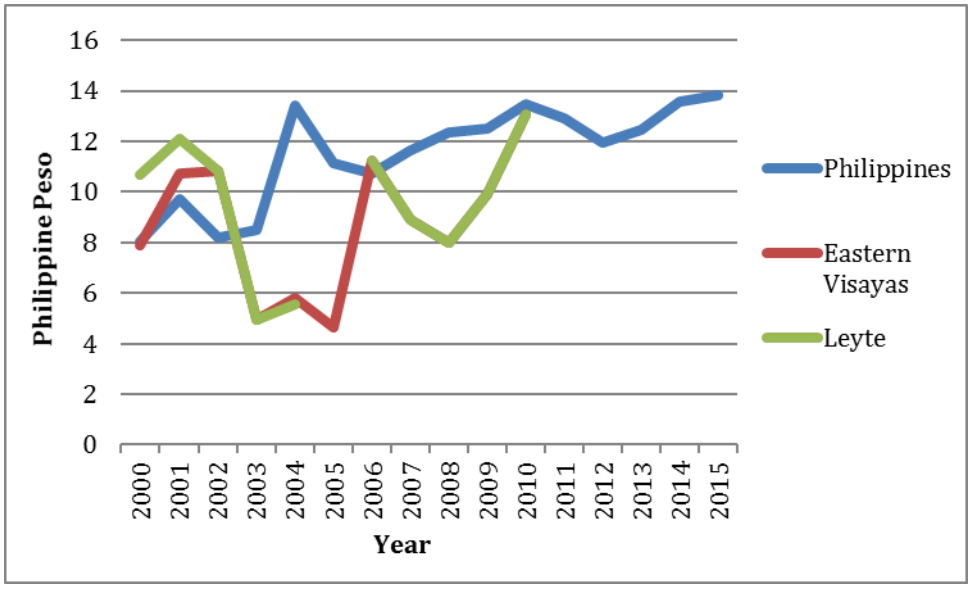

Figure 5.14 Farmgate price of jackfruit by location in Philippine Peso (data sourced from Philippines Statistics Authority, 2016e)

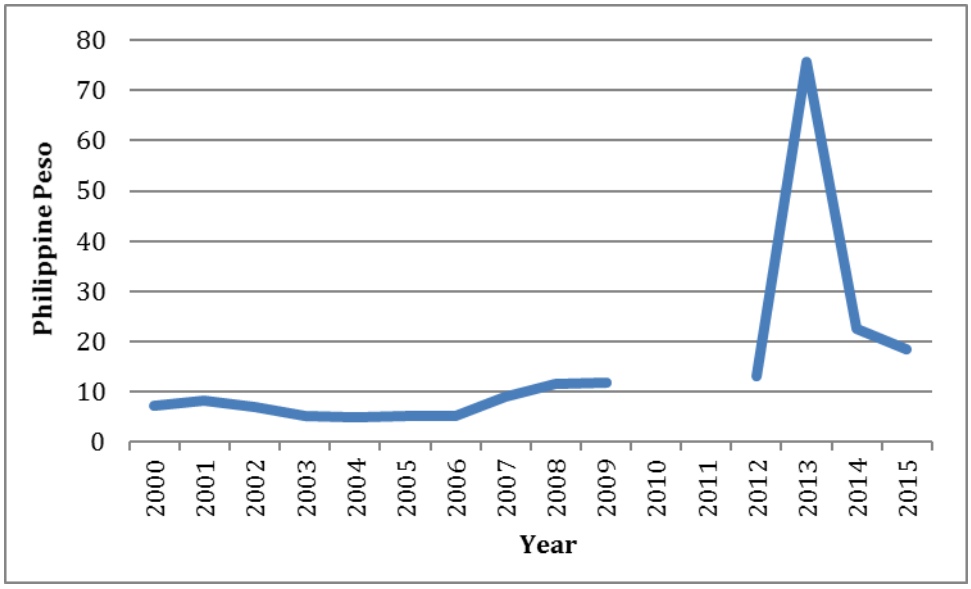

Figure 5.15 Wholesale price of jackfruit in the Philippines in Philippines Peso (data sourced from Philippines Statistics Authority, 2016i)

Similarly to the other two case study commodities the average farmgate price (₱11.52) is lower than the average wholesale price (₱14.67). The average farmgate prices for Eastern Visayas (₱8.72) and Leyte (₱9.52) is lower than both the average

Philippines farmgate and wholesale price. There is data missing for Eastern Visayas and Leyte from 2011 onwards however, when data is compared between the three locations prior to this, the price is still significantly lower.

Table 5.9 displays a basic estimated cost of production and return for one hectare. The table does not include value-adding activities. Data was sourced from (Department of Agriculture, 2013b; Department of Agriculture, 2011).

Table 5.9 Cost of production

Item	Cost
Maintenance – labour, water, research and development and communication	₱ 2.52/kg
Fertilisation	P 2.07/kg
Pest control	P 0.31/kg
Harvesting	P 0.14/kg
Transport	P 0.92/kg
Miscellaneous other costs	P 2.81/kg
Cost to produce a kilogram	P 8.63/kg
Average farmgate price from 2000-2015	Jackfruit - ₱9.52
Profit per hectare	₱0.89

5.4 Conclusion

In conclusion, this chapter has provided an overview of the banana, coconut and jackfruit case studies and highlighted how they are structurally similar. A summary of the key points is included in Table 5.10. This data will be utilised in the next chapter to populate the cultural adaptation diagrams.

Table 5.10 Summary table			
Item	Banana	Coconut	Jackfruit
Production levels	2013 - 8,645,749 tonnes, 8.1% of global production	2014 - 15,353,200 tonnes, 24% of global production	2015 – 43,666 tonnes, there is no data on what global percentage this is
Exports	2000-2013 – 104% increase	2000-2013 - 24% increase	No long term data
Key policies and authorities	High value crops development program Research, development and extension center Priority commodities investment plan	Philippines Coconut Authority Coconut Farmers Development Act Coconut Industry Development Act FAO nursery management and operations training	High Value Crops Development Program Bureau of Agricultural Eastern Visayas Research Centre Agribusiness and Marketing Assistance Division
Plantation and harvesting rate increase in Leyte	2000-2013 – 7%	2000-2012- 12%	2008-2013 – 4% 82% in one town
MT/ha	2013 - 19.39	2009 – 4.61	2013 - 3.17
Domestic consumption	2015 - 735,316 tonnes	2015 - 5,029,209 tonnes	2015 – 42,054 tonnes
Key issues	• Diseases • Fertiliser and pesticide uses – cost and socio-environmental impact • Transportation	• Diseases • Fertiliser and pesticide uses – cost and socio-environmental impact • Transportation	• Diseases • Fertiliser and pesticide uses – cost and socio-environmental impact • Transportation

	issues • Spread of diseases and pest due to planting materials • Loss of fruit due to handling and poor packaging • Good agricultural practices are not always utilized • Lack of access to technologies	issues • Long wait time for produce • Lack of distribution of materials (seedlings and fertiliser by the PCA) • Good agricultural management practice do not always occur	issues • Limited number of fruit in the first few years • Short shelf life (two or three days) • Damage of fruit during harvesting • Lack of utilisation of low cost technologies which could increase productivity
Difference between farmgate and wholesale price	73% lakatan 45% saba	111% coconut mature	27%
Profits per hectare	₱4.86	Coconut matured - ₱1.98 Copra ₱10.32	₱0.89
Value adding activities	• Banana chips – processing in major cities • Otherwise there is a lack of value adding activities farmers can undertake	• Some processing occurs in the major cities • Farmers are able to produce copra.	• Processing occurs in the major cities • There is a limited amount of value adding which farmers can undertake

Chapter 6: Discussion

In this chapter, I apply the data from the results section to populate the cultural adaptation template. The first diagram (Figure 6.1) shows the government's belief and resultant policy orientation on agricultural intensification to create bulk commodity production. An understanding of the government belief was formed through secondary data. This diagram displays the conventional wisdom for the banana and coconut crops and demonstrates the structural similarities between the crops. The second diagram (Figure 6.2) shows the farmer's perspectives and highlights the socio-economic costs of bulk commodity production. The third diagram (Figure 6.3) demonstrates the current situation regarding jackfruit. In all three diagrams feedback loops and commodity traps will be highlighted. In the final jackfruit diagram, points of intervention aimed at changing the structure of this system will be discussed. These diagrams demonstrate the first research question regarding whether the cultural adaptation templates can be utilised to explain cash crop commodities. This section aims to address the second research question regarding jackfruits' potential to be a profitable cash crop in Leyte and the required measures for its success. The section also addresses the third research question concerning whether jackfruit will become a commodity trap for farmers and how this can be avoided. This chapter will conclude with a discussion on the application of this research and suggest areas warranting further examination.

6.1 Conventional Wisdom

Figure 6.1 highlights the dynamics of the government's conventional wisdom perspective and the relationship between the different variables. The processes driving this system are explained in Table 6.1.

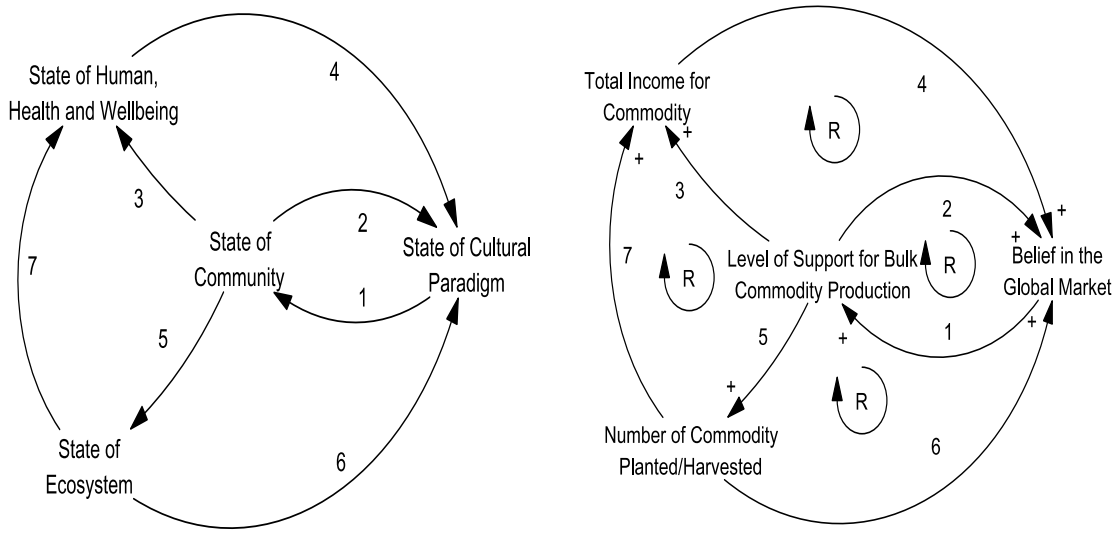

Figure 6.1 System of interest for conventional wisdom of banana and coconut commodities. Links are explained in Table 6.1 (adapted from Dyball and Newell, 2015)

Table 6.1 Influence links in the conventional wisdom system of interest (Figure 6.1)	
Link	Action/processes/mechanisms represented in Figure 6.1
1	This is a positive link. Agricultural agencies have and continue to develop policies such as the high value crop development, commodity investment and access to markets programs, which focus on increasing agricultural productivity. The creation of international trade agreements (with South Korea and China) provides Filipino producers with a larger market to sell products into hence increasing export levels. These policies also contain poverty alleviation elements which the government believes increased agricultural production can address.
2	This is a positive link. The perception that policy mechanisms favor the markets further reinforces the belief in agricultural production. The creation of new trade agreements increases the belief in the global market.
3	This is a positive link. Policies which promote maximum commodity production have an underlying belief that farmers' income will increase. The establishment of free trade agreements creates a wider market for produce. This is being reinforced by an increase in the amount of a commodity being planted and harvested to meet the increased demand from the export market development programs that the government is pursuing.

4	This is a positive link. Increased farmers' earnings reinforce the governments' belief in the global market and that such an approach will aid in addressing poverty.
5	This is a positive link. The policy focus promotes an increase in agricultural production which results in an increase in the amount of a commodity being planted and harvested. This is being reinforced by expanding global market opportunities.
6	This is a positive link. An increase in the number of a commodity being planted and harvested reinforces the belief in global market. This is being reinforced by the expansion of foreign markets and by bulk commodity production policies.
7	This is a positive link. The predominate belief is that a continued increase in the amount of a commodity being planted and harvested will result in an increase in levels of income for farmers. This is being reinforced by the continued level of support for maximum commodity production through agricultural policies and the expansion of the available market through export polices.

The Filipino government's current policy orientation focuses on bulk commodity production and agricultural intensification. The policies also contain social elements such as poverty alleviation. Their approach centres on the belief that cash crop are a useful tool to reduce farmer's vulnerability to food insecurity, increase farmers' incomes and provide employment (Maxwell and Fernando, 1989; Von Braun, 1995; Von Braun, 1986; Zeller and Sharma, 2000; Jones and Gibbon, 2011). On the national level the Filipino government promotes these policies to increase government revenue (Von Braun, 1986). The need for continuous high growth was highlighted in a recent World Bank report on the Philippines stating that for poverty to reduce growth needs to occur (World Bank, 2015).

The Filipino government believes that an increase in agricultural production will reduce levels of rural poverty. This policy approach is based on the original food security concept discussed in the background section regarding increasing food production to address food shortage issues (Ingram, 2011a). The Fillipino government has achieved this by pursuing policies which increase areas planted and harvested for specific crops, as well as economic stratergies such as export policies through free trade agreements. This approach does not address the concept of food in a broad and holistic manner. Rather it only focuses on

intensification and does not consider biophysical and human environments or the activities from production through to consumption. The policy focus on agricultural intensification creates significant socio-environmental issues which are not being addressed. These will be discussed later on in this chapter.

The government's policies have resulted in limited differentiating factors between the structure of the banana and coconut case study. The system appears in such a way that a new crop such as jackfruit could be 'inserted' into any policy with ease due to the government's current agricultural policy mindset. This highlights how the government's approach to agriculture only focuses on intensification.

6.2 Farmers' Perspective

The government's conventional wisdom perspective, which was presented in Figure 6.1, is vastly different to what is occurring on the ground from the farmer's perspective. Figure 6.2 highlights the farmers' perspective of the situation and the links are explained in Table 6.2.

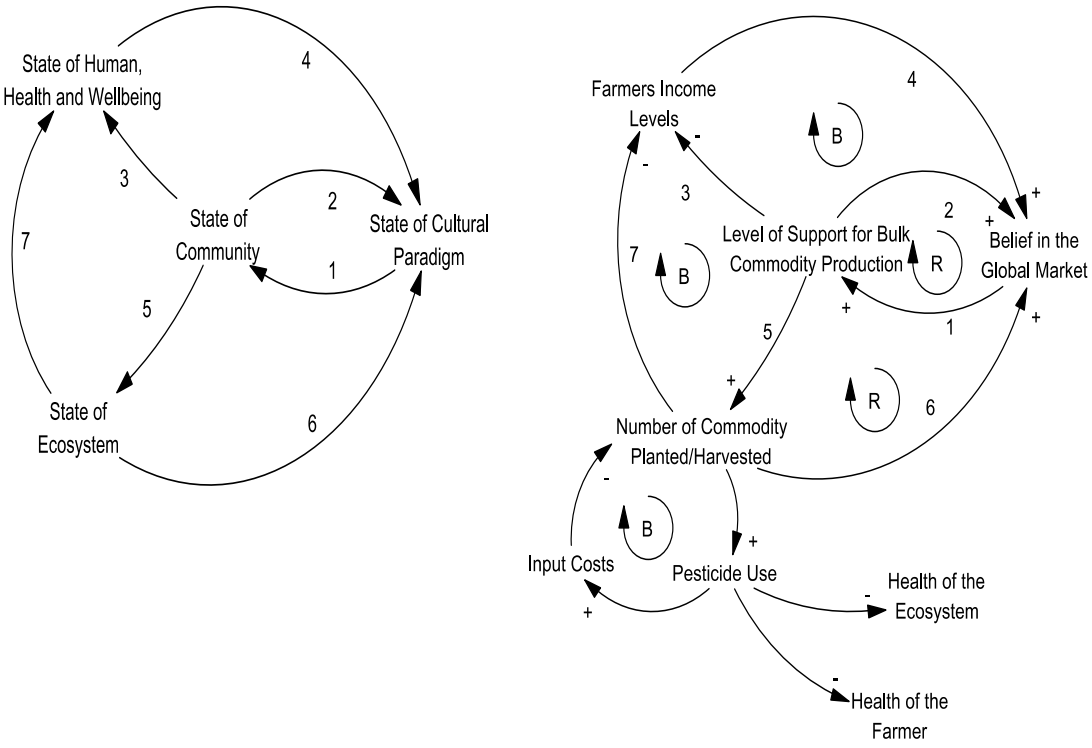

Figure 6.2 System of interest for the farmers' perspective. Links are explained in Table 6.2 (adapted from Dyball and Newell, 2015)

Table 6.2 Influence links for the farmers' perspective system of interest (Figure 6.2)	
Link	Action/processes/mechanisms represented in Figure 6.2
1	This is a positive link and is the same as the conventional wisdom table.
2	This is a positive link and is the same as the conventional wisdom table.
3	This is a negative link. Policies that promote agricultural intensification also contain social policy elements such as poverty reduction. However, these are not creating long lasting changes to the state of human health and wellbeing.
4	This is a positive link, but weak. If a farmers' income was at a level which results in them being above the poverty threshold this would reinforce their belief in the global market. However, poverty rates are not significantly falling. This should result in the government changing its stance on both export policies and belief in cash crop commodities as a viable economic tool, however this does not occur. This demonstrates how rural farmers have a limited impact and influence on policy and government decisions.
5	This is a positive link and is the same as the conventional wisdom table.
6	This is a positive link, but weak. If pesticide use and input costs increase it should decrease the belief in the global market due to the environmental and social degradation which occurs. This degradation should present a concern to farmers and policy makers and should result in the government changing its policy approach. This again demonstrates how those in rural communities have a limited impact and influence on policy and government decisions.
7	This is a negative link. Farmers have limited options at escaping the system other than increasing the number of hectares they plant to increase the number of bananas to harvest.
Sub loop	Policies promoting agricultural intensification are resulting in increasing hectares of commodities being planted and harvested. Numerous commodities such as banana are susceptible to diseases and pests and pesticide use is required to address this. Environmental issues occur such as damage to water sources, soil erosion and damage to flora and fauna. This results in a decline in the health of the ecosystem. The health of the farmer is also impacted, as there is a link between pesticide use and human health concerns ranging from headaches to cancer. As pesticide use increases farmers are required to increase

	input costs to cover the price of fertilisers. The resultant environmental issues cause a reduction in the number of bananas being harvested. To counter this, there is then an increase in the hectare of bananas being planted and so balancing loop continues to negatively impact human and ecosystem health.

The current policy approach being pursued by the Filipino government has resulted in significant increases in prices of produce over time. However, it is clear by the statistics presented earlier that it is not having the desired long-term impact on poverty levels. For example, poverty levels in rural areas are still high, (Philippines Statistics Authority, 2016a), Leyte has the 5th largest number of poor people nationally (Asian Development Bank, 2009), the prevalence of underweight children under five years of age using child growth standards has been increasing (Philippines Statistics Authority, 2015) and a high percentage of rural family household expenditure is still being spent on food (Philippines Statistics Authority, 2016e). Whilst prices of produce have been rising the average income farm workers receive is in the lowest national income decile. For example, in 2012 the average income of a farm worker is ₱50,406.5. This is 17% less than the national farm worker average of ₱60,819.95. This means a farmworker is in the lowest income decile. Hence, the current income, which farmers receive, is far too low and does not provide a sufficient income for a farmer or a community to live off. As a result they are one of the most financially disadvantaged groups in the Philippines and it creates a community decline trap. Farmers are pushed into a negative feedback balancing system with no way to leave. In the diagram this is displayed by the loop of link 2, link 3 and link 4. The approach is not creating people centred development which was a key aspect of SEARCA (2015) approach.

The World Bank has highlighted that levels of poverty would reduce only if high economic growth occurred (World Bank, 2015). This demonstrates the need for continued increases in productivity. This feeds into the government's current policy approach of addressing issues of food by only focusing on increasing agricultural productivity. Clausen (2008) argued that the current world economic system is based on the need for an endless supply of commodities. The Filipino government's policy approach is feeding into this system and economic growth is being prioritised over both the environment and farmers' welfare.

This same policy approach of utilising cash crop commodities to achieve poverty alleviation in the Philippines has been used since the Ramos Administration in the 1990s, by the World Bank since 1965 and by the Asian Development Bank since 1970.

As previously demonstrated, thi policy approach is not having the desired impact on poverty alleviation. However, the Filipino government is continuing to utilise this approach. As a result, an alternative policy approach should be considered to meet the policy objectives of poverty alleviation.

Clausen (2008) highlighted how the use of pesticides and fertilisers does not address the original problem of an economic system which is built on the need for an endless supply of a product. The creation of agricultural intensification policies within the Philippines which promote cash crop commodities for export builds on the structural dependency between the north and the south and is an example of export-oriented monoculture (Niblett, 2011). The Philippines Economic Update, which was discussed in the background section, highlighted how a reduction in extreme levels of poverty was expected if high economic growth continued (World Bank, 2015). The Filipino government's current policy orientation is feeding into an economic system where continued growth is needed in order for the agricultural sector and their associated towns and communities to survive. It also stems from the government's perspective that food security issues can be addressed by increasing agricultural production (Ingram, 2011a). However, the approach of continuous growth and continuous agricultural production is creating a range of significant environmental problems, for example through the use of pesticides.

The sub loop is an example of a negative feedback balancing system. The environmental costs which arose through the use of pesticides to address diseases and pests, are overloading the environment. This has created an environmental pollution trap as the continued increase in production produces waste which exceeds the environment's natural waste absorption rates. Environmental and social consequences then occur. In the banana case study these ranged from water issues to cancer. Ingram (2011a) highlighted how this level of environmental damage then degrades food production capacity, thus becoming a self-reinforcing system. Addressing the environmental pollution trap is crucial in the jackfruit case study and will be discussed later on.

6.3 Is Jackfruit Becoming a Commodity Trap?

This diagram highlights the current situation regarding jackfruit production in Leyte. Figure 6.3 highlights the farmers' perspective on the situation and the links are explained in Table 6.3.

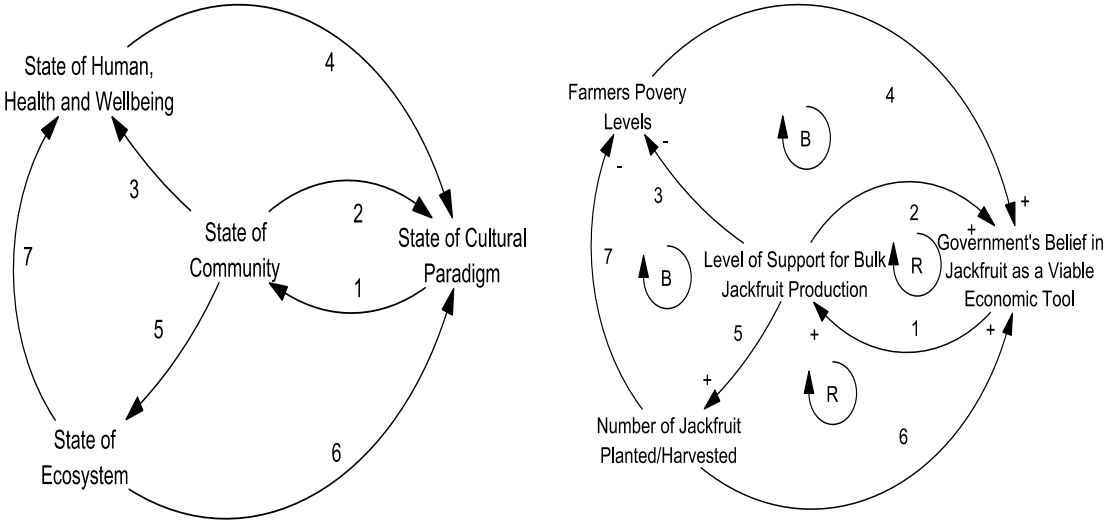

Figure 6.3 System of interest for jackfruit. Links are explained in Table 6.3 (adapted from Dyball and Newell, 2015)

Table 6.3 Influence links for the jackfruit system of interest for (Figure 6.3)	
Link	Action/processes/mechanisms represented in Figure 6.3
1	This is a positive link and is the same as the conventional wisdom table.
2	This is a positive link and is the same as the conventional wisdom table.
3	This is a negative link. Policies that promote maximum commodity production have an underlying belief from the government that poverty reduction will occur. However 50 + years of this approach has not created substantial results. As a result, it is highly unlikely that the same policy approach for jackfruit will achieve significant results in reducing poverty levels.
4	This is a positive link, but weak. The current policy approach has not been established long enough to reach a conclusion regarding its success or otherwise on reducing poverty levels. However, an increase in poverty levels should decrease the government's belief in jackfruit as a viable economic tool. This did not occur in the banana or coconut case study. This highlights the limited influence farmers have on policy.
5	This is a positive link and is the same as the conventional wisdom table.
6	This is a positive link. An increase in the amount of jackfruit planted and harvested reinforces the government's belief in jackfruit being a viable economic tool. This is being reinforced by the continued level of support for maximum commodity production through agricultural policies.

7	This is a negative link. The government's belief is that a continued increase in the quantity of a commodity being planted and harvested will result in a decrease in poverty levels. However, this continued policy approach over time has not resulted in significant long-term changes in poverty levels.

Currently, jackfruit is subject to policies focusing on increasing agricultural intensification, similar to the other two crops. This has led to an increase in plantations in Leyte in recent years, similar to banana and coconut. For jackfruit, while there is recognition of the significant market potential of the species, this recognition is not being supported by the government's export policies as it is not an established crop and thus the potential export market opportunity is not being fully utilised. The jackfruit case study is not as developed as the banana and coconut examples as there is a lack of institutional support regarding exports or export policies. The jackfruit system of interest is currently established in a structurally similar manner to the banana and coconut case studies. As a result, it is expected that jackfruit will become a cash crop commodity in Leyte, unless the system structurally changes. As a result, interventions in the system can be provided to ensure the issues arising from the other two case studies are not repeated for jackfruit.

The analysis suggests key points of intervention. The major issue that needs to be addressed is changing the policy approach from the federal government. There needs to be a change in the dominate paradigm focus away from agricultural intensification, which promotes bulk commodity production for export. It has been highlighted that a food security approach of increasing agricultural production does not reduce levels of poverty. As this thesis has shown, this current approach creates environmental (soil erosion through pesticide use), social (poverty levels) and economic problems (low profit returns from crops), with economic growth being put first. However, by changing this policy focus, human wellbeing and ecosystem health would not be traded-off for agricultural production. The above mentioned policy proposals would only be possible with a shift in the dominant discourse. There needs to be a change from the idea that continuous growth is the only way to achieving a positive level of human wellbeing.

By changing the policy focus from commodity intensification to one, which focuses on diversification, innovation and local value adding, process Link 3 would become a positive. The literature review highlighted how a key characteristic of a cash crop was that the standardisation of a produce results in it being indistinguishable no

matter its location of origin. Organic certification such as fair trade is one example, which has been promoted globally (Sawin *et al.,* 2003). This could incorporate numerous environmental (reduced pesticide use) and social (reduced levels of poverty) goals. The creation of a minimum environmental standard could reduce the amount of waste entering the system and hence address the environmental pollution trap. For organic jackfruit plantations to become viable, consumers need to have an understanding that their demand for organic certified produce from Leyte would have a positive feedback loop and function to reduce negative environmental and social consequences. Consumers then need to be willing and able to pay more for organic certified produce, which aligns with their values. If there is not this market demand, overproduction and a decline in income may occur (demand growth loop). In addition, due to the potential global demand for jackfruit the produce may be produced in the location where the environmental goals (lack of deforestation or lack of erosion) can be achieved for the lowest cost which is another characteristic of a commodity system. The creation of a minimum price could not only address this issue but also improve the income of farmers, hence addressing the community decline trap.

The coconut case study highlighted how value adding through copra production resulted in farmers receiving a higher price for produce. For example, in Leyte in 2005 the average farmgate copra corriente price was ₱18.68 as opposed to coconut mature of ₱6.83. In addition, the basic cost analysis of copra and coconut production highlighted how copra results in a higher return for farmers. While fresh jackfruit can be preserved and canned, these value adding options occur in processing factories in major cities and are out of the direct control of farmers. Further research needs to occur into what farmers can do to increase their income through value adding of jackfruit products. Without this occurring, the current market structure of the middleman receiving a substantial income at the expense of the farmer, will continue. To further address this problem, the farm to market programs which the Filipino government is currently running, need to be strengthen.

Link 4 should be strengthened so farmers and those involved in rural agriculture have a greater influence on the policy direction pursued by the Filipino government. As these are the people who the policies impacts they need to have a larger and stronger voice in the policy process. This would enable active community and local institution participation to occur which is a key aim of the SEARCA (2015) approach. Consultation meetings and information sessions need to occur. However, this should not occur with only large-scale producers. Farmer cooperatives need to be fostered and

resourced as a means of putting forward alternate policy options on behalf of communities or regional areas. As a consequence, feedback loop Link 2, Link 3 and Link 4 would become reinforcing as all the links would have positive polarities.

Another suggestion from the literature is the establishment of collective agreements (Sawin *et al.*, 2003). This occurs when the producers agree on rules which work to restructure the system. If collective agreements were to occur in the jackfruit system of interest this could make either or both Link 3 or Link 7 positives. Doing so, would result in loop Link 3, Link 5 and Link 7 becoming a positive reinforcing loop. This could then address the community decline trap (poverty, nutrition levels and income spent on food). For this to occur, a few options are presented:

1. limit the number of producers through a license agreement;
2. create harvest controls limiting the maximum number of jackfruit which can be sold to market each season by each producer;
3. create a production quota of jackfruit on a per hectare basis;
4. ensure there is sufficient information between farmers and the government regarding the state of the system; and
5. create a price floor which is above the minimum needed to maintain a farm, produce a crop and sustain a family.

The creation of a harvest limit would work to address the community decline trap. This would ensure prices are kept high and would provide a decent income for farmers. In addition, the creation of a price floor would also address the community decline trap, as farmers would have a sufficient income to survive. A harvest limit, a production quota or a price limit would stop the efficiency boosting loop. By ensuring that production and prices have to stay within a certain limit, stops the system from become a commodity trap. Creating a harvest control or production quota would limit the environmental damage in the system, hence addressing the environmental pollution trap. There would be a need for all producers in an area to be involved in the development and implementation of a collective agreement. There would also be the need to establish rules, laws and penalties to ensure the agreement and the system is sustained. However, it should be noted that significant power issues could arise between large scale and small scale producers (or farmers).

Another intervention strategy could address government taxes and payments. The government should create the goals and rules which control the system. This could occur through taxing pesticides which would reduce the amount of waste entering the

system. This would address the environmental pollution trap and tackle human health and ecosystem concerns. To ensure that an alternative other than the use of chemical based pesticides is found, investment in research and development into natural pest control methods should occur. It should be noted that this approach may have limited application as it may be utilised as a revenue raising approach by the government. The Filipino government would need to recognise that their agricultural intensification policies which promote bulk commodity production are causing environmental and social damage.

Another approach is providing financial support for sustainable environmental and social practices. A key issue which arose in the banana case study was the lack of supply of good quality, planting material which is free or subsidised. Providing farmers with the knowledge about why this is important is also crucial. Addressing this to ensure that either nurseries or government run program can provide planting material will reduce the spread of diseases and also reduce costs which enable farmers to spend their available funds on other needs. This has the potential to address the environmental pollution loop. However, there could be issues regarding corruption with payments. Both these approaches however do not address the drivers of growth within a system (i.e. the need to meet the market demands of the system). As a result, until the requirements placed on farmers by the needs to meet markets demands for produce are met and addressed, utilising taxes and payments will not be successful.

Unless interventions occur in the jackfruit case study, it will become a cash crop commodity for farmers. The banana and coconut case studies contain numerous environmental, economic and social concerns. Due to the structural similarities of the case studies including increases in production, expansion of markets and continuation of the dominant discourse of agricultural intensification, there is likely to be little change and the status quo is likely to continue. As a result, in the long term jackfruit will not be a profitable crop. In the short to medium term however it will be profitable. This is due to the lack of producers in the national and international market. However, as government policies drive an increase in production levels, and markets expand, it is likely to become a non-profitable crop.

The increased earnings which farmers would receive from implementing the above options should not be reinvested into equipment as this will in turn increase levels of production (i.e. the usual application of the capital growth feedback loop should be put on hold). This money should be reinvested into improving both processing and shelf storage operations. Improving storage options would be beneficial as mature and unripe

jackfruit can be stored at 13°C for approximately three weeks (Paull and Durate, 2010:111), while fresh jackfruit only has a shelf life of two or three days (Pua *et al.*, 2007:630).

6.4 Research Application and Further Directions for Research

This research on jackfruit can be applicable to other regions in the Philippines due to both the similarities between areas and the generic nature of government policies. The general findings regarding cash crop commodities such as certification and increased farmer involvement in policy making would also be applicable to other crops in the Philippines.

Further research on jackfruit in the Philippines could focus on a systems thinking analysis on processing centres in the major cities where value adding occurs (for example snacks and flour). This aspect of the system should highlight different environmental and social concerns which were not addressed in this thesis.

This thesis, has added to the growing literature on food systems and systems thinking. Both areas have the potential to continue developing and addressing the way policy makers and the literature view and address food issues. Governments should utilise a food systems approach to ensure policy decisions consider the whole system in an holistic manner. This would enable the totality of the problem to be addressed instead of subsections of the system. By utilising systems thinking to address an issue such as agriculture the impacts of actions can be addressed hence ensuring a long-term focus on a commodity. The cultural adaptation template has not been heavily utilised in the literature. It can easily be applied to environmental problem spaces due to the simplistic yet visual manner in which it presents information. It, like systems thinking, can aid in addressing complex problems.

Current research into cash crop commodities is focusing on gender issues (Anderman *et al.*, 2014; Due and Gladwin, 1991; Hoddinott and Haddad, 1995; Kennedy and Peters, 1992) which could be applied in either the Philippines or to jackfruit. Research in India has focused on suicide rates of farmers (Kennedy and King, 2014). There is limited literature on the impacts which cash crops have on mental health. There is thus a large scale issue of human health and wellbeing impacts which could be addressed. Politically, issues such as power and corruption surrounding agriculture in the Philippines could also be addressed. This leads on from the work of

Amartya Sen regarding how access to food as opposed to availability of food is crucial to achieving food security (Drèze and Sen, 1989; Sen, 1981).

Chapter 7: Conclusion

In conclusion, this systems thinking analysis on cash crop commodities in the Philippines has highlighted the structural similarities between the banana, coconut and jackfruit crops. The Filipino government holds the view that agricultural intensification through bulk commodity production is the way to ensure both economic growth and to achieve social policy goals. This view results in new crops such as jackfruit being able to be 'inserted' into any agricultural policy with ease.

This thesis has demonstrated that the cultural adaptation template can be applied to cash crop commodities hence answering research question one. In doing so it has highlighted how all three crops are structurally similar. All three crop have seen an increase in area planted and harvested in hectares, increase in export levels, the development of export policies and government agricultural intensification policies which promote maximum commodity production. The current policy orientation creates an environmental pollution trap through the use of pesticides and a community decline trap through insufficient profit to sustain a family or a community. This then requires the system to be structurally changed to ensure jackfruit can become a successful commodity for farmers in Leyte. These structural changes include a change in policy focus to ensure that those involved in rural agriculture have a greater influence and participation in policy, the creation of farmers' cooperatives and value adding options. The use of trap breakers such as organic certification, collective agreements and government taxes and payments was discussed as a means for this to occur. However, the government's current policy orientation feeds into the current world economic system which is built on the need for an endless supply of a product (Clausen, 2008). As a result, the government ultimately needs to have a paradigm shift in their views regarding agricultural policies. They need to move to an approach which does not lead to environmental degradation and social consequences. Until there is a shift in the cultural paradigm, jackfruit will become a cash crop commodity for farmers (RQ3) and will not provide a substantial income in the long term (RQ2). As a result, Inclusive and Sustainable Agricultural and Rural Development (ISARD) which helps in achieving the goals of food security and poverty alleviation (SEARCA, 2015) is unlikely to occur in the jackfruit case. Jackfruit is not contributing to an environmentally friendly and people centred development approach (SEARCA, 2015).

This was the first time the cultural adaptation template had been applied in published literature on cash crop commodities in the Philippines. This research

demonstrates the potential of this template and food systems and systems thinking approaches to address complex problems surrounding food. This thesis contributes to new ways of understanding cash crop commodities through the perspective of food systems and systems thinking research. It enables a greater level of understanding of the connection between global economic drivers and the resultant environmental and social consequences occurring at the site of production.

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Legislation

Agriculture and Fisheries Modernisation Act (1997) (PHL)

Coconut Farmers Development Act (2016) (PHL)

Coconut Industry Development Act (2016) (PHL)

National Research Centre for Banana (2016) (PHL)

Appendix A: Area of Banana Planted/Harvested

This appendix contains the data utilised to populate Figure 5.1. It shows the area planted/harvested of banana in Leyte from 2000-2015.

Year	Hectares
2000	5,893
2001	5,881
2002	5,909
2003	5,909
2004	5,951
2005	5,982
2006	6,021
2007	6,021
2008	6,210
2009	6,247
2010	6,247
2011	6,249
2012	6,328
2013	6,328
2014	4,895
2015	4,890

Source: Philippines Statistics Authority, 2016l. *Other Crops: Volume of Production by Region and by Province,* Available at: http://countrystat.psa.gov.ph/?cont=10&pageid=1&ma=A60PNVOP (accessed 3 March 2016).

Appendix B: Area of Banana by Species Planted/Harvested

This appendix contains the data utilised to populate Figure 5.2. It shows the area in hectares planted/harvested of banana by species in Leyte from 2002-2015.

Year	Cavendish	Lakatan	Saba
2002		88	1,460
2003		88	1,460
2004		88	1,482
2005		80	1,491
2006		85	1,525
2007		85	1,525
2008	15	88	1,610
2009	32	91	1,615
2010	32	91	1,615
2011	32	93	1,615
2012	34	97	1,655
2013	34	97	1,655
2014	26	75	1,250
2015	25	75	1,250

Source: Philippines Statistics Authority, 2016l. *Other Crops: Volume of Production by Region and by Province,* Available at: http://countrystat.psa.gov.ph/?cont=10&pageid=1&ma=A60PNVOP (accessed 3 March 2016).

Appendix C: Banana Exports

This appendix contains the data utilised to populate Figure 5.3. It shows the amount of banana exported per year from 2000-2015 in millions of tonnes.

Year	Millions of tonnes
2000	1599920
2001	2129309
2002	1684986
2003	1829384
2004	1797343
2005	2024322
2006	2311540
2007	2218051
2008	2192624
2009	1743891
2010	1590066
2011	2046743
2012	2646380
2013	3267562

Source: FAO, 2016b. *Crops and Livestock Production*, Available at: http://faostat3.fao.org/browse/T/TP/E (accessed April 5 2016).

Appendix D: Farmgate Prices for Banana

This appendix contains the data utilised to populate Figure 5.4. It shows the farmgate prices of banana from 2000-2015 for Leyte by species in Philippine Pesos per kilogram.

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	Average
Banana Lakatan green				2.92	5.82	8.25	12.23	13.94									8.63
Banana Latundan green	4.09	3.98	4.04	4.46	4.57	4.72	8.66	9.53	9.22	10.52	9.54	11.48	12.25	12.32	17.74	17.02	8.97
Banana Saba green	3.21	2.85	2.78	2.80	4.01	4.44	6.59	6.36	8.50	9.35	9.63	10.22	11.61	11.29	18.03	17.50	8.07

Source: Philippines Statistics Authority, 2016g. *Fruits: Farmgate Prices by Region and by Province,* Available at: http://countrystat.psa.gov.ph/?cont=10&pageid=1&ma=K20PRFPC (accessed 3 March 2016).

Appendix E: Retail Prices for Banana

This appendix contains the data utilised to populate Figure 5.5. It shows the retail prices of banana from 2000-2015 for Leyte by species in Philippine Pesos per kilogram.

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	Average
Banana Lakatan ripe	21.96	21.60	22.86						19.98	20.79	21.24	23.58	30.51	32.31	62.72	60.24	30.71
Banana Latundan ripe	15.10	15.20	14.70	13.60	14.00	15.20	14.70	15.50	15.80	15.10	14.20	15.90	19.00	21.40	47.81	41.72	19.31
Banana Saba ripe	9.63	9.72	9.99	9.99	10.62	11.79	11.16	11.25	11.79	12.51	11.52	14.76	14.94	16.38	43.34	33.90	15.21

Source: Philippines Statistics Authority, 2016h. *Fruits: Retail Prices by Region and by Province,* Available at: http://countrystat.psa.gov.ph/?cont=10&pageid=1&ma=M70PRRPC (accessed 3 March 2016).

Appendix F: Wholesale Prices for Banana

This appendix contains the data utilised to populate Figure 5.6. It shows the wholesale prices of banana from 2000-2015 for the Philippines by species in Philippine Pesos per kilogram.

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	Average
Banana Lakatan ripe	11.43	11.79	11.88	12.42	14.31	15.66	15.39	16.92	19.44	20.70	24.30	25.83	25.74	28.08	38.44	15.91	19.26
Banana Latundan ripe	8.90	8.55	9.80	9.90	10.70	11.60	12.10	12.40	13.40	13.90	15.60	16.80	15.80	17.30	22.88	22.76	13.90
Banana Saba ripe	6.21	6.66	7.02	7.11	8.19	9.18	8.82	10.17	10.98	10.44	11.34	12.06	13.05	13.77	22.88	22.78	11.30

Source: Philippines Statistics Authority, 2016j. *Fruits: Wholesale Prices by Region and by Province,* Available at: http://countrystat.psa.gov.ph/?cont=10&pageid=1&ma=L60PRWPC (accessed 3 March 2016).

Appendix G: Area of Coconut Planted/Harvested

This appendix contains the data utilised to populate Figure 5.7. It shows the area in hectares planted/harvested of coconut in Leyte from 2002-2014.

Year	Hectares
2000	150,100
2001	150,155
2002	150,100
2003	150,100
2004	150,101
2005	150,103
2006	150,110
2007	150,112
2008	156,530
2009	158,340
2010	166,257
2011	167,973
2012	167,974
2013	94,744
2014	94,700

Source: Philippines Statistics Authority, 2016l. *Other Crops: Volume of Production by Region and by Province,* Available at: http://countrystat.psa.gov.ph/?cont=10&pageid=1&ma=A60PNVOP (accessed 3 March 2016).

Appendix H: Coconut Exports

This appendix contains the data utilised to populate Figure 5.8. It shows the amount of coconut exported per year from 2000-2013 in millions of tonnes.

Year	Tonnes
2000	2403
2001	1988
2002	4140
2003	1188
2004	3116
2005	3130
2006	2306
2007	1086
2008	1892
2009	1925
2010	2578
2011	7605
2012	2261
2013	2991

Source: FAO, 2016b. *Crops and Livestock Production,* Available at: http://faostat3.fao.org/browse/T/TP/E (accessed April 5 2016).

Appendix I: Farmgate Prices for Coconut

This appendix contains the data utilised to populate Figure 5.9. It shows the farmgate prices of coconut from 2000-2015 for Leyte by species in Philippine Pesos per kilogram.

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	Average
Coconut green, young 'buko'							2.47	2.50	3.14	3.57	3.85	3.91	4.37	4.67			3.56
Coconut matured	4.78	6.32	4.42	2.89	4.18	4.26	3.52	3.21	5.33	3.87	4.94	8.79	4.49	4.02	11.38	6.83	5.20
Copra Corriente	5.87	5.07	7.94	10.21	15.73	13.31	12.47	18.06	22.34	12.96	19.73	30.62	18.18	13.91	22.98	18.86	15.52
Copra Resecada	7.26	5.94	7.64	10.49	14.21	13.17											9.79

Source: Philippines Statistics Authority, 2016b. *Commercial Crops: Farmgate Prices by Region and by Province*, Available at: http://countrystat.psa.gov.ph/?cont=10&pageid=1&ma=K30PRFPC (accessed 3 March 2016).

Appendix J: Retail Prices for Coconut

This appendix contains the data utilised to populate Figure 5.10. It shows the retail prices of coconut from 2000-2015 for location in Philippine Pesos per kilogram.

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	Average
Philippines	8.45	7.15	7.65	8.10	9.69	10.49	10.57	11.52	14.00	13.85	14.26	19.51	18.83	17.62	20.53	20.87	20.87
Eastern Visayas	6.17	5.40	6.49	6.69	8.41	8.77	9.06	9.67	12.28	12.02	12.12	14.83	13.48	12.32	19.24	18.76	10.98
Leyte	6.89	5.86	7.22	7.73	9.30	10.45	9.29	8.57	12.52	11.47	11.01	12.88	11.19	9.86	27.03	24.39	24.39

Source: Philippines Statistics Authority, 2016c. *Commercial Crops: Retail Prices by Region and by Province,* Available at: http://countrystat.psa.gov.ph/?cont=10&pageid=1&ma=M80PRRPC (accessed 3 March 2016).

Appendix K: Wholesale Prices for Coconut

This appendix contains the data utilised to populate Figure 5.11. It shows the wholesale prices of coconut from 2000-2015 for location and species in Philippine Pesos per kilogram.

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	Average
Coconut matured	7.23	6.31	7.24	8.23	10.40	11.68	11.89	12.41	14.64	16.45	12.80	18.87	18.44	16.34	17.96	22.59	13.34
Copra Corriente	6.99	5.03	8.70	10.46	15.92	13.66	12.06	17.04	21.12	12.73	19.14	28.00	16.66	13.16	19.61	17.5	14.86
Copra Resecada	9.18	6.85	11.47	13.24	20.3	17.37	16.24	23.13	28.73	17.55	25.56	40.05	24.26	20.2	29.44	26.96	20.66

Source: Philippines Statistics Authority, 2016d. *Commercial Crops: Wholesale Prices by Region and by Province,* Available at: http://countrystat.psa.gov.ph/?cont=10&pageid=1&ma=L70PRWPC (accessed 3 March 2016).

Appendix L: Area of Jackfruit Planted

This appendix contains the data utilised to populate Figure 5.12 and Figure 5.13. It shows the area in hectares planted/harvested of jackfruit in the Philippines from 2008-2013 (Figure 5.15) and in Leyte from 2003-2008 (Figure 5.16).

Year	2008	2009	2010	2011	2012	2013
Hectares planted	14419	14401	14428	14378	14404	14526

Sourced from: Espino, R. R., C., and Espino, M. R. C., 2015. *The Status of the Fruit Industry in the Philippines*, College of Agriculture, University of the Philippines, Los Banos. Available at: http://www.fftc.agnet.org/library.php?func=view&style=type&id=20150810090507

Year	2003	2004	2005	2006	2007	2008
Tonnes	775	784	792	798	803	809

Sourced from: PCAARRD, 2009. *Jackfruit-Volume of Production* Available at: http://www.pcaarrd.dost.gov.ph/home/joomla/index.php?option=com_content&task=view&id=1601&Itemid=748 (accessed 10 April 2016).

Appendix M: Farmgate Prices for Jackfruit

This appendix contains the data utilised to populate Figure 5.14. It shows the farmgate prices of jackfruit from 2000-2015 for location in Philippine Pesos per kilogram.

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	Average
Philippines	8.04	9.69	8.18	8.50	13.42	11.14	10.71	11.65	12.36	12.48	13.49	12.89	11.96	12.47	13.57	13.83	11.52
Eastern Visayas	7.88	10.71	10.84	4.96	5.81	4.64	11,22	8.92	7.97	9.91	13.04						8.72
Leyte	10.67	12.09	10.84	4.96	5.56		11.22	8.92	7.97	9.91	13.04						9.52

Source: Philippines Statistics Authority, 2016e. *Fruit Vegetables: Farmgate Prices by Region and by Province*, Available at: http://countrystat.psa.gov.ph/?cont=10&pageid=1&ma=K00PRFPC (accessed 3 March 2016).

Appendix N: Wholesale Prices of Jackfruit

This appendix contains the data utilised to populate Figure 5.15. It shows the wholesale prices of jackfruit from 2000-2015 for location in Philippine Pesos per kilogram.

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	Average
Philippines	7.27	8.39	6.91	5.13	5.03	5.27	5.19	9.00	11.56	11.89			13.17	75.67	22.53	18.4	14.67

Source: Philippines Statistics Authority, 2016i. *Fruits: Wholesale Prices by Region and by Province,* Available at: http://countrystat.psa.gov.ph/?cont=10&pageid=1&ma=L60PRWPC (accessed 3 March 2016).