Mobile phones and the promises of connectivity: Interrogating the Role of Information, Communication Technologies (ICTs) in Marketisation

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I hereby declare that this thesis is the result of my own investigation, and where I have drawn on the work of others, due acknowledgement has been made. The text is no longer than 60,000 words.

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Abstract

This research investigates the role of ICTs (mobile phones) in economic development particularly in the Papua New Guinean coffee and fresh produce value chains. It aims to interrogate the promises and unwavering optimism attached to the 'ICT revolution' by examining the effects of ICTs on economic practices and the extent to which communication and network integration will be a driver of development.

Following the deregulation of the telecommunications sector in 2007, considerable attention has been paid to the digital transformation in Papua New Guinea and the Pacific Islands and the unprecedented growth of mobile phone and social media use. PNG's mobile phone penetration has increased exponentially from approximately 2% to over 48.6% in just over ten years (from 2005 to 2016 - World Bank 2017). Media commentators have noted with delight that there are now more Pacific Islanders with mobile phones than bank accounts and that in PNG alone, internet access from mobile phones is forecast to increase to about 50 per cent of the population in the near future (UNESCAP 2006, Beschorner 2008, SPC 2012).

Much expectancy and promise has already been attached to the future impacts of such increased connectivity as World Bank Economists postulate that a 10% improvement in Internet penetration leads to an increase in GDP of up to of 1.5%; while 10% increase in mobile penetration can translate into a 0.81% increase in growth (Qiang et al. 2009). These projections are mainly premised on the assumption that increased connectivity will facilitate better access to current information about market prices and reduce price dispersion; producing savings in time, transport and search costs. Furthermore, ICTs could directly link small scale producers to buyer's markets by weeding out 'rent seeking' brokers and middlemen in the value chain through a process referred to as 'disintermediation'. Using case studies from key regional economic sectors, this thesis interrogates if such claims are borne out on the ground and tests if information infrastructure is necessarily going to lead to more openness, equality and an all-encompassing 'digital provide' (Jensen 2007).

Contents

Abstract 3
Acknowledgements 5
List of Abbreviations 6
1 Information Communication Technologies (ICTs) in the Pacific Region: the promises of connectivity as a tool of development 7
1.1 State of the field: Dearth of Research into ICTs in Papua New Guinea and the region 11
1.2 Theoretical Framework 15
1.2.1 Development Informatics 18
1.2.2 Mobile Phone Coverage and Producer Markets 22
1.2.3 Market Structure, Trading Practices and Discontinuous Information 24
1.2.4 Digital Disintermediation 28
1.3 Conclusion 29
1.4 Chapter Overview 30
2 Methodology 32
Case Selection Rationale 35
Coffee: The Classic Buyer Driven Value Chain 35
Fresh Produce Trade 37
Village profiles: 38
3 'Relational Coffee' and the Mobile Phone 43
3. 1 Mediated Communication and Space 44
3. 2 Embeddedness of Economic Behaviour 57
4 Digital Disintermediation and the Social Role of the *Namelman* 68
4.1 Seeing Like a Smallholder Farmer 70
4.2 Impersonal information and the affective ties that bind 75
4.3 Middlebuyers and the Social Organisation of Trade 79
5 Information, arbitrage and efficiency: Mobiles and the circulation of price information 84
5.1 Arbitrage and Price Setting 86
5.2 Coffee, the Classic Buyer Driven Chain: The Price Setting Context 88
5.3 ICT based Development Interventions in the Coffee Sector: Information Delivery and Access 98
6 Information, Communication Technologies (ICTs) in the Fresh Produce trade: Imagined Affordances, mobile solutions and data for development? 106
6.1 The Formal and Informal Fresh Produce trade 109
6.3 MOMIS (Mobile Market Information Service) in the Fresh Produce Sector 115
6.4 Migration of Administrative databases online: Data for development, the future? 125
6.4.1 CASE STUDY: Mobile based reporting – Workflow and Organisational changes 127
6.5 Conclusion: From an 'ICT revolution in the digital islands' to a data revolution? 130
7 Conclusion 136
References 143

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List of Abbreviations

ACIAR	The Australian Centre for International Agricultural Research
ADB	Asian Development Bank
ATM	Automated Teller Machine
CEO	Chief Executive Officer
CIC	Coffee Industry Corporation (Papua New Guinea)
CSCM	Centre for Social and Creative Media (Papua New Guinea)
CUGs	Closed User Groups
DFAT	Department of Foreign Affairs and Trade (Australia)
EHP	Eastern Highlands Province, (Papua New Guinea)
Fairtrade ANZ	Fairtrade Australia and New Zealand
FCLC	Fiji Crop and Livestock Council
FOB	Freight on Board
FPDA	Fresh Produce Development Agency, (Papua New Guinea)
GDP	Gross Domestic Product
HOAC	Highlands Organic Agricultural Cooperative, (Papua New Guinea)
ICA	International Coffee Agreement
ICT	Information and Communication Technology
ICTD	Information and Communication Technology for Development
IFAD	International Fund for Agricultural Development
INGO	International Non-Governmental Organisation
MDGs	Millennium Development Goals
MIS	Market Information Systems
MNC	Multi National Corporation
MOMIS	Mobile Market Information Service
MoU	Memorandum of Understanding
NGO	Non-Governmental Organisation
NICTA	National Information and Communications Technology Authority, (Papua New Guinea)
NYSE	New York Stock Exchange
ODA	Official Development Assistance
PMV	Public motor vehicle
PNG	Papua New Guinea
PNGDF	Papua New Guinea National Defence Force
RML	Reuters Market Light
SDGs	Sustainable Development Goals
SMS	Short Message Service
TADEP	Transformative Agriculture and Enterprise Development Program
VEW	Village Extension Worker

1 Information Communication Technologies (ICTs) in the Pacific Region: the promises of connectivity as a tool of development

Villagers will soon be able to use mobile phones to access their bank accounts, and fishermen and farmers will be able to check market prices for their produce.
- Marcelo Minc,(former)Asian Development Bank country director for Papua New Guinea

Communication is a basic human right…
- Vanessa Slowey, (former) Digicel Pacific CEO (ADB 2012)

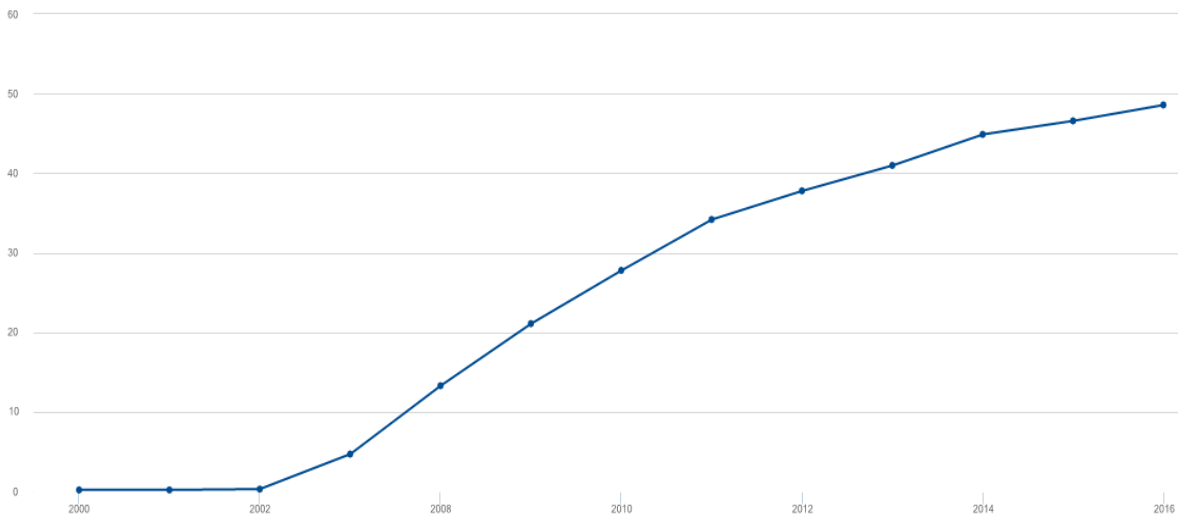


Figure 1: Mobile cellular subscriptions (per 100 people) – Papua New Guinea
Source: World Development Indicators – World Bank Data (2017)

Much ink has been spilled in heralding the onset of an economic and social phenomenon that has been dubbed the 'ICT revolution in the Digital islands' by the World Bank and other commentators (Beschorner, Kuek and Narimatsu 2015, World Bank /Perry 2013, McDonald 2012, Cave 2012). Several development actors and multilateral agencies are engaged in this space with substantive resources and Official Development Assistance funds being channelled into telecommunication modernisation projects and into infrastructure to improve rural communications, particularly in the last 5 to 10 years. $15 million was invested in the Rural Communications Project (2010 - 17) designed to improve access to telecommunications infrastructure and services in rural and remote areas of Papua New Guinea. This project set out to bring together donor agencies with Digicel (PNG) Limited and the National Information and Communications Technology Authority (NICTA) to establish a universal access and service (UAS) regime and install telecommunication points of contact in a mandate to boost total population coverage from about 20% in 2009 to around 93% by the end of 2014.

The World Bank's ICT Pacific Regional Connectivity Program focussed on using broadband internet to connect people in 'one of the most isolated places on earth' (World Bank 2012), committed US$17.20 million to fund the submarine fibre-optic cable from Tonga to Fiji through the International Development Association[1]. A further US$47.50 million was allocated for the Palau-FSM Connectivity project in December 2014 (total project cost is US$ 72.50 million). Given the fact that the entirety of the Australia Aid budget (largest regional donor) for the Pacific region in 2014-15 was AUD $199.5 million, the resource intensiveness of these large techno-scientific projects is very evident. Moving beyond new fibre-optic cable architectures, even a marginal improvement in existing telecommunications infrastructure in rugged Papua New Guinean rural terrain requires a huge commitment of resources (Suwamaru 2014) that could possibly have been invested in a variety of other competing economic and social development programmes. In fact, recent funding for the high speed underwater internet Coral Sea cables connecting Solomon Islands and Papua New Guinea was secured by channelling money from 2018-19 Official Development Assistance (ODA) allocations to the health, water and sanitation fund and away from other bilateral commitments in the region[2] (Hansard 2018).

Therefore, it is instructive to analyse the discourses surrounding these emerging technologies and drawing on the well-developed body of literature from Social Construction of Technology (SCOT) and Science and Technology Studies (STS) allows for useful points of entry into the range of expectations that attach to technology policy development. The importance of optimistic forecasting and discourses that creatively imagine future trajectories (Wilkie and Michael 2009) lies in the early stage of development of these projects; as the

> *expectations of a technology's success are constitutive in attracting necessary allies and building mutual agendas (Borup et al. 2006)*

The recent literature around the Pacific Regional Connectivity Program speaks to this incipient techno optimism (Perry 2013, World Bank 2013). From the Tongan fresh produce farmer talking about using smartphones for monitoring pests in the field to the Tapa producer

[1] In addition to this grant, a further US$16.8m was raised from the ADB, Pacific Regional Infrastructural Facility and Government.

[2] This much publicised telecommunications project touted to bridge digital divides and support the future digital economies of PNG and Solomon Islands was launched as part of Australia's effort to 'step up' intensified engagement with the Pacific region. Senate Estimates confirmed that $30 million was reallocated from the health, water and sanitation fund, $30 million from bilateral assistance to Indonesia, $6 million from Cambodia, $15 million from the innovation fund and $90 million from the increase in funding to the Pacific (when compared to 2017-18 outlays) to support this ambitious project.

describing about the potential of high speed internet to generate visibility and market her work to the world, various dimensions of the expectations around connectivity emerge.

> *Our accounts, records and sales will all be online, and we'll be able to have face-to-face conversations with international buyers. I can see our growers using smartphones to manage any pests in the field – photographing them, identifying them and then learning how to deal with them, quickly,*
>
> Farmer/owner of Nishi Trading, a family-run farming and export operation sending Tongan-grown produce, such as watermelons, squash and butternut pumpkins, to kitchens in Australia, New Zealand, Japan and Korea.

> *Calling on the phone to confirm orders is very expensive, but we really have no choice. If any of us try to use the internet at night, it is so slow, it is very hard to use it at all.*
>
> Tapa producer and operator of a women's collective that hand weaves tapa, a traditional fabric woven and worn by Tongans at home and abroad
> (From Perry 2013)

The International Trade Centre in collaboration with the Fiji Crop and Livestock Council (FCLC) with funding from the European Union introduced a range of mobile phone applications aimed at farmers, agri-food processors and exporters. A unique 'buy and sell' platform called 'Fiji Makete' was also commissioned to connect local farmers with wholesale buyers usually in the tourism and retail industries. Now, using a web interface, buyers could source local produce from a range of listings[3] from primary producers. Theoretically, using this centralised information system, farmer's planting and harvesting plans can be better tailored based on existing demand. SMS alerts with important industry messages targeted at audiences in defined locations, a market price tracking system as well as an agricultural tips messaging service that provides useful information on growing crops was made available to FCLC members.

As is evident from the quotation above, the excitement about ICTs derives from the expectation that they can allow co-presence in a singular 'global village' where there is accelerated time and space compression and the shackles of geography and distance have been thrown off. Some of this language is directly reflected in early ICT publications with authors like Cairncross (1997) predicting the 'death of distance' in the digital age where Euclidean distance is increasingly irrelevant and comparative economic advantage

[3] For say 1000 units of root crop or 200 units of leafy vegetables.

represented by agglomeration economies and industrial clusters in geographical proximity is transformed by digital processes that mark the 'end of geography' (O'Brien 1992, Tranos and Nijkamp 2013). Given the geographic and demographic challenges of the region where populations live dispersed across small remote islands at considerable distance from global economic centres, one can see how appealing the promise of connectivity, the dissemination scale and speed of the medium really is.

These analogies are pertinent now more than ever as an overarching, large global policy imperative for investment in ICT for Development projects exists. Since 2010, there has been a dedicated, high-level 'Broadband Commission for Sustainable Development' (established by the ITU in collaboration with UNESCO) that advocates for higher priority to be given to the development of ICTs and broadband services in the international policy agenda. With the ambitious target of 'connecting the other half', the mandate of the commission extends to showcasing the power and benefits of digital technologies as critical infrastructure to accelerate the delivery of sustainable development goals. Many other such coordinated initiatives exist. Recently a host of high profile celebrities like Bono and 'freedom technologists' (Postill 2014) from the Silicon Valley came together with Mark Zuckerberg and the Gates Foundation (representing significant commercial interests[4]) to sign the global 'Connectivity Declaration'. This campaign advocated for commitment to worldwide internet connectivity by 2020 in addition to the new global goals and the U.N.'s recently adopted 2030 Agenda for Sustainable Development. It was also a widely covered media event (coordinated on social media under the hashtag #ConnectTheWorld), which reflects how pervasive the agenda linking global development and global connectivity currently is (New York Times 2015, Chandy 2015).

The fact that the 2016 World Bank World Development Report focusses on 'Internet for Development' in the crucial agenda setting first year after the post-2015 sustainable

[4] Serious efforts aimed at reaching the bottom billion who live predominantly in remote communities without existing internet infrastructure have meant futuristic projects like Internet.org's unmanned, solar powered aircraft that can beam internet broadband down from the sky. Mark Zuckerberg announced at his keynote at the F8 2015 conference (annual developers conference) that it had survived its first test flight and plans are underway to use drones 'like these (to) help connect the whole world because they can affordably serve the 10% of the world's population that live in remote communities'. Google's Project Loon, designed to beam internet through specially equipped high altitude balloons, ran tests in New Zealand in 2013 and secured permission and partnership with Indonesia's three largest telecommunications providers to pilot the technology in the country in early 2016 (Wired 2015). Similarly, Elon Musk (the billionaire, entrepreneur and technologist responsible for Paypal, Tesla and Zip2) proposes to launch 4000 satellites to provide Internet, again targeted at the remotest populations where technology has not yet reached.

development milestone also signals its policy import and currency. As monitoring progress against goals is a crucial aspect of post 2015 development effort, there are calls to harness what is called the 'data revolution' - the availability of quantifiable, large, digital datasets that is an outcome of the dramatic increase in access to mobiles, internet and social media - to monitor development outcomes. A range of such initiatives[5] are currently being piloted. These include the use of information about shrinking mobile airtime top-off amounts to indicate economic distress and loss of income in a locality 'before that data shows up in official indicators' (World Bank 2014, Sundsoy et al., 2017), and the use of call detail records to track population movements to measure labour market shocks. An ambitious attempt to calculate GDP in real time by using light emission data (collected via remote sensing) is also underway.

1.1 State of the field: Dearth of Research into ICTs in Papua New Guinea and the region

Irrefutably, over the last few years, there has been an exponential growth rate in mobile phone access in PNG. There is preliminary evidence to show that liberalisation of the telecommunications markets in 2007 corresponded with a 0.7% increase in GDP[6] in the following year (Logan 2012). The subsequent impact of this increasing teledensity has been felt on the communications ecology of region. Yet, this empirical moment has not been documented and investigated with sufficient academic rigour despite early efforts (Watson 2011) to characterise the arrival of mobile telephony to PNG in terms of the rural 'communication drum' or '*garamut'* - the ceremonial wooden drum used to communicate between villages using a code of beats (Gourlay 1975, Leach 2002).

Interesting parallels can indeed be drawn between mobile phones and the role played by percussive instruments, such as the *garamut*, in communication. The crucial difference, however, in the affordances of the two devices, that Watson (2011:6) notes only in passing, is

[5] Other such projects that are based on big data include the use of 'night time illumination patterns captured by satellites to infer the spatial distribution of poverty; (ii) internet search keyword data to improve forecasts of price series; and (iii) twitter data to better understand public reactions to policy decisions'. Monitoring communication patterns reveals micro-violence in a locality evidenced in 'patterns of mobility and migration, similar to what you might see after a natural disaster'. Software to 'crawl the Internet daily and collect prices on products from thousands of online retailers' enables the calculation of 'daily inflation statistics which are used by academics to conduct economic research and public institutions to improve public policy decision-making and anticipate commodity shocks on vulnerable populations.' (World Bank 2014, Lehdonvirta 2011, Blumenstock & Donaldson 2013).

[6] The official GDP figures do not capture the fresh food trade or informal marketplaces.

the private nature or the peer to peer topology of mobile systems and their far greater geographic range that enables non proximate communications. Anderson (2013:319), in her study of how 'phone friend' stories fit into the gendered modalities of intimacy, notes that:

> *The mobile phone's capacity to facilitate intimate contact across geographical and social distance is perhaps particularly exciting in PNG, where a lack of roads, difficult terrain, and high transport costs hinder easy movement both within the 'mainland' of New Guinea and between the mainland and its many outlying islands*.

Although fascinating in its portrayal of how quickly[7] moral concern over transgressive female mobility has been encoded into cautionary tales like the fate of a woman who was 'phone friends with a snake', this study stops short of launching a considered exploration of the problems of mediation and the 'contraction of physical distance' (Anderson 2013:331). In order to understand the potentially wide-ranging effects of this shift in hierarchies of communication, scales of contact and inter/intra community connectivity and the subsequent recasting of spatial imaginaries, much further research is required. In contrast, the arrival of big data or the proliferation of traceable, large 'social' transactional data generated by digitalisation in post-industrial societies sparked wide debate (Savage and Burrows 2007, Burrows and Savage 2014), polemic statements about the 'coming crisis of Empirical Sociology' and an ongoing vibrant research programme (Adkins and Lury 2009, Latour et al. 2012, Marres 2012, Lupton and Schmied 2013, Marres and Weltevrede 2013). After much intellectual soul searching, digital transactional and social media data, and the implications for digitally mediated lives they represent, was recognised as a major empirical disruption to the object and methods of sociological enquiry.

Other work in the small body of research in this area in Papua New Guinea describes the domestication of 'mobails' by the semi urban Murik communities in Wewak (Lipset 2013) . David Lipset, reporting on his preliminary findings, asserts that rather than privileging 'modern forms of individuated identity and social organisation', mobile phones are being used firmly within the matrix of 'collectivist values'. He observes calls being made to remind affine to fulfil trade obligations, micro-coordination between kin and instances of lampooning where new communications technology is used to 'lend a new trope to hereditary joking relations'.

[7] Relatively affordable prepaid mobile phones entered the PNG market in 2007.

After noting that within Murik culture, the only place for 'subjective states' is within collective contexts like mourning or public oratory, he emphasises how conversations never begin with greetings that overtly privilege an autonomous self. Therefore, rather than asking 'are you ok?', chance meetings on the road begin with 'where are you going?'; placing and reaffirming identities within the locus of relationship to place. He does, however, note emerging changes in linguistic conventions with new technology 'eliciting elements of a modern subject' or a self-narrative with greetings such as the former being more common during 'mobail' conversations. The dualistic trope of a collectivist tradition populated by kinship obligations, interdependencies and place attachments versus an individuated modernity oriented towards 'ego-centric networks' and agency is not necessarily the most useful analytical framework. However, the changes in interpersonal expression and the new self-reflexive voice that Lipset uncovers in his study are of critical significance and worth exploring further.

> *…the entry of mobile telephones in Papua New Guinea (PNG) is making culture and person more dialogic – actors remain subjects of their own signifying discourse as well as objects of authorial discourse from afar...*
> *…the increased capacity to speak dyadically across time and space that mobile telephony in and of itself allows seems to be altering interpersonal expression.* (Lipset 2013:336)

Robert Foster (2015) postulates in an early presentation of his current research into the moral economy of mobile phones that mobiles are now taking the place of Coca Cola in Papua New Guinean consciousness. In a similar vein to his landmark study of 'Coca-Globalisation', where he maps and characterises the commodity circulation of Coca Cola to remote PNG contexts as a 'local version of a global modernity'; mobile phones are increasingly becoming ubiquitous. In the case of Coca Cola, he employs the concept of objective 'complex connectivity' (Tomlinson 1999, Foster 2008) to describe the movement of everyday objects of consumption, forging new linkages between disparate and geographically distant nodes. However, the linkages created by mobile devices, that in their very definition commodify connectivity and offer it as a product, stands under theorised.

Curry et al. (2016) ask if proclamations of an ICT driven revolution are comparable to the transformations unleashed by Green Revolution technologies. Based on preliminary research they suggest that in PNG there is a spatial and gender based digital divide between those with access to mobiles and the livelihood enhancement opportunities they represent and those

without. However, within policy narratives, mobile phones and communication technologies are unambiguously portrayed as having the potential to reconfigure regional connectivities and to usher in tremendous new opportunities for ICT-enabled economic development and job creation (for a detailed operationalisation of the idea in the Pacific context see Beschorner, Kuek and Narimatsu 2015). The potency and promise of the medium warrants further investigation and documentation. Therefore, the aim of this thesis is to unpack the promises of Information Communication Technologies (ICTs) as a tool for development and the ways in which it embeds into existing economic practices and flows of commodities. In order to empirically unpack and assess the development potential of mobile phones in PNG, I undertook a comprehensive literature review of the discussions about the transformations the coming of the mobile phone and a subsequent exponential growth in connectivity is supposed to bring. By foregrounding the economic impact (or the changes to livelihood activities) that the kind of contact facilitated by mobile systems where communications are now possible across vast distances, the following section crystallises the key propositions from the literature into four main themes and builds them into the core theoretical framework for this study.

Following an overview (section 1.2), section 1.2.1 elaborates on the dominant idea from *Development Informatics* that mobile phones lead to better information circulation and subsequently to better price arbitrage. This implies that with the mobile phone as a potent 'search technology', the farmer is able to find out the price of coffee or produce in a different place; and if it is greater than the price offered at a nearby market, this price difference can be exploited for profit. Section 1.2.2 qualifies the above claim by drawing on empirical studies in remote producer markets that show that as phone ownership is not evenly spread across the population, benefits from the use of phones tend to accrue unevenly. These contradictory findings underscore how trade practices and marketing decisions are often determined by factors other than price information signals – perishability, storage requirements of the crop, remoteness of markets and seasonality mean that it is not often possible to immediately move produce to more lucrative markets even when notified of the current market prices there. Section 1.2.3 draws on anthropological studies of price making in actual market settings[8] in order to contextualise the existing market relationships and practices into which mobile communications are expected to produce opportunities for arbitrage and a fundamental shift

[8] Much of the development informatics literature and rely heavily on econometric proofs and modeling based on assumptions about market behavior.

in market power for the smallholder farmer. This theme is revisited in Chapter 3 (section 3.2 – Embeddedness of Economic Behaviour) in order to draw out the social and physical realities of trade and '*bisnis'* in PNG and the well documented importance of exchange relationships. The main contribution of this thesis lies in the critical manner in which it intersects this long standing focus on the sociality of market relationships in PNG within traditions of economic anthropology with discussions about the informational advantages and better market price circulation generated by mobile phones in remote agricultural markets. Section 1.2.4 elaborates on the final proposition that mobile phones with its peer-to-peer topology can bypass middlemen and produce structural changes in what is called the 'disintermediation thesis'.

1.2 Theoretical Framework

Imagined affordances emerge between users' perceptions, attitudes, and expectations; between the materiality and functionality of technologies; and between the intentions and perceptions of designers.

- *Nagy and Neff in Imagined Affordance: Reconstructing a Keyword for Communication Theory (2015:1)*

There are several important strands of literature that have to be to engaged with in order to understand the transformative effects of rapidly changing communication technologies. A survey of published research, policy-oriented reports and case studies of the sudden entry of mobile phones in various developing contexts demonstrates the interpretative flexibility of mobiles in the manner in which their use is conceptualised by designers and practiced by users. Nagy and Neff (2015) call this 'imagined affordances' - the invariable gap between expectations for a technology and what the material configurations of the medium allow it to do. They posit that properties of technologies that are 'imagined' by users shape 'how they approach them' and 'what actions are available to them' (2015:5). Furthermore, people can shape their media environments and produce practices that are not 'encoded into such tools by design'. At the same time, communications devices mediate experience for users and there is an often-ignored *affective* element to the way users perceive and use technological artefacts. This largely accounts for the differences between the visions of 1st generation ICT for Development research and later critiques based on empirical evidence from disparate socio-cultural contexts. Rather than being interpreted as contradictory, the range of literature on the topic is best understood as reflecting this diversity of perceptions, attitudes, meanings, intentions and expectations that get attached to a communications platform.

The dominant theoretical approach that documents the role of mobile phones is that of *'Development Infomatics'* (Jensen 2007, Donner 2008, Donner and Escobari 2010, Heeks 2010). Authors like Robert Jensen argue that mobile phones and ICTs in remote settings provide access to market information that in turn leads to spatial arbitrage, reduction of price dispersion and thus better efficiency in producer markets. There are several detailed econometric proofs of this proposition. This body of research also contends that information can transform the market power of smallholder farmers and put them in a better position to bargain for better prices for their produce.

In contrast to the first generation of ICTD research, there is a small but growing cluster of critical research that questions what it views as the top down technocratic thrust of these projects. Burrell and Oreglia (2015) for instance, develop a critique from an STS and sociology of expertise perspective of the manner in which the one study of fishermen and phones in South India by Jensen has been covered by the Economist (2007), and adopted as definitive policy advice by the World Bank by stripping it of its interpretative context.

In order to test if mobile phones do indeed have a positive impact on economic development, it is necessary to understand the *sociality of market relationships* in PNG that frames the use of mobile phones in an economic setting. In this context, Papua New Guinea offers a particularly fecund empirical site as there is a large literature documenting the economic inventiveness of its people and 'their ideas about compensation, which rest on complex notions of ownership and the transactability of resources ' (Strathern 2005:1). Going back all the way to the research of Malinowski (1920), economic anthropology has generated and sustained a long standing intellectual project engaging with reciprocity and exchange in the Papua New Guinean context by mapping transactions along the binary of gifts and commodities (Gregory 1982). Contemporary work on oil palm and cocoa plantations by Curry and Koczberski (2012) demonstrate how economic exchange is embedded in kinship and other social institutions rather than in an atomised, rational utility maximising calculus. They show how extended family alliances used to be drawn upon during the harvesting season (a '*wok bung wantaim*[9]*'* production strategy rather than a commercially oriented or

[9] This phrase means collectively working together or a group working together. *Makim mun* which means 'to mark the month' refers to a more individuated production strategy where there is less inter-household cooperation and decisions about labour and distribution of proceeds are made not by the head of the block but by individual co-resident households using a rotating schedule.

'*makim mun'* strategy). Gibson's (1994) work further underscores this point by demonstrating how unprofitable rice growing business in PNG is less based on pure economic rationality than on the cultural politics of development that valorises import substitution and self-sufficiency. Recent research explores the demarcation of space and how turf is laid out socially within markets (Bainton and Macintyre 2013, Sharp 2013). Finney (1973) analysed the continuance of 'traditional' forms of social organisation into 'modern' market life. In a study of *Entrepreneurship and Economic Growth in the New Guinea Highlands* he argues that the dependence of enterprises on individual big-man leadership and the emphasis on investment for reasons of prestige are potential stumbling blocks.

However, recent work has dismantled this binary opposition between commodity exchange and gift exchange with one dealing with alienable goods and the other with inalienable goods (independent actors versus dependent actors). Miller[10] and Carrier (Carrier 1991, Miller 2002) demonstrate that monetised/market based and status based gift exchange systems can co-exist in the highly debated series of articles on virtualism, exchange and alienation. Furthermore, this notion that economic exchange in only 'non-market societies' is embedded in other social institutions has been debunked by mainstream economic sociology studies that show that this is the case much more widely. Even epitomes of rationalised, high finance such as stock markets and corporate take-overs are entangled in social networks (Granovetter 1995, Hardie and MacKenzie 2007), and based on reading social cues through complex, interdependent economic devices (Beunza and Stark 2012). Therefore, it becomes evident from these ethnographic representations that the structure of economic relationships frame the role of market information and the leveraging possibilities that mobile phones can potentially produce.

The final body of work that this literature review will draw upon is the critical geography work by the 'Connectivity, Inclusion, and Inequality Group' that adds a spatial dimension to these debates. Drawing on empirical evidence from the study of economic impacts of fibre optic broadband in East Africa, this research (Graham 2008, Graham and Mann 2013) uses Doreen Massey's notion of 'power-geometry' and Eric Sheppard's definition of 'positionality' to test if ICTs have the power to alter the positionality and accessibility of a place in the Global South. Sheppard (2002:308) uses 'positionality' to refer to the 'the shifting, asymmetric, and path-dependent ways in which the futures of places depend on their

[10] Miller demonstrates this using empirical data from a case study of the Jagmani system

interdependencies with other places'. In a novel attempt to discuss the manner in which ICTs interact with the constraints of distance and geography, Sheppard invokes the concept of 'wormholes'. Using internet based marketing, a wormhole opens up in a commodity chain when, say a Thai silk weaver bypasses traditional intermediaries and connects directly with a buyer in Boston (Graham 2008), thereby altering the relative positionality of the two nodes. In practice, however, the introduction of ICTs is rarely an inevitable, linear movement towards increased access and openness. This becomes evident while discussing the preliminary results from research into the efforts of the Kenya Tea Board to integrate their information systems and make current tea prices and the like publically available online. With the increasing importance of informationalisation (Carmody 2012, Unwin 2014), they ask if new players, information brokers or 'info-mediaries' might emerge at network hubs (Mann 2013) to limit access to critical market information that could flatten traditional power asymmetries.

The following four sub-sections explore the implications of these strands of literature in detail and examine the propositions of these research programs in turn.

1.2.1 Development Informatics

This body of research contends that information can transform the market power of smallholder farmers, providing them the tools to compare and evaluate various outlets for their produce and with leverage to bargain with middlemen in a way that leads to overall welfare transfers.

In a landmark study that has come to define research in this area, Jensen uses micro-level survey data from Kerala to delineate the mechanisms by which improvements in information impacts market performance and producer and consumer welfare. He posits that in a well-functioning market economy, 'when goods are more highly valued on the margin in one market than another, a price differential arises and induces profit-seeking suppliers or traders to reallocate goods' towards that market. Since within neo-classical economics the price mechanism is assumed to transparently reflect scarcity and coordinate impersonal market exchange, this movement of goods reduces the price differential between the competing markets and thus increases welfare effects for those involved in both. In reality, however, only costly and imperfect information is available to market actors, and therefore a search

technology like mobile phones can, according to Jensen's proofs, add up to US$5.11[11] in increased profits per day for users. Calculating the cost of a handset at US$138.89 and the monthly costs of use at US$13.89, the investment costs of buying a phone would thus be recovered in less than two months. Revenue gains by fishermen without phones averaged US$2.41 per day as improvements in market efficiency led to less wastage of caught fish.

The significance of these findings are compounded by the fact that apart from being a staple of the local diet, providing protein and other important nutrients, over 1 million people in the state are directly employed in the fisheries sector (Government of Kerala 2005). Jensen identifies a significant obstacle in this crucial yet time sensitive livelihood activity, in that, fishermen when at sea are ordinarily unable to observe prices at the markets dispersed along the coast and end up selling their catch at their local market. This meant a loss of profit of as much as US$94.44 during some days in the observation period. Using sardine price data from 15 coastal markets over 5 years, Jensen observed a great deal of price dispersion with some markets recording an effective price of zero (when fishermen come in with a catch and are unable to sell them because all the wholesale/retail buyers have left) to US$0.28 per kg on the same day. He highlights one case where, had the average boat carrying 381 Kg of sardines docked at a market within 15 km of the market it chose to go to, the fisherman could have gained US$99.08 more than he did that day (assuming US$5.69 as fuel cost). Since the 'law of one price' states that 'price of a good should not differ between any two markets by more than the transport cost between them', these instances of price variation demonstrate an undeniable market inefficiency and the suboptimal 'allocation of goods'.

Since the introduction of mobile phones, however, Jensen found a dramatic reduction[12] in price dispersion leading him to assume that the shift provided clear evidence for a 'natural experiment of improved market information' (Jensen 2007:880). After accounting for alternate exogenous factors that could explain this shift, he notes a significant growth in profit even for non-phone owning fishermen and makes a case for how stable prices can lead to welfare transfers to consumers. He calls this the 'digital provide', thus refuting the 'digital divide' thesis that had come to dominate research on ICTs in development until them. The

[11] These calculations use the exchange rate 1 USD = 36 INR which are the values in Jensen's 2007 article. Changes in these rates mean that now the net profit figures would be lower as would the cost of the mobile handset in terms of USD.

[12] 'Mean coefficient of variation of price across markets (the standard deviation divided by the mean) declined from 60–70 to 15 percent or less' (Jensen 2007:883).

digital divide refers to the notion that in developing countries, digital devices pose an added risk of exacerbating the dividing lines of exclusion based on access, when they can only be afforded by the wealthy and educated. Jensen, however, posits that mobile phones vastly improve market performance and provide perfect conditions for a virtual auction with a large number of respondents in his sample reporting that they carried with them lists with 'numbers of dozens or even hundreds of potential buyers' (Jensen 2007:891). They 'would typically call several buyers in different markets before deciding where to sell their catch... and committing to a price while at sea' (Jensen 2007:892).

The coordinating effects of mobile phones prevent wastage of fish when the price is zero and also impacts market signals and pricing behaviour. For instance, 'insurance pricing', where risk averse fishermen accept lower than value prices can be effectively avoided. Mobiles minimise risk and uncertainty so as to put an end to practices like buyers paying a premium to ensure supply, especially when the first arriving fishermen misrepresent sea conditions and the potential for a good catch that day.

In addition to coordination work, Jensen's characterisation of mobile phones as a viable search technology has been supported by subsequent research. Aker and Mbiti (2010) researching mobile phones in Niger finds that their introduction reduces price dispersion in grain markets by 10%. The effect is higher for market pairs that are further apart and linked by poor roads. Similar to results from fieldwork among coffee smallholder[13] farmers in PNG, a majority of these market agents in grain markets in Niger traditionally preferred personal travel to weekly markets for obtaining price information (Aker 2008).

The second key proposition of this body of work is the disintermediation thesis. This concept has gained wide currency among authors like Jenny Aker and Marcel Fafchamps and with economists working across the World Bank's Agriculture and Rural Development (ARD) sector. Given that producers in remote, rural contexts rarely sell directly to consumers, historically a sophisticated network of intermediaries have positioned themselves between the farm gate and the final marketplace. These include traders, wholesalers, retailers and others depending on the degree of vertical disintegration of the value chain, specialisation and differentiation of skills but most importantly, historical relationships organised around spatial

[13] PNG's Coffee Industry Corporation defines smallholders as those with holdings of less than 5 hectares.

and social power. The information asymmetry between farmers who are cut off from marketplaces and these intermediaries who are up-to-date with local prices, stands open to exploitation. Within this context, Market Information Systems (MIS) that inform local farmers of the current prices using SMSs could theoretically

> *1) Intensify competition between collectors;*
> *2) Generate better spatial arbitrage (some farmers could for instance sell at markets further away); and*
> *3) Increase farmers' bargaining power* (Galtier et al. 2014:238)

Within the PNG context, early economic geography work flagged an important distinction from market places in Africa, on which the majority of the above literature is based, in that Pacific marketplaces are dominated by 'producer-sellers' (Brookfield 1969, Epstein 1982). Professional full-time traders were thought to play only a few limited roles in the Melanesian market place until recently. Scholars like Benediktsson (2002) studying the fresh food trade and Sharp (2012) researching the betel nut trade have documented a fairly well differentiated commodity chain with traders and several levels of 'middlemen' playing a growing role. In fact, Benediktsson (2002:29) draws on the concept of 'trader's dilemma' postulated by the 'Bielefeld' group[14] of development sociologists (Evers and Schrader 1994, Schiel 1994) to suggest that a distinctive minority of 'outsiders' – Australians and other 'ethnic outsiders' - rose to fill the role of traders in the Papua New Guinean fresh food trade. The trader's dilemma refers to the tension in a 'peasant society, stemming from a trader's need for capital accumulation and sociocultural demands for redistribution' (Benediktsson 2002:29). The need for disentangled outsider groups who are not completely immersed in local kin networks (who place demands on producer's earnings) in part explains the much documented ambiguity in Melanesian engagement with cash earning opportunities. Furthermore, cash based transactions in turn are embedded within larger livelihood activities and a culture of 'flexible engagement in cash earning' (Sharp 2015:1) as has been highlighted by recent research (Allen et al. 2009, Barclay and Kinch 2015).

A distinct class of 'middlebuyers' set up on various contracts (based on volume delivered, credit contracts, and quality contingent contracts) by exporters exists in the PNG coffee industry. In the Eastern Highlands Province they are indeed seen and identified as '*namelman'* particularly by conscientised small holder cooperative groups who aim to

[14] These researchers draw mainly on empirical evidence from work in South and South East Asia.

dismantle this structure. The middlebuyer's use of mobile phones and communication technology as a resource in relation to the small holder farmer's has not been studied before. Furthermore, the significance of Australian exporters in the coffee trade (both historically and now), attests to, at least, the partial applicability of the trader's dilemma theory in the PNG context. The manner in which exporters located in urban Goroka, equipped with better mobile phone coverage networks and well-resourced[15] ICT links to global commodity price hubs, integrate into the local communications ecology forms an interesting and topical case study.

Thus, development informatics underscores the role of information in efficient and rational market performance. It also formulates a range of testable hypotheses about the transformational potential of mobile phones and I have made an explorative attempt to glean the applicability of these in a Papua New Guinean context in the above sub-section. Several follow up studies, conducted at diverse empirical sites, have examined the veracity of these claims.

1.2.2 Mobile Phone Coverage and Producer Markets

Follow up research on the potential of mobile phones to generate an overall 'digital provide' rather than a 'digital divide' has come up with ostensibly contradictory findings.

The thrust of most economics literature on the role of information in the efficient functioning of markets revolves around consumer markets (Stigler 1961, Reinganum 1979, Stahl 1989, Brown and Goolsbee 2002). Aker and Fafchamps (2014), however, explore the role of ICTs in reducing the cost of information in producer markets by using market-level panel data on millet, sorghum and cowpea in Niger. From 2001 to 2008, mobile telephony was introduced in Niger in a staggered manner and by the end of this study, 44% of the nation's population had mobile phone subscriptions. Latest figures from the International Telecommunication Union and the World Bank database put current PNG mobile penetration rates at a comparable 42% (in contrast to 2% tele-density in 2005 and 4% countrywide and 0% tele-density in the majority of rural areas that accommodate 80% of the country's population in 2007 - World Bank 2007). Nonetheless, phone ownership was not evenly spread across the

[15] These Goroka exporters are well resourced as most of them are subsidiaries of multinational coffee giants as documented in the methods section.

study population – in 2008 30% of traders had access to a mobile phone in contrast to 5% of farm households at the same time.

Aker and Fafchamps (2014) found that the potency of information technology to reduce price dispersion varies by the perishability and storage requirements of the crop, remoteness of markets and seasonality (i.e. outside of main market times when information is at a premium). In combination with results from Tack and Aker (2014), they find that mobile phone 'coverage increased traders search behaviour with most of the reductions in search costs accrued to traders' (Aker and Fafchamps 2014:3) or the middle man (who is often demonised as rent seeking and exploitative in this literature) during this time. Furthermore, while farmers were more likely to use phones as a search tool, phone ownership and the reduction in price dispersion of cowpea did not lead to higher sales prices for the producers.

Another study that qualifies claims about the impact of information signals on market performance and an empowerment outcome for the smallholder farmer is Kumar's (2014) review of a New York Times 2008 article on the successes of MIS text messaging service in rural India. The article claimed that in response to Reuters Market Light (RML – SMS based agricultural information service), one farmer held back the sale of 30 quintals of soybeans for 15 days after noting that prices had been rising in the previous days leading to a profit of US $ 6.02 per quintal. Kumar finds that the additional income was not the result of a considered decision to wait for prices to rise but due to changes in the larger historical and economic context.

Fafchamps and Minten (2012:412), in their study, report that the farmers in their sample do tend to associate RML with a number of key decisions they had made but the magnitude of these effects were small and there was 'no statistically significant average effect on the price received by farmers, crop value-added, crop losses resulting from rainstorms, or the likelihood of changing crop varieties and cultivation practices'. They also flag the potential for negative effects of a market information system which could encourage collusive practices and the service can potentially be used to check if others are complying with the price and agreements to fix prices.

1.2.3 Market Structure, Trading Practices and Discontinuous Information

Classic Economic Anthropological ethnographies of price making in actual market settings show that the 'intensity of bargaining is less a function of the scale of the transaction or the opportunity cost of time, than of the point in the information network where the transaction takes place' (Geertz et al. 1979, Alexander 1986). Jennifer Alexander (1986:108) studying the red chilli trade in Java notes that:

> *While many other traders have accurate information on prices in their particular sector of the market, only the depot operators have sufficient information from both supply and distribution networks to reconstruct the price system as a whole.*

Within the red chilli trade, small scale traders who are tied to a locality from where they buy produce, supply it to the depot after which clients buy and transport these chillies to large economic centres. She documents the strategic position of the depot as an intermediary in the flow of commodities where even when regular chilli deliveries are made to the depot through bicycle carriers, the exchange of money is relatively secretive and payment is never entrusted to the bicycle carrier. Various traders have accurate price information about their own sector but do not have the vantage point of the depot to reconstruct the price system as a whole in this account of the much studied Javanese peasant marketing systems (Anderson 1980, Chandler 1981).

This clearly indicates how prices are almost never set by a mere coming together of supply and demand but are 'made, produced, and challenged by a variety of actors in the market process' Caliskan (2007a:242). Therefore the utility of Market information systems in these contexts is not straightforward. Caliskan researching cotton prices in Turkey shows that agricultural commodity prices in 'urban and rural contexts produce various price forms, each prefigured by the specific power relations among market agents' (Caliskan and Adaman 2010:10) . It is hard to imagine that price negotiation processes would not be similar in PNG given the sociality of market relationships in Melanesia.

Jenna Burrell and colleagues launch a nuanced critique of the economistic logic of ICTD by demonstrating how, as it lies at the intersection of developmentalist and computer science expertise, it is prone to several blind spots as an epistemic culture (Knorr-Cetina 2009). Burrell unpacks the manner in which the study of price arbitrage among fishermen by Jensen (2007) gained popular currency after being covered by the *Economist (2007)* and converted

into policy advice. Using the performativity of economic models framework, she shows how that one study through repetition, lots of slippages and vague generality gained legitimacy in a way that impacts future Market Information System (MIS) and database design choices and development policy interventions.

After proposing that mobile phones are a 'social item' rather than just an information delivery platform (Wyche and Steinfield 2015), these researchers refute the 'notion that information critical to decision making is scarce and actively sought after by farmers/fishermen/small traders in rural settings' (Burrell and Oreglia 2015). The source of the information is often almost as important as its content itself. Burrell and Oreglia demonstrate how several farmers in their rural Chinese sample interactionally asserted the veracity of price information through oral conversations thereby underscoring the importance of relational context. Much of their information gathering practices were not based on written text but on oral exchanges and prices were embedded within relationships between people. For example, they quote farmers who valued the expertise of official extension officers who could put price information in context and as he was known personally to them would bring news about new government schemes (like the distribution of free fishing nets) that could be of benefit. Referring to findings from their Ugandan field site, they note that 'there was no word in Luganda that directly translates to 'information' so the word for "news" was used as the best substitute' (2015:279).

They also dismantle the 'myth' perpetuated through much of ICTD literature that market price drives key marketing decisions. Long term relationships with trade partners, gender and even attitudes to risk structure economic exchange and the possibility of price negotiation. Drawing on agricultural experiences in Uganda and China, they underscore the role of trust especially in weak institutional contexts where enforcement structures for contracts do not exist. Using MIS price information and phone calls to ascertain prices might boost market efficacy but they do not constitute firm commitments to a particular price and such atomised information disembedded from a network of trade relationships and relational contexts do not serve the same purpose. They quote from an instance where low level fishermen working on salaries and with credit dependencies on middlemen might be thought to be 'working behind the bosses' back' if they were to check price information in alternate markets. Women and older farmers might prefer income predictability and may not have the risk appetite to venture into unknown markets for a better price.

Furthermore, it has been suggested that Melanesian attitudes to cash earning activities are embedded within larger livelihood strategies (Sharp 2015). Therefore the price maximisation impulse of a farmer sorting through potential markets with up to date price information acquired in real time needs to be conceptualised within the context of villagers moving in and out of cash cropping in response to fluctuating commodity prices and household cash requirements (for instance, Curry et al 2007 describe the use of cash crops as a recurrent 'ATM'). During fieldwork, several respondents spoke about keeping bags of coffee in their houses and then selling partial bags when they needed to meet household expenses. One smallholder farmer remarked in response to a question about savings that he doesn't bother saving because his bank was nearby - meaning his coffee garden.

Finally, they point out that the most important affordance of mobile phones in the context of rural trade activities might not be the provisioning of market prices. The assumption in Development Infomatics that 'improvements in market functioning that follow from the arrival of phones necessarily stem from the acquisition of market price information (and not other kinds of information)' might be a completely spurious one (Burrell and Savage 2015:278). Mobile phones perform important coordination work and are used to increase flexibility and for 'micro-coordination'/iterative coordination (Ling 2004) and 'Phatic' Communication in a new communicative ecology (Miller 2008). Burrell (2014) in her study of 'material modernities' and the uptake of mobile telephony among Ghanaian market women, describes an instructive case where a female vendor uses the mobile phone to do relational work and maintain long distance ties with her supplier. Through a call that is interspersed with instructions about acquiring cocoyam and plantain, she coaxes and counsels her supplier to package it better and asks after their kin. Similar to Malinowski's (1923) use of the term 'phatic exchange' in 'describing a communicative gesture that does not inform or exchange any meaningful information or facts about the world', these sort of verbal engagements serve 'a social purpose, to express sociability and maintain connections or bonds' (Velghe 2012:2).

While the use of mobiles to maintain individuals' social networks has been confirmed by several studies (Molony 2006, Murphy and Priebe 2011, Porter 2012). Horst and Miller (2005, 2006) describe the monetisation of these relationships in their research into mobile phone use among Jamaican youth through the introduction of the concept of 'link ups'. One

canonical understanding (Rainie et al. 2012) of the unprecedented spread of new communication technology is that it is predicated on individual networking in how it allows individuals to establish extensive networks. Rainie and Wellman in a highly influential study, refer to this as the rise of a new social operating system of 'networked individualism' which 'liberates us from the restrictions of tightly knit groups; it also requires us to develop networking skills and strategies, work on maintaining ties, and balance multiple overlapping networks'. Horst and Miller (2005, 2006) weigh in on these debates around social capital and the rise of individualisation by describing the way in which low income Jamaicans engage technology for networking.

> *What the poorest individuals really lack is not so much food, but these critical social networks.* ***The cell phone, and its ability to record and recall up to 400 numbers****, is therefore the ideal tool for a Jamaican trying to create the ever-changing social networks that Jamaicans feel are ultimately more reliable than a company, employer or even a parent or spouse alone.* ***This feature, perhaps more than any other, represents the critical economic impact of the cell phone in Jamaica*** *(Horst and Miller 2006: 111) [emphasis mine]*

Using a reference to Munn's (1976) work on Melanesian Kula ring, they add:

> *It is the expansion of the name of the person in Jamaica that seems parallel with the expansion of the 'fame' of the island in Kula networking.* ***Sending out ones name to be retained in the address books of perhaps hundreds of other individuals, the result is a kind of demonstrable expansion of self, distributed and confirmed by one's presence in the lives of others****. [emphasis mine]*

While Horst and Miller argue that within Jamaica, ego centred networking is traditional rather than a novel consequence of new technology, the manner in which this translates to sociality within the Melanesian context of relational dividuality provides a fertile site for further investigation. They document instances of low income Jamaicans using cell phones for day to day survival strategies like looking through their address book and calling up those they think could help with money for school, uniform and capital expenditures. They do not articulate the importance of connections in terms of social capital as Wellman does, but they are aware of the way friendship, kinship and other ties are used as a coping strategy[16].

[16] Horst and Miller qualify this by saying that in Jamaica one finds an unusual degree of individualism expressed in monetary terms – which is very different to notions of reciprocity and value in Kula – but it is matched by extensive networking devoted to the practices and process of enlarging and maintaining link up. This concept is very different from sociological debate on individualisation and social capital and is worth exploring further.

1.2.4 Digital Disintermediation

The enduring potency of the concept of digital disintermediation, whereby marginalised populations can self-organise with digital tools and bypass 'rent seeking middlemen' is premised on an ideal typical notion of peer to peer participation. There is an expectation that putting digital tools in the hands of people automatically produces transformative effects. This is quite similar to early expectations attached to participative, decentralised features of Web 2.0 that led to predictions that social media now constitutes the 'Fifth Estate' (Dutton 2009) holding traditional governance structures to account. There is a pervasive techno-optimism that surrounds networked systems whereby non-hierarchical communications and other positive outcomes are expected to happen routinely as a result of better telecom network coverage and information infrastructure (Foster and Graham 2015).

Paige West (2010, 2012) notes that the idea of an exploitative 'rent seeking middleman' is an exaggeration that plays into the marketing strategies of niche, specialty coffee companies in what she terms 'eco-neoliberalism'. She quotes from the online blog (aimed at Western audiences) of an employee of such an 'ethical' coffee vendor who reproduces ahistorical fantasies of Papua New Guinea's coffee industry as economically primitive, remote, biodiverse and 'scarce' - therefore worth paying an extra premium for:

> *Historically, they would sell their beans to a number of middlemen who wait by the only road, giving the farmers pennies for their labour. But we are here to change that. We are here to work with several farmer associations to create legally recognized cooperatives, and to create more direct trade relationships that should increase the farmer's income fourfold, as well as increase sales…*
>
> *…There are no roads connecting the capital, Port Moresby, with the rest of this island, which is the size of New England. We have to fly to the interior, and I am glued to the window of the small plane, knowing that below me are anacondas and pythons, tree kangaroos and Birds of Paradise, wild rivers and still uncontacted tribes.* West (2010:702)

Such claims about middlemen are a blatant exaggeration (that fits in with the descriptions of anacondas and uncontacted tribes) that distort the social value of their roles.

Furthermore, the growing number of cooperatives in the coffee industry work to subvert opportunistic 'brokers out to cheat smallholder farmers'. Sambasivan et al. (2010) describe how cooperative members would call brokers and then share information with the group on a

weekly basis thereby undercutting the informational advantage of the broker or middle buyer. They call this 'intermediated interaction' (Sambasivan, Cutrell, Toyama and Nardi 2010). Thus, oversights such as misrecognising the social embeddedness of middlemen and the existence of alternative coffee procurement systems throws into question the certainty of the digital disintermediation argument and begs for research with more nuance and contextual depth.

1.3 Conclusion

Much of development informatics and contemporary development initiatives aimed at 'making markets' or rationalising rural producer markets (often informal) proceed on the assumption that markets are the best mechanisms for allocating resources. The core aim of coordinating exchange is thought to be to match production with consumption desires. This thesis will interrogate the place of ICTs in these emerging efforts to make calculable, rational and efficient markets (a process Caliskan and Callon call 'marketisation' - 2009, 2010, 2015). A grounded theory approach will be employed to document emerging ways in which ICTs and mobile phones in particular are used within economic activities. I will explore if claims about digital disintermediation bear out on the ground and study the role of information on price formation.

In doing so, I will make original contributions to current discussions on how technology use is mediated by sociality, provide critical baseline information during a key phase in the diffusion of ICTs in the region and broaden discussions of global digital cultures. Studying the role of price information in producer markets – in key subsistence and cash crop value chains will help map how growers, producers-sellers, middlemen and traders participate in Oceanic capitalisms. This is particularly relevant as McCormack and Barclay (2013) in a recent agenda setting book have postulated that the theoretical dichotomization of societies into capitalist and non-capitalist (with 'capitalism' dominating in one and moral economies, gift exchanges and subsistence affluence in the other) is unhelpful.

This thesis presents results from the first detailed study of the role of ICTs in livelihood activities in PNG. While policy documents and media reports have talked in general terms about the economic impact of the growing mobile uptake, it investigates the embedding of mobile devices in economic practices and within organisations using detailed ethnographic

data. It considers the much idealised Market Information Systems (MIS) within the context of the political economy of telecommunication providers who as private entities seeking commercial capture, form uneasy coalitions with development partners. The interpretative impulse of current work on mobiles in the region (Anderson 2013 and Lipset 2013) has been to stay clear of market transactions and trace the role of mobile phones solely within the 'social' which is much documented and disproportionately emphasised in the Melanesian case. Lipset draws attention to kinship institutions and Anderson looks at the transformative effects on intimate communications. I will deviate from this approach in order to draw out the manner in which communication practices are emerging within intersecting social and economic domains that clearly co-produce each other.

1.4 Chapter Overview

In Chapter 2 which follows, I set out the methodological approach of this research and the case selection rationale for focusing on the coffee and fresh produce value chain as these represent the two most important livelihood activities in the Eastern Highlands Province in Papua New Guinea.

Given how recent the growth of mobile phone use in the region is, chapter 3 provides a broad introduction to the observed changes following its entry. Before exploring whether there is enough evidentiary support for the disruptive transformations predicted by the coming of mobile phones, chapter 3 sets out to answer whether their coming has produced any change at all. Along with the development of unique text codes in the PNG Highlands that activate local relational obligations and exchange norms, the communicative possibilities of the phone are most significant in the manner in which it softens geographic frictions and bridges the barriers of distance. The mobile phone makes voice communications portable and generates new mobilities that are particularly significant in the movement of produce to market given the stark distances, difficult terrain and poor transport options available. This is particularly significant as the sourcing of coffee from dispersed, remote sites and the movement of fresh produce is a formidable logistical undertaking. This chapter introduces and builds on theoretical literature that establishes that economic practices are socially embedded in order to develop a conceptual scaffolding for the following empirical chapters. This discussion (section 3.2) is important in understanding the practices and indigenous logics that structure

economic behaviour before investigating if better price information signals and connectivity can produce structural transformations in these markets.

Using data from the coffee trade, chapter 4 interrogates the disintermediation thesis and chapter 5 addresses the claims about ICTs and mobile phones producing better price arbitrage and information circulation. Chapter 6 relates findings from the fresh produce value chain to the questions set out in the theoretical framework about the livelihood enhancement opportunities created by ICTs in four parts. This chapter focuses on mobile use within informal food markets and then on the commercial long distance trade activity. It provides details on an ICT based intervention called MOMIS (Mobile Market Information Service) developed by the Fresh Produce Development Agency and concludes by exploring a case study where mobile apps were in the process of being introduced to replace paper-based reporting systems for extension officers and contact farmers. This thesis ends by providing evidence that foregrounds the political and commercial interests entangled in technology solutions and the challenges of working with mobile operators. It also draws attention to the terms under which, Digicel as a foreign owned, dominant telecommunications provider, does business in PNG and provides the setting in which such ICTD projects unfold. Chapter 7 concludes the thesis by returning to the central arguments and relating the findings from the empirical chapters to the questions about arbitrage, disintermediation and the other transformative claims set out in the theoretical framework in Chapter 1.

2 Methodology

In order to develop a situated understanding of the use of mobile phones within livelihood activities, a mix of semi structured interviews and participant observation was used. Traditions of research that fall within a media ethnography approach focus on the materiality of the technology and everyday communication practices (Tacchi et al. 2003, Horst et al. 2012). However, in this case, in order to shed light on the socio-economic context within which mobile use is entangled, a key aim was to first map the producer to buyer value chains in the coffee and fresh produce trade, focussing geographically on the Eastern Highlands Province in PNG. Therefore, in addition to investigating the localised complexities of mobile phone adoption and use, I undertook to trace the role of intermediaries, traders, local exporters (and roasters and distributors more broadly) in order to construct as complete a picture as possible of the economic parameters into which information technology embeds itself. I then asked respondents what they mainly use their phones for and sought to ascertain if they use it to find out about current prices. Questions about marketing practices included whether they would hold off on selling coffee on the expectation that local prices will go up, whether they have approached a buyer they didn't usually trade with over the phone and whether they trusted that they will pay the quoted price. I pursued a similar line of enquiry with fresh produce growers. This was supplemented by questions to staff of the semi-autonomous government entity, Fresh Produce Development Agency (FPDA) about an ICT based intervention called MOMIS (Mobile Market Information Service) and a related project where mobile apps were in the process of being introduced to replace paper-based reporting systems for extension officers and contact farmers.

This required a multi-sited ethnography (Marcus 1995) as opposed to an immersed single site engagement, the advantages of which are obvious and necessary given the nature of the research problem. Several scholars working within the global value chain (Dolan et al. 2004, Gereffi et al. 2005), global commodity chain (Gereffi et al. 1994), and global production network (Henderson et al. 2002, Dicken et al. 2003, Coe et al. 2004) frameworks have adopted such an approach. Anthropologists who trace the social life of commodities and some economic geography researchers (Cook 2004) likewise map the movement of objects and the linkages they produce between places at various local, regional and global scales.

In order to observe varied market structures, I focussed on two case studies - coffee as cash crop with a longer, formal and more organised value chain and the fresh produce trade which has a large subsistence component with food being grown for household consumption, as well as a growing commercial sector. Research data was collected at various points on these value chains so as to capture information on how price variability impacted on the scope for renegotiation and the role that mobile phones played in the process. Key informant interviews were also held with local telecom policy experts and NGOs supporting these industries.

Taking advantage of the fact that I was part of a larger, concurrent DFAT funded research project on women's economic empowerment among smallholder coffee farmers in the same sites in the Eastern Highlands Province, I was able to draw from the project's quantitative data on market structure[17]. This included data from a representative sample of 143 households on the proportion of the population that sold parchment as opposed to green bean or cherry, and the outlets for the sale of this coffee – to a village buyer, cooperative, roadside buyer, factory or exporter (Tables 1 to 3). The research was undertaken in three districts: Goroka District, Unggai-Bena District, and Okapa District (two sites). The sites in Goroka and Unggai-Bena were not further than 10 kms from Goroka, the provincial capital town and the sites in Okapa were more remote, difficult to access and purposively chosen to test for the impact of distance to market on price. This work also collected qualitative interviews with women and men (total 64) in the coffee household, and key informant interviews (total 35) and this first period of fieldwork was completed in August 2015 towards the end of that year's coffee season. Despite the project being mainly focussed on women's economic empowerment, a module of the interview schedule included preliminary questions about mobile use. Therefore, with access to the data from this project, I was able to ascertain background information necessary for streamlining research questions and deciding on the way to operationalise them.

I adopted a staged research strategy – after analysing the mobile and ICT based responses from the first part of fieldwork, I returned to the field sites to conduct interviews that

[17] The research, led by Richard Eves, was undertaken as part of the larger research project, *Do No Harm: Understanding the Relationship Between Women's Economic Empowerment and Violence Against Women in Melanesia,* a collaboration between DPA (Department of Pacific Affairs) and IWDA (International Women's Development Agency) that involved working with CARE International's Coffee Industry Support Project (CISP). The research was funded by the Department of Foreign Affairs and Trade's Pacific Women Shaping Pacific Development (*Pacific Women*).

investigated mobile use in livelihood activities at depth by building on the access, familiarity with various communities and knowledge of local market routes/trading practices cultivated through the previous engagement. I returned to Goroka in November 2016 and stayed till June 2017 and a further 19 (coffee) and 10 (fresh produce) recorded semi structured interviews were conducted in addition to informal conversations, observations and discussions with cooperatives, farming groups and at development practitioner conferences. These methods generated a large corpus of material for analysis including notes from face to face interviews, from open ended conversations and observations at the fresh produce markets/coffee road side markets and a daily field log. This was in addition to the large collection of audio recorded interviews from the previous women's economic empowerment research which included detailed information on the community context from the 35 key informant interviews and fine grained qualitative and quantitative data at the household level about economic assets, division of labour during the coffee season, market access, size of coffee gardens, decisions about income from coffee sale and financial resources. I gathered local newspaper stories during the fieldwork period that referenced mobile phone usage. I also surveyed policy documents where donor agencies reviewed the benefits of mobile and ICT use in the Pacific context in order to understand the justificatory discourses for ICTD interventions and map the expectations and narratives around what problems would be solved by accelerated connectivity – the analysis from this document review is presented in the introduction (Chapter 1) and sections 5.3, 6.3 and 6.4.

Snowball sampling technique was used to get further contacts and leaders of coffee cooperatives proved particularly helpful in facilitating introductions. Participating coffee growing villages are profiled and described in detail at the end of this chapter. Moving towards the upsteam end of the value chain, since middlebuyers are semi-autonomous individuals, the initial plan was to make contact through extension officers who had contacts in the Goroka roadside market. After securing a list of Goroka based middlebuyers from an NGO that supports the coffee industry, I discovered that one of the occupants in an adjoining apartment in the accommodation compound I was living in was a former coffee buyer and taster who still had links to the coffee industry. I was thus introduced to a wider network of processing factory managers and traders. Following interviews with exporters, I was introduced to a middletrader who accompanied me to the Goroka roadside market and facilitated further introductions. As a trusted (former government official), well respected figure, this allowed more roadside buyers to open up to me. It also proved to be an invaluable

opportunity to triangulate information gathered through previous engagements with them. While I intended to conduct one on one interviews with these roadside buyers, the observations of coffee buying on the roadside and one on one conversations often transformed into small gatherings with a number of listeners joining in and then becoming speakers themselves. For instance the use of various text codes to signify different things specific to the coffee trade was suggested to me by traders who spontaneously gathered around me and the interviewee to brainstorm and confer to check if there were any codes that they had missed out (see chapter 3).

Interviews were held at every level of a large exporting company after the managing directors consented to an organisational ethnography. In all instances, potential participants were approached directly in order to attain their informed consent and it was made clear that I, as an independent researcher, do not represent the interests of the NGO, exporter or local leader who referred me to them. It was also communicated that participation is voluntary and they could opt out any time they chose. The qualitative methodology used was inherently flexible. Interviews were conducted around broad issues and designed to encourage participants to speak freely - follow up questions were then asked depending on the answers participants provided. In addition to representing two of the most common and important livelihood activities in PNG, the sections below demonstrate the benefits of tracing the coffee and fresh produce value chains and how their structural properties constitute specific opportunities for mobile phone use and market price circulation.

Case Selection Rationale

Coffee: The Classic Buyer Driven Value Chain

The global coffee industry as a classic buyer-driven chain poses interesting questions about the limits of the bargaining power that a smallholder farmer can obtain even with better information.

The political economy of global coffee chains is well documented (Ponte and Gibbon 2005, Macdonald 2014, Neilson et al. 2014) but there are fewer studies of the coffee industry in PNG that offer a larger, structural perspective (for example, Imbun 2014 documents the rise of small holder farmers after the end of colonial plantation size land holdings). A buyer driven chain is one where a small number of multinational traders and roasters dominate and

can set requirements for other actors in the chain thereby shaping economic outcomes for all producers in these regions. Roasters such as Nescafe can, for example, prescribe, the 'criteria for minimum quantities needed from any particular origin to be included in a major blend' (Ponte 2002). Ponte argues that this kind of barrier used to be set by governments on the basis of political negotiation under the International Coffee Agreement (ICA) commodity regime. The trading stage of the chain is even more concentrated, with just three companies dominating (Kaplinsky 2004): Neumann Kaffee Gruppe (German Group)[18], Volcafe Holdings Ltd (Swiss Group)[19] and Ecom Agro-industrial Ltd (Swiss/Spanish Group)[20] which have operations in seventeen, twelve and thirteen coffee producing countries in Latin America, Africa and Asia respectively. Each of these multinational corporations are represented in Goroka, EHP - PNG Coffee Exports is a major subsidiary of Neumann Kaffee Gruppe, Monpi of Volcafe and Highlands Coffee of Ecom.

The power asymmetries in this value chain are demonstrated well by the fact that a 1 pound bag of Komono Dragon Blend coffee beans at a typical Starbucks café in the US (2006 figures when world coffee prices were quite high) would cost US $ 12.95 (West 2012). However, growers received just US $ 0.59 per pound for the parchment in Goroka and $1 if it was sold through Fairtrade networks (for a grower located near a road). This parchment would then be sold by an exporter for $1.41. West notes that:

> *Out of $12.95 paid for a pound of fair trade beans, only $1.41 stays in PNG. Rest of that price, $11.54… is the value added to the coffee once it leaves Lae. (2012: 16)*

There is a dedicated development and communication technology intervention aimed at 'Linking farmers in Papua New Guinea to Fairtrade Markets' which also provided a promising case study opportunity. This initiative by Fairtrade ANZ and the International Fund for Agricultural Development (IFAD) distributes cell phones to Fairtrade farmers so that they can access market information and was piloted in Okapa which was a region I was familiar with through previous research. Coffee is one of the most important cash crops in PNG with around 3 million people being dependent on it (Imbun 2014:27). It brings in US$100 million in export revenues each year. Globally, PNG ranked 18th in the world for

[18] Honduras, Nicaragua, Costa Rica, Peru, Mexico, El Salvador, Brazil, Colombia, Guatemala, Rwanda, Burundi, Kenya, Uganda, Tanzania, Vietnam, PNG and Indonesia.
[19] Mexico, Guatemala, Honduras, Costa Rica, Colombia, Peru, Brazil, Kenya, Tanzania, Uganda, Indonesia, PNG
[20] Colombia, Guatemala, Costa Rica, Brazil, Mexico, Honduras, Nicaragua, Peru, Ivory Coast, India, PNG, Vietnam, and Indonesia.

coffee production (2016/2017) and the Eastern Highlands Province is one of the most important regions when it comes to Arabica coffee production output.

Fresh Produce Trade

The Fresh produce trade provides opportunities to observe coordination and communication patterns in a sector with storage needs (as perishable commodities) and price variability.

The fresh produce marketed in Papua New Guinea is estimated to be worth more than 250 million Kina per annum (Fresh Produce Development Authority chairman - 2010) and therefore is a major source of income, especially for women. Furthermore, the Fresh Produce Development Agency (FPDA) and Digicel provide a mobile market information service to farmers who opt in.

The FPDA conducts weekly market surveys in eight main markets - Goroka, Mt Hagen, Lae, Port Moresby, Kokopo, Madang, Wewak and Popondetta. Reviewing the implementation of this mobile market information service provided an invaluable opportunity to investigate important issues to do with text codes and need for digital and financial literacy to access such ICTD initiatives. As the price notification sent out is price per kg rather than per bag questions about the information needs of different markets can be addressed using this case study (urban markets in PNG do not price produce according to volume – it is always per bag or loose).

In order to develop an understanding of the lived experience and daily practices of growers, those approached for interviews about coffee were also asked about the fresh produce they grow. This approach unearthed interesting findings. A village (Sukapass) with a large coffee cooperative falling on the Highway route to Lae had enrolled the services of wholesale trucks returning empty after delivery (that are technically not supposed to take on additional cargo as they are on contract to deliver goods to retailers or hotels) for the transport of their fresh produce to Lae. While a few respondents indicated that the fresh produce from the garden was mainly for household consumption with an unplanned surplus going to the roadside or even the Goroka town market, a large majority (especially women) said that they would bundle up bags of produce grown with an intention to sell. In order to trace the dynamics of commercial fresh produce trade I focussed on the humble and ubiquitous commodity - the sweet potato or *kaukau*. This emerging, commercial scale trade now involves movement over

large distances and several layers of intermediation in the figures of middlebuyers (or consolidators as the FPDA designates them), truck drivers, transporters and retailers. This part of the value chain analysis benefitted from the data shared by an ACIAR project (that I was not otherwise directly involved with - HORT/2014/097) that demonstrates the emergence of various new end markets, routes and the current estimations of volumes being traded.

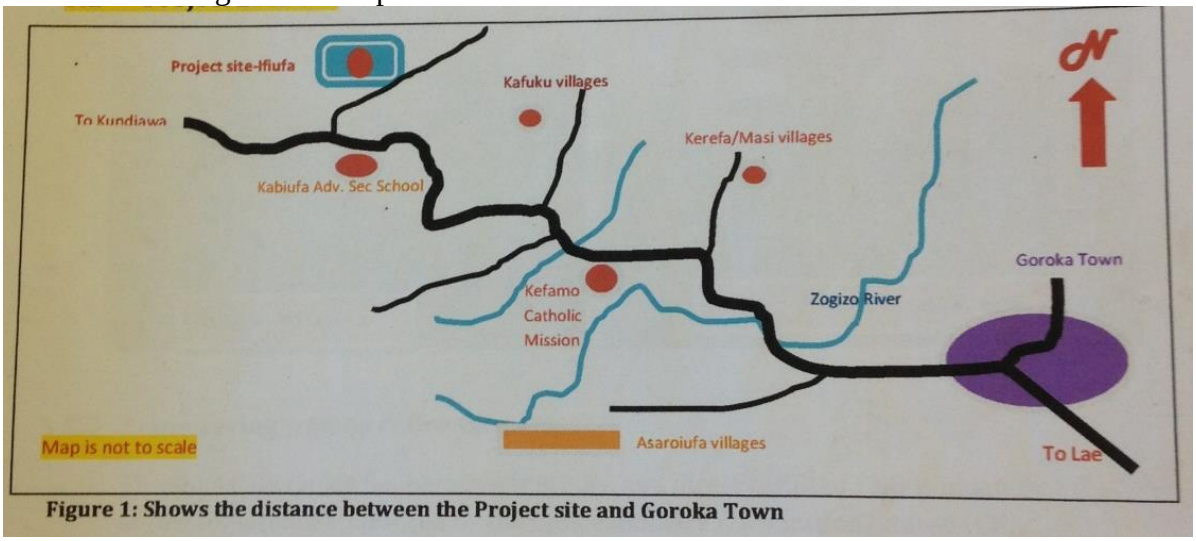
In addition to the Goroka market as an empirical site, since the majority of sweet potato grown at commercial scale and in a market oriented way was from the Asaro valley in the Eastern Highlands, I made several visits accompanied by FPDA staff to the growers of the highly sought after *Gemani* and *Rachel* variety. This was supplemented by informal conversations at a few major urban markets and observations along the main trade routes. In addition to these short term visits, following is a description of the main sites where sustained ethnographic engagement was undertaken. In the empirical chapters that follow, the quotes cited are mainly from respondents in these sites. The relevant interview material has been translated to English and the original Tok Pisin version is only displayed alongside when a particular term (such as '*wantok price'* or *'tok gris'*) used suggests a contextually rich local meaning or a categorisation that would be lost in translation. I learnt Tok Pisin before travelling to PNG for the first time in 2015 and cultivated a good working proficiency. I was a lot more fluent by the end of the fieldwork - respondents who were familiar with me would start off conversations with greetings in English and then effortlessly swap to Tok Pisin when they were describing something at length or elaborating details while answering a question or making a point.

Village profiles:

GOROKA DISRICT: The Ifiyufa village in the Mimanalo LLG (Goroka district) is situated approximately 4 kms to the north west of Goroka town. Adjoining the Okuk Highway, this field site had an active coffee cooperative (with a gender focus) called the Sukapass Women's Cooperative. Its membership comprises households from the adjacent villages of Akameku, Down Under, Holipoka, Kono Blacks, Sukapass, and Yatega. These villages are connected by a feeder road and the cooperative leader facilitated interviews with farmers from a few of these villages as well. Below is a map produced by local leaders showing the relative location of the cooperative's resources hub and their proximity to the provincial capital, Goroka, schools and highways. The cooperative was established in 2012 with an aim

of ‘taking development into their own hands’ following what they described as years of neglect and lack of access to basic government services following independence. In terms of topology and physical geography the land in this area is fertile and well suited to agriculture. The community identified that they have enough land mass for further extension and intercropping.

Figure 2: Sukapass and the route to Goroka Town



One needs to be careful about drawing inferences from the household survey due to small sample sizes but the below data are indicative of the marketing avenues available for the sale of coffee for the respondents in Goroka district and every effort was made to make the sample as representative as possible. Respondents were chosen through multi-stage cluster sampling from a sampling frame created from a list of registered farmers (with the number of coffee trees ranging from 150 to 14000) with geographic subgroupings like hamlets proportionally represented. Computations were made to ensure that the probability of each name appearing in the sample was proportional to population size of the respective location and that each geographical site was represented.

Table 1: Value chain structure in Goroka District: Coffee marketing decisions

	Percentage of cherry sellers	Frequency
Cherry - Village buyer	57.7	15
Cherry - Cooperative	4.2	1
Cherry - Roadside buyer	8.3	2
Cherry - Factory	4.2	1
Cherry - Exporter	0	0

	Percentage of parchment sellers	Frequency
Parchment - Village buyer	4.4	1
Parchment - Cooperative	4.4	1
Parchment - Roadside buyer	28	7
Parchment - Factory	26.1	6
Parchment - Exporter	4.35	1

Note: Answers to question: 'Did your household earn money from selling cherry coffee/parchment last Year? If yes, who did you sell it to?'. The responses from the green bean questions are excluded as there was no one who said they sold green bean. This was a 'circle all that apply question, therefore the percentages do not add up to 100%.

UNGGAI BENA DISTRICT: Gotobe block and the Gotobe plantation were the main villages I focused on. They are located off the Highlands Highway about 10 kms from Goroka town. The leaders of the Lower Unggai Development Foundation, a coffee cooperative whose activities are detailed in the following chapters, facilitated interviews with the adjacent villages of Sete Block Arikaiufa, Amaka, Ketarobo and Masumave. While the strategy has been to choose 2 sites close to Goroka and therefore to coffee exporters and 2 that are harder to access, the Lower Unggai Development Foundation being a wide reaching network had 2 clusters that were quite remote. The cooperative leaders facilitated access to farmers from the village of Nivi in cluster 4 and I was able to comparatively assess the impact of remoteness in getting coffee and produce to end markets. Other cash crops grown in this region are pineapple and oranges and other vegetables, while cassava, sweet potato, banana, taro, rice and beans are grown for household consumption only. The majority of houses are made of bush material with only a small proportion having an iron roof and even fewer are made of permanent materials. Most households use dry pit toilets and bathe in the nearby river or stream.

Table 2: Value chain structure in Unggai Bena District: Coffee marketing decisions

	Percentage of cherry sellers	Frequency
Cherry - Village buyer	38.9	7
Cherry – Cooperative	5.6	1
Cherry – Roadside buyer	16. 7	3
Cherry - Factory	44.4	8
Cherry - Exporter	0	0

	Percentage of parchment sellers	Frequency
Parchment - Village buyer	5.6	1
Parchment - Cooperative	0	0
Parchment - Roadside buyer	47.4	9
Parchment - Factory	50	9
Parchment - Exporter	5.6	1

Note: Answers to question: 'Did your household earn money from selling cherry coffee/parchment last Year? If yes, who did you sell it to?'. The responses from the green bean questions are excluded as there was no one who said they sold green bean. This was a 'circle all that apply question, therefore the percentages do not add up to 100%.

OKAPA DISTRICT: Purosa and Urai, just over 100 kilometres from Goroka, were difficult to reach as the last 25 kilometres of road from the Lufa road junction to Purosa are unsealed. Urai is even more remotely located with farmers having to transport their coffee bags to Purosa where there is a coffee processing factory before they can be taken to the exporters. During the wet season, the road to Goroka is almost impassable. Reliable four wheel drive vehicles are required to transport coffee to the main markets and several respondents complained that owing to the state of the roads, a considerable amount of money goes into repairs and vehicles do not seem to last very long on those roads. There were only two conventional vehicles and two privately owned two-door land cruisers in Purosa and the cost of transport was a constant worry. There were several cooperatives in operation in the region among which the leaders of the Highlands Organic Agricultural Cooperative (HOAC) were keen to participate in the research. They were partnering with Fairtrade ANZ to implement an ICT project and my 11 day stay in Okapa preceded the first visit from the Fairtrade team after which they became the first cooperative in PNG to be incorporated into the network.

I observed several changes between the two fieldwork trips – there were more smartphones in use during the second visit. As the second visit led up to the 2017 General Elections, I discovered that several middlebuyers had put themselves forward as candidates and were utilising their networks and resources from the coffee trade to campaign for votes. The end of the 2017 coffee season was not typical owing to the lively activities surrounding elections and the increased presence of campaigners from elsewhere in Goroka town. Being in the field at that time, helped me observe the importance of the coffee trade specifically in creating local leaders and producing respect and legitimacy for those who coordinated and participated in it. Furthermore, the increased presence of campaigners meant that I was able to hitch rides into villages where access and transport had been an issue so far. Several

respondents reported that they needed to sell the year's coffee produce before faction based violence erupted during polling time depending on who won. This underscored the local complexities of the coffee trade and demonstrated how situated, relational issues drive marketing decisions.

Table 3: Value chain structure in Okapa District: Coffee marketing decisions

	Percentage of cherry sellers	Frequency
Cherry - Village buyer	0	0
Cherry – Cooperative	0	0
Cherry – Roadside buyer	0	0
Cherry - Factory	25	1
Cherry - Exporter	0	0
	Percentage of parchment sellers	Frequency
Parchment - Village buyer	13	6
Parchment - Cooperative	84	42
Parchment - Roadside buyer	2.2	1
Parchment - Factory	31.4	16
Parchment - Exporter	0	0

Note: Answers to question: 'Did your household earn money from selling cherry coffee/parchment last Year? If yes, who did you sell it to?'. The responses from the green bean questions are excluded as there was no one who said they sold green bean. This was a 'circle all that apply question, therefore the percentages do not add up to 100%.

3 'Relational Coffee' and the Mobile Phone

When price is low they send 'id24', which means you stay at home... don't come, price low... shortcut [sic]. Mobile phones cost money, we don't often have a lot of credit on the phone, so these texts are good. (Roadside coffee buyer in Goroka town, Interview 48, 13th June 2017)

The communicative possibilities of the mobile phone in the coffee value chain are manifold. In addition to the development of unique text codes in the Highlands, as the quote above demonstrates, mobiles have already entered the discursive field of the coffee trade in a significant way.

There is a large body of work that traces the adoption, diffusion and use of ICTs in developing contexts. However, there is a paucity of research that maps the situated manner in which people choose to use the technology, activate affordances and draw it into their sociocultural lexicon (Donner 2008). As opposed to diffusion studies (Baliamoune-Lutz 2003, Meso et al. 2005, Rouvinen 2006) that describe the one-way impact of cellular phones on a passive user, it is instructive to foreground the interplay of social, economic and cultural factors. This is particularly relevant in the Melanesian context where the economic role of the mobile device is inextricably entangled with local ways of doing 'bisnis' and the exchange economy.

Results from the household survey of the four research sites show that 63.6% of men and 22.7% of women said that they had a mobile phone. Of the 143 households sampled in sites across three districts in the Eastern Highlands Province, 10% said that they mainly used these phones to coordinate the transport of coffee[21]. 5.6% said that the main use of these phones was to find out about the current coffee price. Respondents were chosen through a randomisation process using multi-staged cluster sampling with each site varying in distance from the town centre and access to roads and infrastructure. A further question[22] that probed past the primary utility of the phone to ask if it had been used in the coffee trade elicited a much wider response (Table 4).

Mobile use is clearly embedded within a broader communications matrix that includes needing to contact friends, relatives and for the coordination of transport of other goods (one

[21] Tok Pisin version: Planti taim, yu save usim fone long mekim wanem? (circle all that apply).
[22] Tok Pisin version: Yu save usim fone long ol dispela wok tu? (circle all that apply).

respondent even said that he used his phone mainly to check the time). While phone ownership is unevenly distributed and those with credit on their phones during the interview made for a much smaller percentage, there is indisputable evidence for the growing role of mobiles in livelihood activities.

Table 4: Responses to question 'Have you used your mobile phone for any of the following:

	Frequency	Percent
To contact coffee buyers	17	25.8 %
To coordinate transportation of coffee	12	18.5 %
To find out about the current coffee price	8	11.8 %

Note: These are results from the quantitative survey undertaken with 143 households. This was a 'circle all that apply' question, therefore the percentages do not add up to 100%.

Is there, however, enough evidentiary support for the disruptive transformations predicted by the first generation of ICTD research? The ability of phones to produce spatial arbitrage by making price information widely available within the coffee trade is determined by existing economic practices and the structure of market relationships. Canonical studies of Melanesian marketplaces and colonial trade stress sociability, long standing partnerships and the suppression of competitive practices (Sahlins 1972). Therefore, even when armed with mobile based, real time information about alternate market avenues, it is not solely an atomised, price maximisation impulse that drives transactions. Chapters 4 to 6 delineate the manner in which the embeddedness of economic behaviour and the myriad non market objectives of enterprise in PNG mediate the uptake, 'domestication' (Lipset 2013, Lipset 2017) and use of mobile phones.

The clearest evidence of the impact of this new cellular technology in the coffee trade is in how it facilitates non-proximate communications through the contraction of distance. This newfound connectivity has generated expectations of spatial reconfiguration especially when it comes to the distance to market. What is important to note in this case, is its potential to 'bridge the geographic frictions' (Graham 2015) represented by infrastructure and transport barriers that are unique to the remote regions that coffee is sourced from.

3. 1 Mediated Communication and Space

Harry Boettinger, a former assistant vice president of the American telecommunications conglomerate AT&T, argues that 'the telephone was the first device to allow the spirit of a person expressed in his own voice to carry its message directly without transporting his body' (1977:205). The mobile phone makes voice communications portable and generates new mobilities in a manner that is far more pervasive than its predecessor, the fixed line telephone. The paradigm shift represented by connecting a place to another place (through the telephone) and then a person to person who could be anywhere during the call (through a mobile phone) has been documented by geographers and communications studies scholars. Like the telegraph before it, the affordances of which were mainly confined to 'business communiques, orders, alarms and calls for services' (Fisher 1992:81), the coming of the telephone produced dramatic shifts by increasing the connectivity between two places. As Eric Sheppard (2002:323) reminds us, it became possible 'for information to move more rapidly than the body, severing the space/time of information from that of human movement'. This led to a reconfiguration of spatial organisation and relative positionalities and distances between places and people. Geographers have attributed the late 19th century agglomeration of 'headquarter functions in central business districts (CBDs)' and the dispersion of manufacturing facilities to less expensive, less congested, remote sites to the coming of the telephone (Abler 1977, Moriset and Malecki 2009).

The 'magic' of this moment of change in the developing world characterised by stark distances, difficult terrain and poor transport options is particularly noteworthy. Studies using discourse analyses of the way in which non-proximate connectivity is imagined have traced similarities between how people talked about the coming of railways in colonial Africa at the turn of the century and the transformative expectations attached to new ICTs (Graham, Anderson and Mann 2015). Natasha Beschorner, the senior ICT policy specialist at the World Bank invokes the following comparison from the memoirs of Sir Arthur Grimble to introduce and make a case for the opportunities created by new regional connectivities in the Pacific (Beschorner 2013).

> *For inward shipping, a trading steamer arrived from Sydney every six months or so and once a year (if you were lucky) the London Missionary Society's SS John Williams showed up from Australia and a recruiting vessel from Ocean [Banaba] island….It was normal to get no home news for 6, 8 or ten months together because of the lack of ships. (Grimble 1952)*

The above account of a former Cadet Officer and Resident Commissioner who lived in the former Gilbert and Ellice Islands (now Kiribati and Tuvalu) between 1914 and 1933 was used to contrast changes in the communications ecology brought about by the new fibre optic cables. Distant islands, where one had to wait for months for communications, experience a significant shift in the speed of communications and instant connection thereby altering their historic locational and positional disadvantages. Regardless of the tropes and contrived metaphors used to reshuffle spatial imaginaries and to invoke a sense of transformation, the changes in the scale and geographic range of communications are markedly significant.

Figure 3: Gilbert and Ellice Islands pre-1970 London Missionary Society postage stamp (from Beschorner 2013)

In the case of PNG, how were non-proximate communications previously carried out in the absence of mobile phones? Watson (2011, 2016) compares the function of the mobile phone to that of the '*garamut*' or the ceremonial drum used to communicate using a series of codes or beats. She sees it as a precursor to the phone and describes the almost daily use of the drum in her field site. She also describes how villagers would regularly call out in loud voices to neighbouring houses and conduct entire conversations in this manner. After observing how unusual and discordant it is to the Western ear, she quotes from an interviewee who delineates how shouting fits into the existing communicative ecology:

> *That is with the mouth. If you are very, very close, you can sing out. But if you are far apart you can use the garamut.* (2011: 90)

It is interesting to note the differentiation between social and physical distance implied in the above quotation. The entry of the mobile phone represents a significant shift in the geographic scale of communications. Given the geographic barriers to getting coffee from the household garden to the local and final end market[23], the connectivities enabled by the mobile phone are significantly different to the affordances of any previous communications medium.

[23] Which from the perspective of the farmer is usually Goroka where majority of the coffee exporters are concentrated.

Paige West (2012) describes the circulation of coffee along the commodity chain and coins the category of 'airstrip coffee' to denote parchment from remote villages (like Maimafu, her field site) that has to be carried from the family's hamlet to the village airstrip. It is then weighed and the airfreight cost is calculated (factoring in fluctuating fuel costs) and deducted from the reported current price of coffee in Goroka. Based on the buying arrangement, the grower then puts the coffee on the plane with a record of ownership and is paid. During the process of following coffee from the garden to the morning cup, what becomes apparent is the clear spatial underpinning of economic activity along this chain.

The logistics of sourcing coffee from these dispersed sites constitutes a formidable undertaking; so much so that a former coffee trader recounted an attempt by a Papua New Guinean exporter to utilise the infrastructure of the Papua New Guinea National Defence Force (PNGDF) to systematically charter coffee to his factory. Told to me as a cautionary tale, after getting fed up at how hard sourcing and logistics was in the setting up of his new business, he invested 12 million Kina as part of the formal agreement. This money soon 'disappeared' and couldn't be recouped and he then went on to sue the Air Force leading to a 10 year long court case. The difficulties of navigating distances and such geographic frictions are considerable and mobile phones that facilitate contact across these various points open up myriad possibilities. Several respondents reported how mobiles were used at the airstrip to notify the Goroka based buyer that coffee is on its way. Such instrumental activity represents the use of the mobile for logistical interactions such as the redirection of trips that have already started. While mundane and routine, this capacity to structure and rationalise interaction, 'particularly in the face of distributed participants' is referred to as 'micro-coordination' (Lange 1993, Ling and Yttri 1999). Classic studies of the potency of the mobile phone flag the importance of these functional, routine uses such as the ability to dynamically adjust an agreement to meet as the need arises. Using the example of 'sitting in a traffic jam and calling ahead' while in transit to let them know you are late, Ling and Yttri (1999) refer to this as the 'softening' of time. Following an arrangement to meet, when two parties cannot locate each other, another round of calls confirming the final location is invaluable. This is reflected in the ubiquitous phrase that I have heard used every time a mobile call is initiated:

Yu stap we nau? (Where are you now?)

Despite the 'softening of time' and the 'dissolving of distances', the following chapters demonstrate how the increasing use of mobile phones has not led to perfect mobility, the complete decoupling of market from place or the irrelevance of social distance.

However, it is instructive to first examine what phones have accomplished so far. How far have they gone in dissolving the boundaries and distances that presented significant bottlenecks in the movement of produce to market? Several respondents alluded to how phones bridged these barriers of geography and distance.

> *Interviewer: Have you been working for a long time in the coffee industry?*
>
> *Interviewee: I was born here, we had a farm in the middle of the Ramu valley, and we had one road that took two days to get to Lae when I was born... and most of our cattle was flown in and out for consumption there.*
>
> *I have been working in coffee since 1999. At that time, they had analogue mobiles here and that was all. When I was at the farm we didn't have any mobiles we just had radio [shortwave] communication and a microwave [radio relay] phone system which, back in the 80s [sic], was actually state of the art.*
>
> *[But] that wasn't common. Not a lot of people had access to these communications technologies. It was reasonably well supported in central areas with network coverage. District offices, government offices etc... Analogue only worked around towns, it didn't even work in Kagamuga [Airport]... Kagamuga Airport to Hagen City is about 8 km, and there was no reach in Kagamuga, while the analogue mobile worked in Hagen city.*
>
> *Exporting Company representative, Goroka, Interview 41, 13th June 2017*

This respondent who is now a coffee exporter went on to describe how as network coverage and access was confined to urban centres, corresponding with farmers dispersed over remote, rural locations was practically impossible. Difficulties with reliable network coverage also impinged on their ability to communicate with overseas clients on whose contracts their entire business model is built around. Before the coming of Digicel, only the offices that fell in a good spot had good network coverage. Even with good network access, email and internet communications were slow and another respondent described having to decrease attachment file sizes so that emails could go through to the overseas client when internet speed picked up overnight.

> *...you need to know what is happening overseas now... so you send an email and even if the system is slow and not working, at some point in the night it will happen. The email will go through and you can get a reply in the morning.*

Logistics Manager, Exporting Company, Goroka, Interview 47, 13th June 2017

The entry of Digicel following the deregulation of the PNG telecommunications sector in late 2007 changed this communications ecology in a dramatic manner. Digicel, which already had a large user base in the Caribbean expanded into Pacific markets in 2006 and now dominates the market in PNG and Vanuatu. Previously, the government-owned Telikom monopoly provided fixed phone lines while its fully owned subsidiary company, B-mobile, catered to the mobile market[24]. Suwamaru (2015) reports that in a country with an estimated population of 6.5 million, prior to 2007, Telikom had 64,000 fixed phone subscribers while B-mobile only had 60,000 mobile phone users. Current mobile phone providers are B-mobile and Digicel. The Telikom owned Citifone is now defunct and B-mobile services continue to have a larger presence in urban centres with about 200 towers.Digicel, however, stands dominant with over 97% market share (Foster 2020) and a much broader reach than other providers with an expanding network of over 1100 towers across the country.

The accessibility of Digicel draws not just from its physical infrastructure that ensures widespread network coverage but from their innovative business model. As a privately owned mobile network provider, founded by the Irish businessman Denis O'Brien and headquartered in Kingston, Jamaica, Digicel employed aggressive strategies to make itself competitive in markets like PNG where telecommunication services were provided by ineffective state sponsored monopolies (Foster and Horst 2018). These marketing practices included the offer of inexpensive handsets and low-cost operating rates that the state-owned service provider was soon unable to compete against. While the smallest denomination on a Telikom mobile service used to be 20 Kina, Digicel introduced smaller, cheaper options like 2 Kina and 5 Kina prepaid top-ups. This allowed farmers to use the little cash they had received after a quick sale to make a phone call. Foster (2018) argues that the latest offerings of free talk time during off peak hours act as enticements to accelerate consumption and engender a new 'temporal discipline' and a 'metered mindset' as customers have to use these credits during the promotional period or forfeit it. Digicel also put together easy credit transfer mechanisms and offered discounted text bundles that would expire in 24 hours so as to stimulate 'more and more use in less time' (2018: 143). This opened up unprecedented communications opportunities and widespread uptake to the extent that Digicel was caught

[24] B-mobile has since increased the reach and number of its rural towers.

off-guard and overwhelmed by the demands on the network. Several respondents reported how in contrast to their business approach in the Caribbean, Digicel misread the PNG market and underestimated the volume of pick up. Consequently, the accounting package (with base programs that log calls, the time and the amount you pay) they implemented in PNG was not strong enough to accommodate the growing number of mobile users. Severe continuous constraints on the throughput and network outages at certain times are not uncommon. Coffee exporters based around Goroka report how the network routinely drops out on Thursdays (and Fridays) which are pay days when everyone puts cash into top-ups and the tower and the network is swamped.

Growing demand has led to an exponential increase in mobile phone subscriptions and the use of the phone for user defined purposes and practices that are not encoded into it by design. In the Highlands of PNG particularly, unique text codes have developed (Temple et al. 2009), as we saw in the introductory quotation about 'id24', being sent out when the prices are low to ask people to stay in the village and not make the long trip into town. This goes beyond 'domestication' and represents the co-production of text functions (and expressive messages that confirm relationships) based on local needs. The phone is used for more than voice communications, especially as calls tend to be expensive. While a significant number of respondents reported that they owned a phone and used it to coordinate the coffee trade, a large percentage also reported that they did not have credit on their phone at the time of interview. Local mobile innovations include the use of codes, such as 'ID 24' as an indirect way of telling the recipient that they do not have credit and asking if they would please transfer some credit.

During the first few years of Digicel in PNG when call credit ran out, a pre-recorded female voice message would say that 'they are ID 24' and that the caller had run out of credit. This practice soon changed and when one is now out of credit, the call just tapers off. Soon the phrase ID 24 in the context of the mobile phone came to hold a negative connotation. It is still memorable that way outdated features of the internet in the 1990s would be to those who grew up listening to the dial tone on the dialup modem and the 'you've got mail' sound on AOL messenger (which no longer plays on a 62 bit Windows operating system as it does not come supported with appropriate sound files).

Digicel also introduced coded credit transfer requests that could be used to communicate between phones without actually spending any credit. A #128* function could be used to put credit on another mobile phone and the below syntax would be what is used to send 10 Kina to another mobile number.

#128*__MOBILE NUMBER__*10#

#127* however is used to ask another mobile user for credit. Each person was allocated up to 20 such free requests during the early years of Digicel in PNG. Soon people co-created modifications to this request system. Since ID 24 still meant no credit, they put 24 at the end of the request (#127*__MOBILE NUMBER__*24#) to mean that they would like the recipient to know that they have no money. 60 is used as an indication of an emergency – if someone receives it on their phone they will call back to check what the urgent issue is. Roadside middle traders had repurposed these codes (that were free to send) for the coffee trade by making 'ID 24' mean a broad negative message – they used it to communicate that the price was low on the given day and it was not worth the trouble of paying for a PMV and travelling into town. Few of these roadside buyers also reported that 91 meant 'nice one', 99 meant 'good night' or 'nighty night' and 43 was used to send an 'I love you' message. A local respondent explained that 91 is similar phonetically to 'nice one' and the word 'love' has 4 letters and 'you' 3 – this translated to 43. It is also possible to have a short conversation with these codes. For example if one were to text someone with no credit, they could reply in three text messages. If the replies were 91, 43, and 99, it is possible to read it as meaning: nice one (affectionate term), I love you and good night.

It was not just a self-referencing in-group of coffee growers that created, modified and used these codes. University of Papua New Guinea students habitually send 4 to mean 'meet me at the **forum'** and 12 to mean 'meet you at the cafeteria/or I'm having lunch at the mess'. A group of friends reported that if they had no credit, they would respond to a question with 3 meaning yes and 2 being no. These meanings are interactively defined, confirmed and co-produced within groups and several respondents stressed that it was not just young people who were tech savvy and capable of using these. A couple in their 50s, who were respected community leaders in Unggai, said they used them frequently:

> *This is like our language. Everyone knows it… it is not just known to young people but everyone. If I get an ID 60 message even if I don't have credit on my phone I will go buy a flex card and then call back!*

Coffee cooperative member, Lower Unggai, Interview 38, 11th June 2017

A respondent on a formal, regular salary described yet another adaptation of this practice. Sometimes when communicating with her friends/family via texting, it would become clear to her that they do not have credits, while she on the other hand had a bundle which included 15 or 20 free texts. She said that she would then send a message asking 'are you free tomorrow morning? If yes request from me K3 or if no then request K2'. So when they reply with *2 or *3 on the request code, she would understand what they are saying. It is common to use such means of texting through self-defined codes that only partly draw on the affordances of the system that it was designed for. After the Digicel management caught on to the 'manipulation' of this system, free request codes were cut down to under 7 per top-up.

Another uniquely Papua New Guinean use of the mobile is to make 'phone friends' – after dialling random numbers, the caller pursues a relationship with the person on the other end if they are responsive. As an emergent practice, this mobile innovation has received a lot of attention and cautionary tales about women who trusted these anonymous 'phone friends' and got into trouble are well documented (Anderson 2013). Figure 4 shows a screenshot of an exchange with a prospective phone friend who after calling under the pretence that he was returning a call, continued to send text messages. The spelling shortcuts (stp – for *stap*) and adaptations of Tok Pisin used to communicate that he was keen to be 'phone friends' with the text recipient in Goroka ('*I lak to mak phofrien with u lewa goroka'*) is worth noting.

Barbara Anderson (2013) in her research into the dynamics of 'long-term correspondence and exchange relationships' over the phone points out the moral unease surrounding women's responses to phone friend requests. This is reflected in my interviews among coffee villages as well. The perils of women with autonomous access to phones and the figure of the scheming *giaman* ('trickster') from established folktales who now uses the phone to make mischief were reiterated:

> *...youngpela smatpela meri go long high skul i college. Ol moniman o bisnis man o giaman long ringim ol, stealim mobail number... bagarapim skul wok, future.*
>
> *[Say] a smart young girl makes it to high school or college [from this village]. Some guy with money or a trickster can call her up and thus get her phone number. This can bugger up her school work and ultimately her future.*
>
> *Pastor and coffee grower, Okapa district, Interview 8, 20th July 2015*

Figure 4: Phone Friend request – April 2015

Crucially, she argues that these contestations draw from the manner in which phones or mediated communications lead to a 'radical distortion' of 'spatiotemporal relations… in which the identity of participants can be easily hidden' (2013:318). In the text exchange above, ascertaining location and relationship to place came first. The distinct characteristics of mobile systems - i.e its peer to peer topology and its geographic range that enables non proximate communications - enables contact over great distances and associational/social contexts. This stands as a marked shift from the range of the beats of a *garamut* or the reach of unmediated voice communications.

Given the distances over which coffee trade takes place, the ability of the phone to 'shrink' distances and soften geographic frictions is incredibly useful. It allows for communication about road conditions, so that trips can be rerouted – one cooperative leader said that timely

information about tribal fights along the way helped them reschedule and coordinate vehicle movements. In contrast to well-resourced exporters, such information helps ensure that the hired vehicle driving into a remote community via unsealed access roads (that are slippery and unsafe after rain) does not get held up along the way culminating in a wasted journey. Conversely, a few community leaders expressed concern at the possibility of '*raskols'* using phones to coordinate and communicate with each other (there were a few exaggerated fears that they might use it to '*arrangim kilim'* as well). After observing farmers collect coffee bags, it would become apparent that they are headed to Goroka town and that they will come back with money from the sale – at this point anyone could organise a hold up after coordinating with others over the phone.

While the following chapters explain how relationality mediates physical distance and proximities even with a phone, the material reality of distance cannot be overemphasised. Nivi is a village that falls within the more remote clusters of the Lower Unggai Bena Development Foundation. Located past the Unggai mountain ranges, there were reports of how the remoteness of the group of farmers posed a significant constraint on their ability to market their coffee. When they are not selling to a village buyer, they coordinate among themselves and nominate a leader who will take the coffee to the exporters. Community leaders emphasised how, since the farmers didn't have alternate marketing options, the nominee could drag them into a price or a buying arrangement that is solely in his interest. The village buyer on the other hand, as an autonomous trader intends to the sell the coffee again to a roadside buyer or an exporter, therefore marks it up, so as to shave off a profit and cover his costs in organising transport to Goroka. The trouble families in this village have to go to in order to access services perhaps best demonstrates the manner in which distance structures their lifeworlds and compounds their severe locational disadvantage.

Located in the 'hinterlands' of formal government services, Nivi and other nearby villages are at a spot that is technically within Eastern Highlands Province boundaries but is closer to the reach of Chimbu provincial government services. The roads and access conditions are so bad that pregnant women travel out of the village to their *wantoks,* who live closer to hospitals, a week in advance so that they can be close to delivery and healthcare services. Otherwise they would have to risk sitting through a rough, bumpy drive to the hospital if they were able to organise transport in the first place. Stories of women delivering en route and lives of sick farmers lost while waiting to coordinate enough money for transport and hospital

costs were frequent. Between the first fieldwork visit in 2015 and the second one in 2017, I was told of a young respondent who passed away, following difficulties with accessing healthcare, and leaving behind 4 children.

The persistence of distance and the continued relevance of spatial frictions has a real bearing on search costs. While the above account of a village buyer buying parchment at a low price to cover his transport costs shows the impact of distance to market on price, farmers in several other sites talked about the time savings that mobiles can bring. While the respondent in Purosa (Okapa) was 100 kms from Goroka, he said that it cost him 10 Kina to go from Okapa for 3 hours on a bad road and then come back (another 3 hrs)[25]. The use of the phone in his case produces time savings and lets him avoid unnecessary trips that take almost half a day. Not only does this subsequently impact on margins and profits, it hedges the risks of traveling with the years' harvest without knowing anything about conditions in the end market.

In addition to production costs, development economists studying the movement of produce from 'farm gate' to market flag the role of transaction costs that arise when goods change hands. As a result, a greater distance to market is said to depress farm-gate prices (Mahdi 2012). From the perspective of village buyers and traders, even though the operational entry costs are relatively low, they still have to travel to villages and households to source coffee from those who are ready and willing to sell it. These search costs are significantly reduced by the use of mobile phones. Even though all smallholder farmers do not routinely shop around for the best coffee price, a more enterprising farmer from Ivengoi in Okapa said he used to walk 7 hours to Okapa station to find the coffee price before the advent of phones and then walk back. The 50 plus households in Ivengoi, who now collect their coffee and work with a cooperative, have to cross a river, then traverse a clay[26] access road to reach the end of the road leading to the highway to Goroka. This river is often unpassable after rains. The HOAC cooperative leader reported that previously he would have to jump on a vehicle all the

[25] Research trips to the site took 5 hours.

[26] Following rains during the wet season that coincides with the latter part of the coffee harvest season, the 4 wheel drive used for fieldwork got stuck. After pushing the vehicle for some distance, the clay texture of the road turned slippery and wet (as a considerable portion of it went through an uphill terrain that had tall leafy trees keeping the sun from drying the road after the previous day's rain). This meant that the vehicle's break system would not work and the SUV kept sliding off the edges of the road. It is not hard to imagine an open truck with bags of coffee that have to be fastened and secure, sliding along this muddy road and being utterly dependent on good weather for access.

way to Kainantu to find out about price information and then find a way to communicate it to farmers back home.

Under these circumstances, the introduction of the mobile phone created new meanings and expectations attached to a new communications platform. Several respondents described the manner in which the phone bridged these vast distances and geographic frictions. I heard several accounts of coffee trade coordination that used 'conceptions of distance as a unit that can be shrunk' through this newfound connectivity (Graham 2015). Mobile phones in this context displace the domestic reality of distance and the old way people used to communicate, to create an artificial/mediated context in which communications and social interactions acquire qualities they didn't have before. This is reflected in the development of new text codes as shorthand for specific tasks in the coffee trade, facilitated contact between the producers of 'airstrip coffee' and socially and geographically distant exporters and a fundamental shift in the way non-proximate communications used to be carried out through the *garamut* or voice communications. We have seen how these new mediated qualities are inscribed into the material configuration and architecture of mobile networks. Reports of connectivity dropping out on Thursdays, top up denominations producing certain kinds of calling behaviour, and free text request codes show how these affordances are determined by the throughput[27], accounting packages implemented and the specific historic trajectory of Digicel's engagement in PNG.

Now that we have a much better understanding of the spatial epistemologies of mobile based information and communications architecture in the Highlands of PNG, it is necessary to turn our attention to the testable predictions about the role of the 'ICT revolution' in economic development. In order to interrogate the promises and unwavering optimism attached to the coming of mobile phones and the potential transformation of local livelihoods, it is instructive to examine the existing flows of information, products and capital through local value chains. The coffee and fresh produce trade is embedded within existing economic practices and the local exchange economy. It is therefore imperative to understand these practices that structure market behaviour before testing if the transformative claims of the mobile phone bear out on the ground.

[27] In cellular and mobile networks, throughput refers to the maximum rate at which data packages can be processed or the capacity for successful message delivery over the network.

3. 2 Embeddedness of Economic Behaviour

Much scholarly attention has been directed towards the sociality of Melanesian market relationships and the principles of valuation that people employ to establish comparability between objects that are transacted.

> *Supply and demand are operative in the self-regulating market, pushing prices toward equilibrium, by virtue of a two-sided competition between sellers over buyers, and between buyers over sellers. This double competition, symmetrical and inverse, is the social organization of formal market theory.*
>
> *…Very different are the procedures of primitive trade. Anyone cannot just get into the act… The traffic is canalized in parallel and insulated transactions between particular pairs. Where trade is handled through partnerships, exactly who exchanges with whom is prescribed in advance:* ***social relations, not prices, connect up "buyers" and "sellers."*** *(Sahlins 1972:297-8, emphasis mine)*

This notion of the exceptionalism of 'pre-capitalist' economies in the manner in which exchange ratios are set through trade partnerships has come to dominate research in this area. It initiated a long standing debate on the applicability of neoclassical economic theory and teleological development models in understanding trade and exchange in PNG. The above account of pre-colonial trade stresses the absence of market mechanisms. This stands in contrast to the neoclassical ideal type of a diversity of buyers and sellers coming together over a spot market under conditions of perfect competition; where goods would then change hands with a one-off payment and immediate delivery. Another assumption that is undercut by various ethnographic accounts is that of the price signal as reflecting all available information in an efficient market driven by economic rationality and autonomous, self-interest maximising decisions. Furthermore, the limitation and irrelevance of ideas about perfect mobility with a cascade of options available for lateral movement into different 'open access' markets is evident from the discussion on physical distances and geographic frictions in the previous section (3.1).

Contemporary marketplaces (*maket*), where vendors sit across bundles of produce of varying volume on the rural roadside or in town, were a colonial introduction (Brookfield 1969) that became increasingly popular during the urbanisation spurt post World War II. In these places allocated exclusively for trade, existing ideas from the exchange system remain, imbuing it

with a distinctly Melanesian quality. As the modern marketplace continues to evolve in character (Curry 2003, Sharp 2016), these processes of change have taken a hybrid form with monetised activity and indigenous logics of exchange continuing to be co-constitutive and mutually evolving.

Sahlin's account of trade is reflected in descriptions of subsistence economies elsewhere and the communitarian norms of obligation, coordination and reciprocity that govern 'peasant' behaviour. Scott's (1976) development of the term 'moral economy' refers to this peasant ethic of subsistence where due to scant resources, people have mobilised notions of solidarity and community to pool resources and generate labour and land sharing arrangements. Based on kinship, religious and other institutions, these norms of cooperation (rather than competition) help to ensure that no member of the family falls below subsistence. These moral rights and obligations are articulated as standing in direct opposition to the capitalistic logic of profit and the desire for the maximisation of economic return to the individual. Contact with such an 'exploitative' and 'morally wrong' capitalistic change activates resistance and recourse to traditional economic practices (McCormack and Barclay 2013:14). In this vein, Thompson casts the food riots in 18th century England at the onset of the industrial revolution as the 'last desperate attempt to reimpose the old, paternalistic moral economy as against the economy of the free market' (Thompson 1991:337). Chris Gregory's work (1997) on the reactivation and indeed exaggeration of ceremonial exchanges and gift giving at the point of expansion of the market in a Melanesian context at least partially bears out this proposition.

While Sahlins posits the mechanism of 'reciprocal generosity' through ties of 'diplomacy' and partnership as setting the equilibrium rates that govern the conduct of trade, other ethnographic accounts have discovered a diversity of social forms that coordinate trade. Godelier's ethnographic data on the salt to bark capes exchange in the Eastern Highlands, depicts an unequal trade that persists because of the 'monopolist positions' and the power asymmetry of the Baruya relative to their neighbours (1977:150). Partnerships as conceptualised by Sahlins ensure stability and reciprocity. This implies that trade partners are responsible for the safety of their counterparts in precolonial settings where 'those who initiated new trade relations risked being "killed or eaten"' given the suspicion attached to strangers out of place (Modjeska 1985: 149). Keil (1977) however talks in terms of dyads rather than partnerships where a group of buyers with allegiances to the group as a whole

interacted with a ‘single solidarity’ group of sellers (Sharp 2012). Individuals did not have the option to accept ‘less or more than the fair amount’ (Keil 1977:273) because it puts pressure on the whole group to do the same.

Other accounts of Melanesian trade offer competing explanations for how exchange value is set. Gewertz’s (1983) study of barter relations in Middle Sepik where the relative worth of the fish to sago meant that a ‘ritualised, interactional pattern’ that emphasised the ‘bush inferiority’ of Sawos to the Iatmul keep the exchange system going. Epstein’s (1982) description of monetised urban marketing establishes the role of convention in setting the rate of ‘one pile of tomatoes for 10 toea’. This price form is based on a lagged response to demand fluctuations and is not a real time barometer of changes in supply and demand.

Wide engagement with Melanesian ideas of transactibility and a ‘tiered calculus of value’ (Modjeska 1985) has generated a large literature dominated by detailed ethnographic accounts, especially by substantivist anthropologists. For the purposes of this study, there are three aspects of this literature that helps illuminate the social and historical underpinnings of economic exchange.

These are:

- the cultural calculations that accompany attempts at establishing commensurability or ‘establishing equivalences’ (Strathern 1992),
- the gift economy and the possibility of possessive individualism and
- market relationships and the way in which trade with ‘known and unknown others’ is changing

In all cases referred to above, both barter (Godelier 1977, Gewertz 1983) and those based on cash transactions (Epstein 1982), exchange involves incommensurable entities changing hands. Considerable effort has gone into understanding the manner in which the relative worth of these goods was established and the implications of the principles of valuation used. Gewertz observed that along the Sepik river, one fish was traded for one piece of sago at a market every few days. Since the Sawos women work at least three times as hard to produce the sago as the Iatmul women do to catch the fish, she sees this commodity barter as intrinsically exploitative. The men in these two groups, however, exchange the prestige goods of shells for axes, through partnerships. Similarly, Godelier observed the rate of 1 bar of salt

for 6 bark capes, which he characterises as an unequal trade given the days of labour put in to create these items. Bradby clarifies that it is not labour days that causes the unequal exchange – she excludes women's labour, which is not valued under this system, and proposes that the 1 for 6 ratio represents roughly equal input in terms of men's labour days. While anthropologists problematise these exchange ratios, for the parties involved in the trade these units are comparable and equivalent. Strathern (1992) applies her theory of partible person-object relationships to illuminate how people establish substitutability; as the analytic focus on the point of exchange obscures how people see the equivalence of units. She proposes that within Melanesian exchange systems, 'enumeration is an aspect of quality' and thus, number is a qualitative attribute (1992:182). Therefore, unit equivalence emerges relationally, as both an 'outcome and precondition of transaction' (1992:185).

There is further evidence for this proposition, as Modjeska (1985: 158) notes, that within the urban market, transactions do not occur based on price per kilo but are based on a qualitative assessment of units. Therefore, with respect to Epstein's case, people compare the 'size, number and condition' of tomatoes sold in bundles – i.e. 'qualities per unit offered at unit prices'.

Secondly, if the proposition of 'partibility' holds and transactions generate ongoing relationships between objects and people, do buyers have full ownership of the goods they purchase? Have ideas of personhood characterised by dividualism changed into one of possessive individualism, where there is a severing of relationship with the previous owner, when goods change hands? While the majority of research has tended to focus on the gift form of exchange, at the expense of non-ceremonial commodity trade, recent work and notable exceptions in this tradition point out how people's engagement with money and commodities can still be based around notions of composite dividuals, with goods viewed as part of their personhood (Mosko 2013). The 'gift' is created based on the 'capacity of actors to extract or elicit from others items that then become the object of their relationship' (Strathern 1992:177). However, the important finding from this research is that even commodity type transactions can be constitutive of relationships and the calculations of how large a sago piece for the fish reflects how 'the person appears in the other's eyes'. Dalsgaard's (2013) ethnographic work shows the hybrid use of individualism, where town dwellers make exhortations of self-reliance to their village based kin who have expectations

of them but rely on the gift economy and support from their *wantoks* when they return to, say, contest an election.

Given the emphasis on dyads and partnerships that structure traditional trade patterns, the changes brought in by marketplaces mean that people need to consider how to engage with known and unknown others. This thesis aims to document the entanglements of information, communication technologies (ICTs) in the value chains of the coffee and fresh produce commodities – vendors and middle buyers do not engage in cash based 'bisnis' solely for social reasons and given the changes in the modern context, both value chains under scrutiny are not gift based. However, as will become clear in the following chapters, the organisation of trade is not based on rationalised transactions between strangers; instead, relational aspects in the construction of markets continue to be relevant.

During a fieldwork visit to one of the villages in the Goroka district, I witnessed a coffee cooperative embarking on a new partnership with the local office of an international NGO. They expected that this connection would open up overseas markets for their parchment and lead to training to improve the quality of their coffee which would then fetch a better price. At the start of this engagement, and on occasions when the NGO manager would venture out into the village for a visit, there were *mumu* and *singsing* ceremonies and even the offer of a *bilum* dress. A carton of lamb flaps, which cost 250 Kina, was organised to give to members who were travelling a long distance to be part of the ceremony. Therefore, participation in the 'modern' market economy was marked with clear signifiers of 'traditional' status and ritual exchanges.

While building on these early studies of the commodity mode of transaction, descriptions of modern markets and bisnis in PNG emphasise the influence of the local exchange economy on purchasing decisions (Curry 2003). Economic geographers studying the emergence of small business enterprises use the case of the village tradestore to demonstrate how, both in its running and stocking of store goods, decisions are driven by social objectives, as much as by the expectation of profit. This is also true of the rural village members' engagement with the store as consumers. George Curry (2003) describes the very small quantities of goods being purchased because bulk buying would mean that relatives could lay claim to the laundry detergent, sugar or cigarette packets bought and the villager would have to oblige these requests. With regard to the minimal, and seasonal, profit generated from the store,

often other aspects of the village based subsistence system, such as cash cropping or the fresh produce garden, subsidised its running costs.

Curry (2003:114) observes that these apparent 'forerunners of emergent rural capitalism', are left unattended for most of the day and usually operate in the early evening, or during the coffee season, when there is money to spend. In terms of investment of capital, the description of cases in his field site in Wosera (East Sepik Province) indicate that the kinship role of some of the investors need to be taken into consideration to understand practices. The mother's brother of the tradestore owner, who was an investor, refused a return from the business which demonstrates how even cash, ostensibly used as capital investment, is earmarked as an investment into furthering social relationships. Accounts of clan members feeling obligated to purchase from members of their own group and feeling entitled to credit at these stores speak to the influence of kin based village settlement patterns (Sharp 2012, Grossman 1986) on the demands on the local tradestore.

Entanglement with the local prestige economy is evident in the way owning tradestores are symbolic of a group's success in engaging with the modern world (Goddard 1995). These contradictions are inherent in the symbolic and status based utility of cash cropping coffee as well. Paige West (2012) demonstrates how those who grow and trade in coffee as a cash crop see themselves as 'modern' while the industry markets their produce in the global North by casting them as 'imagined primitives'. Furthermore, the objectives of these enterprises can go beyond economic profit into creating status symbols and conspicuous displays of wealth like vehicles and well stocked tradestores with concrete flooring built of modern materials. Therefore, when profit is rerouted into such 'non-market' objectives, these business enterprises can seem like an abject failure and a contradiction in terms.

For development practitioners, especially within the current aid paradigm of fostering private sector led growth and market development in PNG's agricultural sector (ACIAR and AustralianAid 2016), these 'failed businesses' would represent irrational priorities that require reorientation. Donor funded solutions focusing on regional growth such as investment in agribusiness skills, financial acumen training and facilitated market access are similar to the misinformed colonial agrarian doctrine of development focussed around raising productivity and the intensification of smallholder farming (Wright 2002, MacWilliam 2013).

Market based approaches to aid are exemplified by Australian funded programs working in PNG's Agricultural sector. Currently these include:

1. Market development facility,
2. Pacific Horticulture and Agriculture Market Access Program,
3. Commodity Support Facility,
4. Incentive Fund,
5. Transformative Agriculture and Enterprise Development Program (TADEP),
6. Trade and Biosecurity Cooperation

These market-centric projects form the core of the Aus-PNG government cooperation portfolio and amount to a sizable proportion of the total Official Development Assistance outlays to PNG. Each of these has a deliberate program level focus on encouraging formal economic participation by intensifying and commercialising the agricultural sector under the Australian aid programme's new strategic direction. This aim to transform existing indigenous economic behaviour by generating a new market orientation and business acumen forms the basis on which aid projects currently engage in PNG.

Post-development scholars and critiques of conventional approaches to development (Koczberski et al. 2001, Curry 2003, Patterson and Macintyre 2011) have been quick to point out the linear assumptions that accompany the efforts to get developing countries to 'catch up' with 'advanced', post industrial economies by making calculable, rational and efficient markets. Modernisation theory promulgates an economic model based on an evolutionary and 'staged trajectory of development' (Curry 2005). Such approaches naturalise uneven economic development because congealed in these economic models are specific cultural understandings of (unidirectional) development trajectories where spatial differences between the Global North and South are seen to be a result of time rather than uneven capitalist development. Researchers have pointed out how at the centre of instrumental approaches to stimulating economic growth are prescriptive, neoliberal 'regimes of governmentality at odds with Melanesian ways of seeing and being in the world' (West 2012). Recent theoretical frameworks have, however, adopted more holistic approaches to understanding economic behaviour. Rather than assume that it is the lack of financial literacy or the absence of a self-interested, individualistic economic return maximising impulse that impedes the commercialisation of agriculture in PNG, recent research has attempted to place market based transactions and economic activity in context.

One of the most vibrant and influential intellectual projects of economic sociology (and anthropology) in the last three decades has been the reclaiming and socialising of market relations and the dismantling of the division of labour between sociologists and economists where the latter study economic transactions and the former their social impacts. In the words of David Stark (2011:7):

> *Talcott Parsons made a pact... You, the economists, study value; we sociologists study values. You study the economy; we study the social relations in which economies are embedded.*

In an attempt to break away from the above disciplinary division of labour, there is now a long tradition of work that traces the embeddedness of the economy in social relationships and organisational networks (in the Granovetterian tradition) and the co-evolution of markets and the polity (Fligstein 2001, Polanyi 1944). Approaches that incorporate this disciplinary shift have been fruitfully applied to the Melanesian context and have illuminated various unique characteristics of economic behaviour in PNG. Recent work (Curry and Koczberski 2012, Sharp 2012) has delineated the continuing significance of social institutions, such as kinship in organising labour and land tenure and the role of norm based prestige and the gift economy in determining decisions. The social embeddedness approach has made evident the modern context and determining characteristics of marketplaces in PNG and the manner in which socio-economic factors affect smallholder coffee production (Curry et al. 2017)

However, later developments in new economic sociology challenge the stable boundaries between the social and the economic for social relationships to provide a context for a separate and autonomous 'economic' as imagined by the embeddedness thesis. Scholars like Viviana Zelizer (2012) have critiqued the 'hostile worlds' conception of an economic sphere defined by a competitive, zero-sum transactional logic and a different exchange logic characterising the social. Instead, it has been proposed that the market is not just embedded in social relationships but are social relationships (White 2002).

Using ethnographic evidence to delineate the social meaning of money, Zelizer develops a processual, relational understanding of economic life as opposed to the macro/structural perspective of embeddedness theory. She accomplishes this by drawing attention to the interactive way in which interpersonal negotiations and the symbolic cultural work of

creating shared meanings not just determines but constitutes all economic activity. She throws into confusion settled notions of an identifiable economic distinct from the social. She suggests that economic action divided into 'arms-length'/asocial relations and embedded transactions doesn't go far enough to illuminate the continuous negotiations required at every instance.

> *…in all areas of economic life people are creating, maintaining, symbolizing, and transforming meaningful social relations (Zelizer 2012:149)*

From this perspective social relationships and a priori institutions do not just structure economic action; instead, asking where the social ends and the economic begins becomes an irrelevant question. At the core of every market transaction or exchange is a process of establishing boundaries between relations, confirming some relations while avoiding others and interactively negotiating what will and will not be exchanged. Zelizer and others writing in this vein use the term 'relational work' to signify these continuous negotiations (Bandelj 2012, Whitford 2012). In asymmetric trading partnerships, this involves interpreting the position of others and ensuring cooperation. Therefore establishing commensurability and distinguishing between meaningful categories is not just relevant in the 'pre-market' scenario of a fish to sago or a salt for bark capes trade. Relational work of setting up equivalences between disparate units needs to be done to establish creditworthiness of potential clients, in recruitment interviews to gauge trustworthiness, and when engaging strategies like withholding of information or hedging risk when a manufacturer enters into a new alliance with a supplier at the inter-organisational level. In the book, the *Purchase of Intimacy*, Zelizer (2005) demonstrates how money is used to earmark and 'designate certain sorts of economic transactions as appropriate for the relation and bar other transactions as inappropriate'. While she discusses this in the context of household economics, health care and insurance in this book, the same mechanisms are at play in a variety of modern cases such as monetary compensation, valuation of customary land and the quantification of environmental impacts.

While the call to go beyond embeddedness is no longer a novel proposition, some theorists have taken this decentring of the economy further to ask if economists make markets. In the intellectual soul searching that followed the global financial crisis, there has been renewed debate on the role of economic models in co-performing the economy and a refocusing of attention to marketisation and financialisation processes. The efficacy and epistemological limits of neoclassical economics, with its lack of empirical testing and unnatural fascination with mathematical formalism, has been called into doubt (Engelen et al. 2012, Mirowski

2013). Landmark studies of economic expertise have examined economic modelling, the atomistic efficient markets hypothesis (Borch 2007), the sociality of price information (Pardo-Guerra 2010) and technology mediated market behaviour to show how devices and models can 'perform' markets. Instead of just observing and describing their principles, economic models especially those dealing with deterritorialised, 'immaterial' forms of labour and value in quantitative finance have been shown to recreate reality in its image (Hardie and MacKenzie 2007, Beunza and Stark 2012). When enough traders use these derivatives models to look for social cues before deciding how to act in highly abstract forms of economic exchange, processes of herding are said to be activated. This in turn creates interdependent decisions which generate a self-propagating bubble and subsequent financial crashes.

MacKenzie (2006) uses the Black-Scholes-Merton model to differentiate between a weak and strong version of 'performativity' where its use altered 'patterns of market prices towards what the model postulated' (2006:23). A key proposition of this literature is that 'economic theories and artefacts format the economy by shaping the way in which value is calculated' (Beunza and Garud 2007). For example, in the first few years after Amazon as a company was instituted, analysts were tasked with valuing its stocks. A controversy emerged between those that categorised its unprecedented business model as 'e-commerce' or 'internet firm' during the late 1990s and those that compared it to the declining profit potentials of the book selling industry. The role of market actors in projecting and then creating those profit opportunities for Amazon draws attention to the interventions that can be made into economic processes by categorisations and performative descriptions. While this is an increasingly influential way of looking at economic activity, other researchers have pointed out the narrow empirical focus of the performativity thesis within financial economics where the buyer and sellers roles can be switched frequently ('exchange role markets' – Aspers 2011). The questionable empirical validity of this proposition in 'fixed role markets' such as the producer markets for commodities (like coffee) we study presents a major limitation. However, the insistence on the need to embrace certain market forms and the push for commercialised farming practices cannot but create reality in its image and have long term consequences. In chapter six we see how confidence in technological innovation and the developmentalist discourse of mobile phones and their transformative potential in the circulation of price information, casts and structures the market in a certain way.

It is, therefore, instructive to refer back to this toolkit of theories of economic action when analysing whether the predicted impacts of the mobile phone bear out on the ground. This theoretical exploration and grounding in existing research is particularly important while delineating the relationships surrounding economic exchange and commodity trade in Papua New Guinea in a research area that is dominated by the 'gift'.

In the detailed empirical chapters that follow, there are various instances where the economistic, developmentalist expectations of arbitrage, price information producing better market efficiency and digital disintermediation are subverted by unexpected uses of the mobile phone. Chapter 4 highlights how different price forms emerge from the interactions with middlebuyers showing how important the relational work of interactively negotiating between trading partners what will and will not be exchanged. The empirical data shows how unrealistic the ideal typical notion of perfect competition is; where unknown buyers and sellers come together over a one off transaction and goods change hands. Market relationships in this context are ongoing and repeated transactions build trust and norms. It becomes apparent that only approaches that don't pay heed to the relational context and the situated processes that produce the organisation of trade in PNG can come up with atomistic conceptions of information and fetishise current market prices delivered via phones. The following chapters provide several discussions of how price is set in food markets by establishing commensurability (chapter 6.3), descriptions of coffee parchment quality and the subjective valuations of the credibility of trading partners (chapter 5.2) and the non-instrumental use of phones to enliven social relationships (6.1) and fulfil cultural obligations (4.2). This shows that economic behaviour of the smallholder farmer is motivated and structured more by the holistic considerations detailed in this section rather than by just a self-interested, individualistic profit maximisation motive realised by pursuing the highest price for their produce.

4 Digital Disintermediation and the Social Role of the *Namelman*

The need to pay heed to the situated processes that produce the organisation and conduct of trade in Melanesian marketplaces is evident from an emerging body of literature. We have reviewed the variety of ways in which economic practices shape and are shaped by kinship, convention and cultural institutions that are usually considered to be neatly tucked away in 'the social'. What is important to note is the particular relevance of this approach in understanding the dynamics of trade in the rural setting where the local 'exchange economy remains strong' (Curry 2005:142). The capacity of the mobile phone to structurally change the returns from the coffee industry needs to be seen in the light of the above discussion.

One of the key propositions of the ICTs for Development literature is that mobile phones have the potential to tackle the challenges of information 'absence, uncertainty and asymmetry' (Jagun et al. 2008) in developing contexts. Producing a more efficient value chain by removing the informational advantage of intermediaries between the producer and the end market, it is hypothesized that ICTs can have enduring structural effects. This process is referred to as digital disintermediation where a 'rent seeking' middleman can be bypassed by connecting the grower directly to the buyer. This chapter reports findings that show that since it isn't just disembodied, atomised information that drives trade, the main role of the phone lies in its utility in lubricating the value chain through coordination work. The potential transformative effects leading up to an all-encompassing digital provide are thus mediated by the use of phones within the local relational and obligation structures.

According to accounts of early colonial history, long distance trade networks were the prerogative of the seafaring lowlands (Sharp 2012, Hughes 1977, Harding 1967). In contrast, Highlanders were known to travel short distances (not more than 24 km) while their goods travelled longer[28]. However, there are now reports of the growing complexity of trade and changing marketing arrangements in an area once dominated by producer sellers (Sharp 2014, Epstein 1982). Correspondingly, in the coffee value chain, there are several points of sale between the grower and the exporter even for those selling the processed green bean. Given the scale of this North-South commodity chain, after the exporter, the coffee is transported and then handled by roasters, traders and passes through numerous hands before

[28] A notable exception is the Huli of the Southern Highlands who engaged in trade up to 70 km from their territory (Sharp 2012, Ballard 1994 and Healey 1990).

making it to the morning cup globally. Even if we are to focus on the flow of the commodity from the grower to the exporters in Goroka, the coffee trade forms a fairly long, well differentiated value chain. Data from the households surveyed in the four site sites reflects this with only one grower in the sample claiming to sell directly to the exporters in Goroka.

Findings from in-depth interviews with actors at various points in the value chain, accounting for different sourcing arrangements, distance to market and varying levels of remoteness, show that much of the benefits of the mobile phone accrue at the upstream end of the value chain. Several farmers described coffee seasons when they contacted buyers over the phone to coordinate the pick-up of an organised volume of parchment bags from the village. Those who had phone numbers of several buyers and actively called them up one after the other for the best price were fewer. Among farmers there is a lot of variability in the cultural understandings of how their activities feed into the complete chain as they do not have a full view of it. However there is an emerging discourse around a profiteering middleman or a '*namelman*' who organised coffee cooperatives seek to do away with in their aspirations to connect to newer markets. The activities of the village buyers, roadside buyers and exporters that are homogenised into the single, disaggregated category of the '*namelman*' include providing transport, hedging risks, bulking and breaking produce by volume and contributing to the circulation of cash in remote locations. Their understanding of their social value and role in the chain is radically different to how growers see their activities. Many resourceful farmers enter and exit the role of the village buyer when they have the money for it.

The relative advantages of these intermediaries lie in their access to credit from exporters and processing factory managers and their structural role in the chain rather than from informational advantages represented by a current knowledge of the market price. Smallholder farmers who now contribute up to 85% of the total coffee output in PNG (Imbun 2014:27)[29], do not individually produce the volume required to interest exporters. Therefore, even with the exporter's phone number and this new found connectivity, bypassing the middlebuyer completely is not a viable option in this opportunity structure. As described later on in the chapter, those with access to large volumes of coffee and cooperative leaders do use phones to help them make decisions about where to sell coffee. Therefore, the

[29] This is a significant sector wide change with the smallholder contribution to volume of coffee output growing from 65% in 1985 to 85 % in 2005. Concurrently, the large plantation holdings (that used to be owned by Australians in what was once a 'white man's business') shrunk post-independence and continues to decline in its contribution to total volume of coffee export.

disintermediating potential of the mobile phone is embedded within structural factors and existing trade practices. While development interventions driven by a cursory reading of global ICTD policies and success stories in a way that strips them of their interpretative context elide over this crucial detail, techno-optimism needs to be tempered by ground reality.

4.1 Seeing Like a Smallholder Farmer

Had liklik... ol baia makim mipela had... middleman ol tasol... ol man i got ka
…ol i save plaim smatpela technique kisim olgeta coffee bilong kommunit. Ol win, mipela lus

"It is a little hard… the buyer makes [life] hard for us… especially the middleman, he has a car and knows to use 'smart techniques' to collect the coffee from the community. He wins, we lose."

Farmer, Sukapass, Goroka District,
Interview 7, 20th July 2015

The above reference to the devious or 'smatpela' techniques employed by middlemen to extract coffee from the village came from a Kamano-Kafe speaking farmer. His family or 'bush-line' resided in a remote part of Akameku where a new coffee cooperative was trying establish its presence. He explained how owing to the asymmetric access to transport, middlebuyers would wait for prices to drop before driving out to the community to collect coffee bags. Public motor vehicle (PMV) costs the last time he had to carry a bag of parchment into Goroka town was 20 toea per kilo in addition to his personal fare of 1.5 Kina from the Sukapass junction (which was in turn a considerable distance from his family's coffee garden).

The running rate for parchment on that day was a low 3.5 Kina per kilo, so he was able to secure Kina 175 or $ 72.9 for his 50 kg bag. Up to 6% of the income from this sale went towards the transport of the parchment bag. Given the dearth of reliable data on the labour time associated with harvesting, pulping and drying a bag of coffee, I draw on Paige West's estimates from a survey of 50 families during 2004-2007. She suggests that at least 286 hours are spent in producing a 60 kg bag of coffee[30] which amounts to 238 hours per 50 kg bag. Coffee is the largest source of income across the research sites with 83.22% of the households saying that they earned an income from it (see figure 5 below). Therefore, given

[30] West (2012)'s figures are for 'airstrip coffee' in the Maimafu region that has to get the coffee by air to Goroka. The time spent in carrying the coffee from the village to the airstrip is 1 hours and 50 minutes. Therefore, for our purposes, we can estimate that 284.5 hours are spent in producing a 60 kg bag of coffee.

the already low (hypothetical) rate of 72.9 $ for a month of work (238 divided by 8 hour days) on the largest source of income for the household, carving off an additional percentage off it so that the middle buyer can have a profit margin would squeeze the household even further. Understandably, the anger and frustration at these 'rent seeking' strategies employed by middlemen to further shift price draws from the very little leeway that a grower has in a subsistence setting.

Figure 5: Household Sources of Income in Last 12 months (from survey of 143 households)

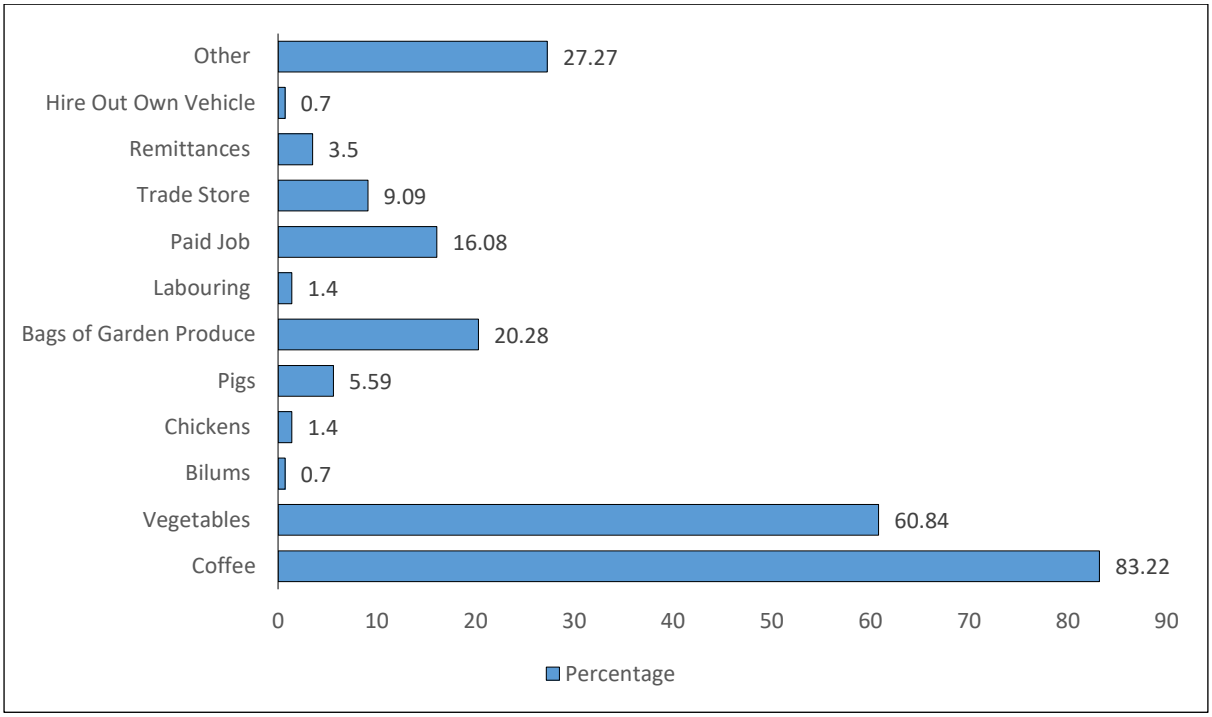


Table 5: Low End Estimates of Labour Associated with Harvesting One Pound of Coffee (West 2012:125)

Walk to garden (Carrying tools, food, water, and children)	30 minutes
Climb tree	5 minutes
Pick one cherry (two beans)	5 seconds
Pick 1500 cherries (1 pound or .45 kg)	2 hours 5 minutes
Pick 198,000 cherries (one bag: 132 lbs or 60 kg)	275 hours
Carry coffee to water for washing	40 minutes
Wash coffee (once as cherry, once when pulped, several times after fermenting)	2 hours
Store coffee in bags	10 minutes
Pulp coffee with hand-cranked hulling machine and bag for fermentation process	3 hours
Unpack and spread coffee on top for drying (twice)	1 hour 20 minutes
Pack and store coffee (twice)	40 minutes
Various other drying labours (turning mats in sun, shooing away chickens, dogs, children, and captive cassowaries)	1 hour
Carry coffee between village and washing to village airstrip in 60	1 hour 50 minutes

kg bags	
Total	**286 hours for 132 lbs, or 60 kg**

Source: Data generated by Paige West based on average of fifty time allocations for fifty families

There were several other reports of the entrenched locational disadvantage of coffee smallholder growers in remote settings. However, respondents were quick to point out that since coffee has been a major cash crop for a long time most people, and especially those who lived near Goroka town knew the current coffee price. When asked about the possibility of middle buyers misrepresenting price, several coffee growers vehemently referred to the 'Highlands spirit'. This meant that as opposed to the supposed meekness of those in the coastal areas, Highlanders were not shy about applying pressure on a buyer who has reneged on a promised price. A coffee cooperative leader with a long history of involvement in the coffee trade recounted instances where farmers have gone so far as to aggressively demand compensation when after organising bags of coffee, the middle buyer was unable to pay the promised price due to global commodity price fluctuations.

While the middle buyer is much maligned in specialty coffee marketing material aimed at the niche, ethical consumer in the Global North (West 2010), it is an exaggeration to claim that they are an undifferentiated group of exploitative info-mediaries who block access to market and critical information. There is not much research on the figure of the middle buyer but West (2010) in her review of these marketing narratives draws attention to these cultivated misunderstandings that obscure their social value and are quite essential to the workings of the ethical coffee global supply chain (Tsing 2011).

The majority of the positional advantages of the middle buyer are to do with assets and infrastructure for moving coffee and are rarely informational. The only 'information rent' (Mahdi 2012) being captured has to do with coffee quality and mobile phones have little leveraging capacity there.

> *Exporters just want coffee, they don't care how we bring it to them… They want to get all our coffee, [they] bulk it up and say it is Y Grade... Then they grade it again after factory processing and charge a better price per kilo. [They tell us to] just work the field and come and give us your coffee. Your coffee is all Y grade, you don't know the business, we do.*
> *…They give money to these middle buyers, how they do their mark-up is not the problem of the exporter.*

Coffee cooperative leader, Unggai Bena District,
Interview 37, 11th June 2017

The exporters have a contact farmer network other than for which they source the bulk of their coffee through intermediaries such as traders or middle buyers. The grading of coffee into X, Y, A, AA by a quality control specialist after cupping and tasting at the exporter's premises has implications for the price the farmer is able to take home. The information asymmetry that arises at this point of the trade derives from the buyers being able to observe the quality of the product while the farmer is not. Some of the more organised cooperatives have plans to train up a cupping and tasting specialist from the community but these plans are far from being realised. There is additional emphasis being placed on training farmers to pulp, bag and dry the cherry the same day as it is picked so as to decrease the moisture content generated through over fermentation when it is stored for too long.

> *Sampela taim ol i traim daunim prais. Olsem ol i toktok, ay, kofi bilong yu i pulap long skin, 'rabis', bagarap – mi givim yu 3.50 Kina tasol*
>
> *sampela taim oli tok kros/tok pait*
>
> *Yu go wanem taim, mipela wanbel o wantok prais em ol baim mipela*
>
> *Sometimes they try to bring the price down. They'll say your coffee [has not been dried properly and] still has skin on it, it is rubbish… so I will give you just 3:50 Kina… We then argue about it… we could keep going on about it or just settle on an agreed price.*
>
> *Farmer, Goroka District,*
> *Interview 4, 17th July 2015*

The above quote refers to attempts by a mobile buyer to shift the price based on the perceived quality of the parchment being sold. Several farmers recounted such disputes but the reference to '*wanbel'* or *'wantok price'* is suggestive. Field observations from groups and individual growers bringing in parchment for sale at the open market in Goroka during the peak coffee season (July to September) in 2015 and 2017 show that some farmers would habitually go up to a known buyer directly. There was a variation of price of up to one Kina (per kg) among the roadside buyers a certain day. I observed that instead of surveying the line of roadside buyers, growers, especially those with small quantities of coffee headed to buyers they knew from the village '*hauslain'* or one they trade with on a regular basis.

The prevalence of terms like '*wanbel'* or '*wantok* price[31] or even 'bulk price' along with the market price, show that several price forms emerge from the interactions with middlebuyers. The former two terms that essentially mean 'mates rates' denote that congealed in the official market price are specific cultural understandings of the value of the commodity being transacted with respect to the relational distance between the trading parties. In Tok Pisin, *wantok* [32] refers to someone from the same language group. This term is widely thought to conjure a sense of 'familiarity and mutual solidarity' (Schram 2015) when used within the urban context or the modern marketplace that is supposedly stripped of the intimacy of co-located kinship based attachments. Ryan Schram argues that its use is strategically motivated to induce 'familiar relationships in uncertain situations' and hail back to the ties left behind at an (imagined) distant village through the activation of a sense of displacement and separation anxiety. Even though in the quote above, *wanbel* means agreement, its etymological origins refer to unity. It is a composite derived from 'one' and 'bel' or the stomach as the seat of emotions, affections and thought; therefore it is similar to the notion of '*wantok'* in that it again signifies the intimacy of 'tribal' or place based ties.

The role of the middle buyer cannot be abstracted from the context of the relationship. As is evident from the above examples, the relational context before and after the trade is as important as the interaction at the point of transaction. Therefore the idea that phones can be used to do away with the interactions between growers and middle men is ill founded. It misrecognises their role and advantages in the value chain and perpetuates an economistic, technocratic vision of inducing value chain efficiency without taking stock of the substance of these chains. Even while denying the alternate logics of intimacy and worth that structure economic practices, the disintermediation thesis misrecognises the fault lines and points of negotiation in the chain that give middle buyers an advantage. The proposition is that a simple, quick call to a list of buyers to ascertain the highest price will generate market knowledge and bargaining power. In practice however, efforts to shift price are rarely made by invoking an alternate buyer prepared to pay a higher price. Disputes and points of negotiation in the coffee open market in Goroka are to do with parchment quality and the weight displayed on the scale.

[31] One grower talked of '*lapun* price' or the price given to an 'old hand' or someone who has been a trading partner for a long time.

[32] 'Wantok' which literally means those who speak the same language, but is generally extended to mean members of one's clan or subclan. Not only can wantok refer to those who share kinship ties, but it extends out, depending on the context, to people who share the same language, are from the same area, from the same island and the same region of the world (Brigg 2009:153; see also Nanau 2011).

In addition to patronising known, *hauslain*[33] buyers in a line-up of about 10 roadside buyers working for various processing factories and exporters, several respondents reported that they preferred to go to the only female buyer on the other side of the road. She had a 20 kg block of iron used to verify and reassure the grower that her scales were correct and she is willing to pay a fair price. There were complaints that roadside buyers frequently manipulate and recalibrate their scales so that a 20 kg bag of coffee will read as 17 kg. This female roadside buyer who self-identified as a trader (because she bought parchment, got it processed and sold it to the exporters as green bean) had established a reputation for the integrity of her scales using the block of iron. This had now come to be regarded as a gold standard or a reference point and used by growers to check the weight of their coffee bag even if they intended to sell it across the road to one of the other roadside buyers.

> *Competitors will come and try to embarrass you saying that you are cheating people... A buyer might send someone pretending to be a grower with a bag of coffee that they claim is 25 kg that is reading as 20 kg on the scales [because that is its actual weight]. We show them the iron, weigh it and then say, this is a 20 kg iron block; if your coffee is 25 kg it will read 25 kg.*
> *...farmers have a lot of trust in our scale, I have seen them take the other [buyers'] coffee and throw it away and say we* ***know*** *this scale [sic], we trust them*
>
> *Husband of the female roadside trader, Goroka, Interview 49, 13th June 17*

This foregrounds the role of trust amongst trading partners. Also important is the role of reputational capital in driving decisions about where to sell coffee. Given the sociality and stickiness of existing buying practices, what use is the mobile phone to growers in helping them sort between potential buyers?

4.2 Impersonal information and the affective ties that bind

Burrell (2014) points out that the majority of recent literature on the topic falls into two categories. One views phones in developing markets from an instrumental perspective as an 'information delivery platform' (Wyche and Steinfield 2015) for farmers, the use of which needs to be encouraged to strategically maximise profit from a sale. It is regarded as a means to overcome the single largest impediment to market efficiency – the farmers' supposed 'lack of knowledge about where and from whom to get the best price for their goods' (Burrell 2014:581). The other approach shows the limitations of this 'info-centric approach' by

[33] Hauslain refers to those from the same sub clan or lineage or those living in a hamlet.

emphasising the continuing necessity of unmediated interaction to build 'trusted relationships'. Both miss the mark and she argues that this opposition derives from a worldview that reifies information and defines it 'as impersonal and as independent of source, a definition that is Euro-American in origins' (2014:581). She calls for research that privileges the preferences, the active role and capacity of mobile phone users to 'do development' themselves. Shifting the analytical focus in this manner would be infinitely preferable to starting with the a priori assumption of the need for modernising inefficient markets in developing countries and using mobile phones to deliver that outcome through the circulation of 'impersonal information'.

The head of an umbrella community organisation who led around 2000 farmers and 23 affiliate groups in four clusters described the challenges of transporting coffee from some of the more remote cluster areas on the border of the Chimbu province (cluster 3). She and her husband had a 20 hectare coffee block in Masumave, 10 km east of Goroka, and produced plantation grade coffee (AX grade) that fetched a good price. With the help of the government regulatory body (CIC – Coffee Industry Cooperation) and an international NGO, they had successfully created a roasted and packaged specialty, single origin coffee product for marketing at stalls at the Port Moresby international airport and niche cafes. The rest of the farmers in the group were smallholders whose parchment would normally go into the lowest priced Y grade to be blended according to exporter requirements at scale and not a small lot specialty market. While trying to pass on best practice, post harvesting training to them, she spoke about advocating for their coffee to go into the organic premium smallholder coffee pool (PSC grade) so that it they can get a better price.

> *Ours is no ordinary coffee… ours is good quality coffee that has been taken care of from the garden… we want to get exporters to go there and buy straight from the door. We don't want to go through the complications of bringing it to them. They will organise transport, go there and bring them.*
>
> *…the mobile phone is a great tool for the remote farmers. Even though they are far away, they can communicate, they can know who is offering what price and make arrangements for transport. [They can say]* ***we got good coffee here, can you come? And we have volume.***
>
> *Community leader, Masumave, Unggai Bena District, Interview 39, 11th June 2017*

While she had high hopes for mobile phones in the coordination of trade, like the connections to exporters she spoke about, these were expectations rather than reality. Follow up

discussions with farmers from Nivi which fell halfway between Lufa and Goroka in the remote cluster 3 (referred to in Chapter 3), revealed that a key community leader's phone had been stolen a while ago. He didn't have any intention of replacing the handset which was 'pulled' when he had it conspicuously displayed while gambling at the community grounds. Since the village in that region had no electricity, there were reports of cheap handsets permanently damaged by the voltage fluctuations caused by the generator while charging. The situated logic of mobile phones in the coffee value chain is severely circumscribed by the material conditions of their use. Except for a few notable exceptions, most of the mobile numbers she dialled so that I could arrange follow up interviews, received no answer because the user was either out of range or had no battery charge because of electricity blackouts. For the purposes of sending word about cooperative activities (*tok save*), she admitted that they might not have their phones on and that she would have to send out someone to get the message out to them based on her knowledge of where they were at that point in time - doing business at the trade store or selling kaukau (sweet potato) at the Goroka market.

The only instance of ongoing phone based buying arrangements was in the Gehatiga hamlet of Gotobe plantation, Unggai Bena. This community had no access to electricity which meant that they had to charge their phones using solar panels or generators owned by a *hauslain* or some of their more entrepreneurial residents. Often the charging of phones to full battery capacity involved a fee in spite of which there were reports that they would '*ringim buyer*' from the first time I entered the community for fieldwork in 2015. In addition to not having running water or electricity, the hamlet was a 5 km uphill bush walk from the main road. There was a narrow slippery bush road on which the large 60 kg bags of parchment had to be carried in order to get it to buyers who are able to drive only up to the main road. On probing further, one of the key informants revealed that all the coffee of the season was organised and collected together and sold to the exporter in Goroka, called Coffee Connections because her husband's sister's son works there. Before the advent of mobile phones, the 'boys' of the village would go to Goroka to check coffee prices before their *hauslain* would commit to a sale but during the 2017 coffee season, they were able to call a few buyers before deciding to sell to Coffee Connections. This is an unusual instance of coordinating enough volume before approaching an exporter directly and was crucially mediated by familiar ties.

During the 2015 coffee season, there were reports that instead of selling to cherry buyers by the road and to Novack, the nearby processing factory, several families had used mobile

based marketing strategies to contact middle buyers from outside the district. The week when parchment was sold, a buyer in Lufa was offering high prices. The 45 year old respondent who organised for the middle buyer to come to them said that he had held off on selling the coffee for about 3 months waiting for prices to rise. The social composition of this village was unique in that the majority of families had moved there over 40 years ago from Lufa to work on the Gotobe coffee plantation which was then a large block holding run by an Australian. They had settled in Gehatiga but spoke the Arikanu language used widely in the Lufa area even though most were fluent in Tok Pisin. They had maintained ties with family in Lufa and they were alerted to the price offered by the buyer by *wantok* in Lufa. A few key community leaders had in that instance found out that the price being offered was higher than in nearby Goroka and that the buyer was prepared to organise transport to come to them.

Approaches that emphasise the modernising effect of phones in producing efficient markets, arbitrage and weeding away superfluous intermediary roles, abstract decision making from the relational context and overlook the familiar ties that coproduce trade decisions. Logics of intimacy and 'particularistic' affiliation is often referred to in a derisive context when the modernising developmentalist gaze engages with the notion of *wantok* to explain corruption or state capture by parochial elite groups. Such an approach misrepresents the interactional manner in which people verify if they can hold the voice on the other end of the line to the price being offered. The preoccupation with information asymmetries in value chains, overlooks the daily, communicative affordance of the mobile device. Mobiles do offer a new capacity for amplifying the extension efforts of the cooperative leader, to organise action when a 'heavy' or a family problem comes up, coordination work, and for information acquisition with the 'latter always inextricably connected to these other capacities' (Burrell 2014:582). A community leader reported that she usually has a queue of people asking to use her mobile phone to call the ambulance for them when there is someone sick. She often does not have credit on her phone so these petitioners come to her with flex cards that have been purchased after collecting contributions for it. Phone use is always mediated by the local relational and obligation structures and we have seen how this interactional context has a bearing on the marketing and sale of coffee through middlemen.

The majority of reports of the utility of mobile phones to coordinate trade show how it is used by growers to lubricate the value chain by asking a middle buyer to come at their expense, when a community has organised a large enough volume of parchment. Rather than to shop

around for prices or initiate new trade relationships, we have already seen how geographic frictions that abound in rural PNG are negotiated and existing arrangements lubricated through mobile use in the coffee value chain. Several growers said that they didn't have phone numbers of buyers but that they would call *wantok* near the Goroka roadside market to mobilise them to look at the prices for the day. In cases where they are able to 'ringim o chekim prais' (ring and check the price) directly, calls are placed to a '*save fes*' or a known face, meaning a known trader.

4.3 Middlebuyers and the Social Organisation of Trade

The relational basis of coordination is true in the case of middle buyers as well. As is evident from the value chain diagram (figure 6), the term 'middle man' refers to a diverse range of roles in the value chain. Exporters have at any given time at least 20 buyers on contract. Some of them are semi-autonomous traders who buy small portions of parchment, get it processed and sell it on to the exporters after getting a standard volume together. Others are mobile buyers who are dispatched to remote communities to gather coffee. Then there are the roadside parchment buyers in Goroka who are sometimes autonomous and sometimes work for a factory owner or an exporter. These buyers often compete for coffee from the growers who have either travelled to town on a PMV with up to two bags of parchment or managed to hire a vehicle to transport the coffee output of the whole village.

According to an exporting house staff member, sometimes when there isn't enough parchment coming in, they keep quoting prices that are higher than the buyer next to them without regard for any kind of economic rationality or what their contract with exporters would give them room to offer a grower. The prices I observed were in the 4 to 5 Kina range (per kilo) but I was told of years when prices have gone up to 7 Kina for parchment on a good day for global commodity prices when there was a shortage of coffee. Then there are village buyers who buy from a junction in a village that is distant from town or the point where the main road meets access tracks into smaller hamlets. They are usually coffee growers themselves with additional income sources or access to transport. A good proportion of coffee is grown in inaccessible communities across the Highlands that need to fly in their coffee, opening up various coordination points in this commodity flow from the missionary aviation airstrip in the remote village to when this 'airstrip coffee' (West 2012) lands in Goroka.

Using the term 'consultant' to explain the value of the middlebuyer to me, a former coffee trader elucidated the financial and physical risks they undertake while procuring coffee from remote communities. After talking about the ideals of the cooperative to bypass middlemen to reach as far as marketing to specialty markets overseas, two cooperative leaders said that middle buyers provide a 'door to door' service. In keeping with research that has shown how villages engage in cash cropping as an 'ATM' (Curry et al. 2007, Sharp 2015), when they need money for buying soap, for compensation[34], or school fees, growers often sell small lots of coffee. The middle buyer at the village injects cash into these communities who would otherwise have to travel to town to sell their produce or access banking facilities. Only a small percentage of the vast majority of the population that live away from urban centres have bank accounts and this figure was a meagre 25% in our sample (39.39% for households in Goroka District, dropping to 14.81% for households in the remoter Okapa District) with only 6.62% of women saying they had their own bank account.

Analysis of the use of mobile phones to coordinate the work of middlebuyers revealed that a majority of them owned phones and their professional use of them was much more sophisticated than the phone based marketing behaviour of growers. Several of them used it as a search technology and negotiated with exporters over the phone when they had accumulated a certain volume. A former career provincial government civil servant and EHP agricultural department head, who was now a coffee trader after retirement, spoke of how competitive the trade was. He moved between exporters six times in the last decade and had been selling primarily to New Guinea Highlands Coffee Exports since 2014. It is worth noting that the relationships between the middlebuyer and exporter even when contracts are used, are informal and flexible but in his case it had been fairly durable even though he is not locked into it. When asked about how he uses the mobile phone, he described the dynamics of price setting and negotiations between the middle buyer and the exporter:

> *[We say], we have volume, you have to give us a better price… or it is very competitive today and hard to get coffee from growers, you need to give us more money if you want the coffee…*
>
> *If exporter doesn't come good, we go to another to negotiate.*

[34] Compensation in the PNG context refers (Filer et al. 2000) to when there has been a conflict which has been resolved by an agreement to pay monetary compensation to the wronged party.

Middlebuyer/Trader, Goroka Roadside market, Interview 51, 13th June 17

Commenting on how his interactions with exporters impacted upon growers on the downstream end of the value chain he referred to the need to make a profit to stay afloat and that this was not just a feature of PNG business culture.

> *If you ask a millionaire in America, if he wants more money, he won't refuse…*
>
> *Get more for paying less, some [middlebuyers] do under pay growers.*
>
> *Some of us don't pass on the higher price, only when there is a lot of competition or there is less coffee from the growers and there are contracts to honour will we put up the price to attract growers.*
>
> *Middlebuyer/Trader, Goroka Roadside market, Interview 48, 13th June 17*

In contrast to the majority of interviewees who stressed the deterministic role of global coffee prices on how price was set locally, this candid reply reveals the lagged response of roadside price to supply and demand and the active, critical role of middle buyers. He went on to describe how he used a website to check the commodity price trends of coffee at the New York stock exchange before approaching the exporter. Even though the website he mentioned was an expired link (futurestocks.com), he was advised of its existence by the Coffee Industry Cooperation and it demonstrates the differentiated access to ICTs at the upstream end of the value chain.

Mobiles featured prominently in inter region trade and parchment factory owners described how days would be lost in sending a man to communicate with a mobile buyer who was collecting parchment from a remote community in the Highlands. With the coming of mobile phones, the task of communicating and coordinating with these middle buyers servicing geographically dispersed producers was made easier. A coffee mill manager a few kilometres from Goroka described how he had made promises advancing credit to middle buyers over the phone. He had around 20 buyers sourcing parchment for him from remote parts of Asaro, Okapa, Lufa, Chimbu and all of Eastern Highlands. He said he would have had to send his 'lad' to go with them to ensure that the money on credit was being spent on buying coffee in the days before mobile phones.

> *Mobail i makim mepla alrait…*

> *They take [the] scale out there [to remote villages] and wait for growers to bring coffee. We assist with purchase and advance money to buy coffee. Say we have sent someone with an advance of 10,000 Kina – so I have to stay in contact with him, I will call him to ask when are you going to come back with the coffee… He might say, I'm still buying, I'll be back in a week or so*
>
> *Hanu Mill Manager, Goroka District, Interview 40, 11th June 2017*

He further qualified this by adding that once a buyer had established credibility, as a consistent supplier to the mill, he would feel more confident about advancing larger sums of money. He recounted instances where they were not able to recoup the money when the middle buyer saw that he was making a loss and then didn't return to repay it. He had farmers with large volumes of coffee calling him to ask for money and requesting credit which he obliged, if he felt he could trust the person he was dealing with.

> *We got to know each other. We got to do bisnis. Exchange… They bring in the coffee, we give them money and system continues till when he needs more money to buy more coffee…*
>
> *Sometime they lie, sometimes tok tru*
>
> *Hanu Mill Manager, Goroka District, Interview 40, 11th June 2017*

A step up the value chain, exporters described the ways in which communications technology integrated into their logistics and transport operations and generated meaningful changes. After the green bean was sorted and graded, there still remains the long journey to Lae to fill up containers to meet overseas contracts. There were complaints about truck drivers using employer issued devices for non-prescribed use to the point where it is routinely out of charge when the operations manager needed to get in touch with them. Nonetheless, there were enthusiastic reports of how given the risk of hold-ups, road and access conditions over the long distance routes, mobiles helped with traceability. It was possible to know where the driver was in case of break down but the frustrating part of relying so much on phones now was that it was hard to control its use and limit it to just work purposes. The Australian export house logistics manager attributed this to culture:

> *If we left it to them to be responsible for the credit they would run out all the time… But we find that credit is used for whatever it is that they do.*
>
> *…We need phones to make things easier but the cultural part of it is that credits are really for my work, they use it for everything but and then it is not usable for work, usually at critical times.*

Logistics Manager, Major Multinational Exporter, Goroka, Interview 47, 13th June 2017

There is overall evidentiary support for the integration of mobile phones at every level of the coffee value chain. In the last few years in tandem with the unprecedented growth in mobile penetration rates, its impact has been felt on the coordination of trade. This is in spite of the fact that mobile ownership has been unevenly distributed with the majority of its economic benefits, from a purely rationalistic instrumental perspective, being reaped at the upstream end of the value chain. However, considering the structural content and social role of intermediaries in the value chain, rather than having a disintermediating effect, the mobile phone was being used to lubricate the chain and navigate between these differentiated roles. The assumptions of information asymmetry and the techno-optimism that underlie predictions about disintermediation misrecognise the relational context within which middle buyers operate. Furthermore, their positional advantages in the Papua New Guinean context pertains to assets and infrastructure for moving coffee and not to do with a complete and real time knowledge of market prices.

Reports of uncertain and limited access to electricity and the transience of battery charge and sim credit affects the use of phones in a tangible way. It draws attention to the manner in which the possibilities of the mobile phone in the coffee value chain are severely circumscribed by the material conditions of their use.

5 Information, arbitrage and efficiency: Mobiles and the circulation of price information

In addition to the digital disintermediation thesis, another key proposition is that the introduction of mobile phones and network coverage opens up new opportunities for arbitrage. Arbitrage refers to the possibility of taking advantage of the price differences for the same produce in different markets.

Spatial or geographical arbitrage, the simplest kind of arbitrage, is what is referred to by development economists when talking about producer markets. It denotes the price differentials (on any given day) between geographically separate markets that a market actor can exploit to strategically maximise profit. When different buyers are prepared to pay different prices for the same bag of coffee, having a mobile phone to seek out this information reduces search costs and produces welfare gains for all involved. This 'digital provide' argument stands in contrast to the earlier criticism that mobiles produce polarising/unequal gains or 'digital divides' when one factors in the differential effect on those who do not have access to them.

The majority of work promulgating this idea is based on econometric studies and theoretical models (Tack and Aker 2014, Aker and Mbiti 2010, Aker 2008, Aker and Fafchamps 2014). The key empirical study that is often cited is Jensen's (2007) analysis of the impact of the introduction of mobile phones on the inefficient fisheries sector in South India. He assumed that those coming in with a catch had no means to observe prices along the coast and ended up going to markets where there might be an oversupply of fish that day. The use of mobiles to gather information on prices at dispersed markets meant that marketing decisions were not random and there was less wastage of fish. Over time (1996-2001) he found less price dispersion and as if drawing on a natural experiment, he concludes that mobile phones produce optimal arbitrage opportunities, better goods allocation between markets and positive welfare outcomes for consumers and producers. There is an emerging debate on the validity of this research that was generalised from a limited sample of 5 ports in a particular subregion and the continuing reliance on this dated piece to make the case for the capacity of mobile phones to improve market information circulation[35]. There is now commentary even from ICTD practitioner communities on policy documents as recent as the World Development

[35] Steyn (2016), Sreekumar (2011), Srinivasan and Burrell (2013), and Steyn and Das (2015) unpack his claims.

Report 2016 relying on its recommendations rather than citing more recent research (Souter 2017, Vota 2016).

It is not entirely clear if the assumption of arbitrage seeking, strategic economic behaviour holds up within the context of flexible Melanesian attitudes to cash earning activities. Several studies show that smallholder farmers sell small lots of coffee when they need to meet school fee requirements, or need petty cash for store goods and socio-cultural events (Giovannucci and Hunt 2009:12). Research on cocoa farming (Curry et al. 2007) has revealed that older cocoa blocks are treated like an automatic teller machine (ATM). Furthermore, much government agricultural extension effort is focussed around teaching farmers to maximise yields by maintaining and rehabilitating coffee and other commercially oriented practices.

Regardless of the relevance of concepts premised on outcome regarding economic rationality or the '*homo economicus*' in the Melanesian context, we have already seen 'process' improvements to trade produced by mobile use where long, and potentially costly journeys to find out about the price can be avoided (Chapter 3). The last chapter discussed structural impacts in terms of the capacity of the phone to bypass middleman and revealed that mediating roles in the coffee value chain were socially embedded. Therefore, the mobile phone in this case is used to lubricate the value chain and to navigate between various intermediaries producing an intensification of their roles, rather than displacing and weeding out the supposedly 'rent seeking' *namelman*.

We have already seen the existence of terms like 'wantok' and 'wanbel' price as against the market price. This foregrounds the rich and diverse processes through which price forms take shape in the local and regional context. Furthermore, as a global commodity, coffee prices are traded daily and move 3-4% every day in the New York stock exchange making it a commodity of high liquidity and volatility. As such it is quite attractive to hedge funds and the financialised economy. This in turn affects the variability of coffee prices and therefore the prices that exporters, in a country like PNG that produces only up to 1% of the coffee bags traded globally (around 1 million bags), are able to offer to farmers downstream. This chapter reviews the price setting context for coffee that structures opportunities for arbitrage and a fundamental shift in market power within the local value chain.

I draw on interviews with exporters who are subsidiaries of global multinational coffee trading arms as well as respondents involved with an alternate coffee sourcing arrangement – the Fairtrade coffee network that adds a social premium to coffee prices and directs its product to niche, ethical consumer markets overseas. The Fairtrade network, as well as the Coffee Industry Corporation have dabbled with communication technology through the setup of mobile based closed user groups (CUGs), Market Information Systems (MIS) and online (and radio) dissemination of prices in the hope that it will help the marketing decisions of remote, geographically dispersed farmers. Since the rapid uptake of digital and communication technologies in recent years, several multilateral aid organisations, donor and government agencies have sought to invest in ICT aided development programming. Presented here are the results from the first research study on the field level engagement with these ICT based development interventions and the social expectations or 'imagined affordances' (Nagy &Neff 2015) attached to this newfound connectivity. The limitations of the private telecommunications provider, Digicel, as a development partner, in terms of corporate subsidy and commercial capture is touched upon (and expanded in the next chapter).

5.1 Arbitrage and Price Setting

Within the coffee trade, the possibility for arbitrage based on price is distributed unevenly along the value chain. Exporters said that they constantly receive calls asking what price they are offering currently from middle buyers and large farmers dispersed along the Western Highlands, Kainantu and Lae region, who form the bulk of their supply system. Smallholder farmers, whose produce forms 85% of the total coffee output also use their phones as a search technology and to coordinate trade. However, they are severely constrained in their ability to individually carry their 3 bags of coffee to any new market or buyer, who might be offering a higher price than what is available through their regular channels.

The notion of optimal arbitrage is premised on the idea that introducing the wide circulation of price information in developing markets, that are otherwise characterised by information asymmetries, will generate efficiencies and conditions for the fulfilment of the two of the most well-known results in economics – competitive equilibria (First Fundamental Theorem of Welfare Economics) and the 'Law of One Price' (LOP). The former refers to the efficient allocation of goods in markets and the second postulates that 'the price of a good should not differ between any two markets by more than the transport cost between them' (Jensen 2007:

879). Without communication devices, in developing contexts, given the geographic distances involved, obtaining price information from a market or a buyer located even 10 km away incurs a cost because it is difficult to visit more than one in a day. This leads to allocation inefficiencies and spatial price dispersion that flouts the Law of One Price. With the introduction of mobiles, price circulation is more even thereby allowing for these markets to 'catch up' to the conditions of economic theory. Much research has been done to emphasise that conventional, teleological approaches to development end up naturalising uneven economic development (Escobar 2001, Curry 2005, Escobar 2011). This is because congealed in their economic models are specific cultural understandings of (unidirectional) development trajectories where spatial differences between the Global North and South are seen to be a result of time rather than uneven capitalist development. In the Papua New Guinean context, an important qualifier needs to be added to theoretical expectations about price information encouraging optimal trade or arbitrage. Perfect mobility across lateral markets is not open and possible in every case due to infrastructural and norm based restrictions (see Bainton and Macintyre 2013 and Sharp 2013 for a discussion of how physical space in urban markets is demarcated socially – this means that not everyone can just get into the trade).

In addition to constraints on mobility, follow up research interrogating the transformations produced by the increased circulation of market price information at the smallholder level show that perishability of commodities being traded has an impact on local price fluctuations. For commodities that can be stored for a while without losing quality, there is no urgency to sell the same day as harvesting and therefore the prices are more or less aligned in the producer market even in the absence of market price information (Aker and Fafchamps 2014:16). Aker and Fafchamps, using panel data from a range of grains produced in Niger during the introduction of mobile phones, show that other factors that impact on the ability to take advantage of spatial arbitrage are the distance to market and seasonality. They found price dispersion to be more when the market for a commodity is significantly further away from where it was produced. In the season prior to the annual harvest, there isn't enough information available on the amount of stock produced that year leading to variability in producer price data. Aker and Fafchamps (2014) find that the impact of mobile technology can differ substantially by the type of crop, the type of market, and the time of year even within the same country. They link these differences in impact to differences in arbitrage opportunities and market behaviour for these crops and between agents. It is owing to these

local specificities of markets that later research did not find overwhelming evidence to support the 'digital provide' argument. Indeed, there have been contradictory findings when it comes to the potency of mobile phones as an information delivery platform poised to modernise markets with new and easy access to price information. Aker and Fafchamps (2014) also found that while farmers were more likely to use mobile technology as a search tool, phone ownership was not correlated with changes in farmers' marketing behaviour or the sales prices that they received.

Within the coffee trade, when it comes to interactions between smallholders and various kinds of middle buyers, we have already seen additional variables that work alongside the price mechanism as a market device. Trading partners (say a smallholder farmer selling at the parchment roadside market in Goroka) use language to convey and obstruct information. They shift price using contestations and misinformation around weight and quality of parchment rather than negotiating just based on the knowledge that someone else is paying a higher price. If the farmer is unhappy, he will withdraw the parchment and go somewhere else. However, even while there isn't the perfect freedom to go to any distant market, the ability to know before embarking on travel if road access is open using the mobile phone is critical in a context like PNG where road density and infrastructure quality is low.

5.2 Coffee, the Classic Buyer Driven Chain: The Price Setting Context

> *All of our contracts are [now] done over the phone. Our biggest suppliers are in the Western Highlands - running around in vans in Hagen picking up coffee …[similarly in] Kainantu and Lae.*
>
> *The ones we deal with are those on contract, we deal with them every day. We know who they are [sic]*
>
> *Managing Director, Exporting Company, Goroka, Interview 42, 13th June 2017*

Amidst the circulation of information and intensification of communication, how does one recognise an opportunity for arbitrage and decide to pursue it? Similar to economic anthropological accounts of economic exchange in an early colonial context where special attention was paid to the principles of valuation and commensuration, contemporary studies of arbitrage discuss the distributed calculations involved within the 'dizzying speed' of

electronic connectivity[36] (Zook and Grote 2017). While the majority of these studies look at trading in quantitative finance rather than in producer markets (with the notable exception of Caliskan (2007), Calışkan (2007), Caliskan and Adaman (2010)) with a broader understanding of arbitrage that goes beyond just geographical arbitrage, their conceptual framework is instructive. Using the 'socio-technology of arbitrage' as their unit of analysis rather than the point of exchange or transaction, these empirical case studies emerging from New Economic Sociology shed light on how 'evaluative devices yield discrepant pricings at myriad points throughout the economy' (Beunza and Stark 2004:5, Muniesa 2000, Maurer 2002, Maurer 2003, Grandclement 2004, Benzua et al. 2006).

The job of the trader is to identify opportunities for arbitrage using mathematical formulae and the advances in computing that have made abstract financial instruments (like derivatives) and immaterial forms of value possible. There is a large body of work that explains how using the socio-spatiality properties of the trading room that allows for certain kinds of interaction and using social cues from complex models (Beunza and Stark 2012), they 'test the market' and execute a trade. While these instantaneous trades are predicated, and made possible by high speed connective technologies, they argue for the persisting importance of the physical location and spatial, face to face interactions.

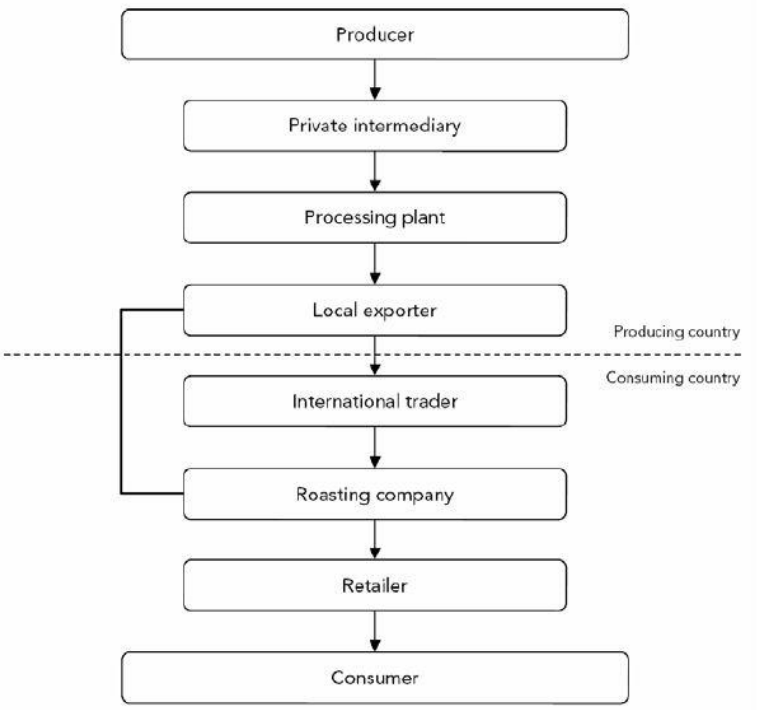
> *The trading room thus shows a particular instance of Castells' paradox: As more information flows through networked connectivity, the more important become the kinds of interactions grounded in a physical locale.*
>
> (Beunza and Stark 2004: 14)

I draw on these socio - technical accounts of new forms of economic exchange to holistically approach the networked apparatus of evaluating the grade of the coffee at the exporter's gate to assign costs. The role of co-location and phone calls asking about the price leading to firm commitments need to be seen within the social-technical context of diverse value chain actors interacting with financialised instruments and volatile global price fluctuations. While dealing with a very different empirical content (see Chapter 3: for the differences between fixed role and exchange role markets), I use their notion of distributed calculative cognition to look at price setting as a network, so that claims of arbitrage can be seen in context.

[36] Zook and Grote (2017:122) suggest that within high frequency automated trading a lot of investments have been made to enhance computing facilities so as to shave milliseconds of order travel time between markets. The entire profession is built around taking advantage of market information traveling to traders connected by satellite or microwave transmission nano-seconds before it reaches others - because 'fiber optic cables transmit at approximately 70 percent the speed of light' while 'satellite or microwaves approach the speed of light'.

As has been established already, smallholder farmers rarely put in calls to exporters unless they have a large volume of bags. If exporters were to deal directly with smallholder farmers it would take too long to fill a container to fulfil an order for a roaster overseas. Village buyers and middle buyers are also on the phone constantly with the staff at the exporting company. A dominant approach to the study of the global coffee trade is the (new) political economy model of seeing it as a 'buyer driven value chain' (Ponte 2004, Neilson 2009). The concentration at the trading and roasting end of the value chain (after it is exported from PNG – see Figure 6) with a small number of multinational companies dominating, leads to what is widely referred to as the "bottleneck' that puts smallholder producers at a disadvantage. Following global structural changes that led to the dissolution of the International Coffee Agreement (ICA) commodity regime, instead of government negotiations, these private MNCs are able to set the requirements for smaller actors at the downstream end of the value chain leading to the claim that the value chain of coffee is buyer driven. Therefore as a global value chain with severe power asymmetries, are there limits of the bargaining power that a smallholder farmer can obtain even with better information?

Figure 6: Typology of the flow of coffee in a value chain from (Slob 2006)



While the structural conditions laid out by these political economy approaches remain true, it is a deterministic, static and unidirectional view. No research has been done to date to see

how the coffee from PNG fits in with this typology. Each of the three International traders that dominate the latter end of the value chain are represented in PNG. Of the 80 local exporters, 24% of the export market was controlled by PNG Coffee Exports (which is a direct subsidiary of Neumann Kaffee Gruppe), 20% by New Guinea Highlands Coffee Exports (Ecom Agro-industrial Ltd) and 8% by Monpi (Volcafe Holdings Ltd) (West 2012). The remaining major local exporters and their market share are given below:

Table 6: Local Coffee Exporters and their Market Share

Local Exporter	**Share of Export Market**
Niugini Coffee Tea and Spice	12%
Kongo Coffee	10%
Nama	9%
Pacific Trading Company	6%
Kundu	5%

Source (West 2012:144)

The governance structure of the value chain still has a direct impact on the distribution of power within value chain actors and therefore on opportunities on the ground. However, changing consumer preferences in industrialised countries, labelled by Ponte as the 'latte revolution' (Ponte 2001), leads to substantial price premiums being paid by consumers for high quality, differentiated products.

> *…the value placed on this expanded range of product and production characteristics within specialty markets creates additional entry barriers at the producer end of the supply chain, thus shifting power within the chain towards producers and tending to increase the prices they receive. This tendency is further promoted in some cases by greater price transparency, resulting from more intensive interactions and information exchanges between buyer and seller in the context of direct purchasing.*
>
> (Macdonald 2014)

Therefore, within the context of direct purchasing there is still price variability on a daily basis and room to find arbitrage opportunities among the prices being offered by local exporters.

> *We have no control over prices because of global market movements. Since early march it has been going down. Look at how much it fluctuates in a single day. It is a huge percentage. The factors that are involved are the grades from A down to Y3. Relative to the New York markets, there is a premium or a discount based on grades.*
>
> *AA might be +60 points [above the NY stock exchange price for coffee] or something like that and Y3 might be -60 points.*

These differentials change… The price is not set externally and it moves every day. Say if I over sold on the top end [with high quality A grades], I will pay at a loss in order to fulfil my contract at times.

Managing Director, Exporting Company, Goroka, Interview 44, 13th June 2017

In addition to changing market prices for each grade of coffee, one also needs to factor in the changing currency exchange rates when the New York stock exchange price is converted from cents per pound to Kina per Kg. Based on these moving differentials, the cost of overheads, supply and demand each exporter arrives at a price they can afford to pay to cover costs and make a profit based on the overseas contracts they have at any given time. It could be the case that the same exporter who was able to pay 7 Kina per kilo for a green bean bag is only able to pay 6.50 Kina the next day because the market tanked overnight. Therefore these interactions with the exporters forms the micro context within which the local form of the coffee price is set and as such is an under-researched and unexplored area.

Roasters like Nestle form the other highly concentrated stage of the coffee chain dominated by four multinationals that compete with each other based on branding, marketing and expensive advertisements[37]. Since coffee from the major producer regions (like Costa Rica, Peru, Brazil, Colombia, Kenya, Uganda, and Indonesia) is grown at different times in a year, for a consistent blend that tastes the same all year round, roasters set the minimum quantities needed from any particular origin. The Arabica coffee produced by the Highlands is very popular in this blending process because of its consistent taste (good acidity and flavour) that holds up in blends with less tasty coffee. Sometimes Roasters buy PNG coffee at a loss because it is required for every set blend (even though it forms a small portion of the global coffee volumes).

This network forms the context within which local prices for the middle buyers and large farmers are set. It includes dominant external value chain actors setting export requirements, the local apparatus for grading of coffee, hedging green bean bag volumes and the New York Stock Exchange price movements sent to the Goroka coffee exporting houses in near real time. This distributed socio - technical apparatus requires its participants to keep abreast of a lot of moving components. The co-location and spatial configuration of local exporters in Goroka with most of the major exporters situated next to each other on the east side of the

[37] Kraft Foods Inc (USA), Procter & Gamble (USA) and Sara Lee Corporation (USA) are the others.

airport (next to the Missionary aviation services that bring in the 'airport coffee' from remote villages) plays a large role in structuring competitive prices. It also contributes to the evaluative principles used by exporters and those they buy from (usually big farmers and middle buyers) to gauge what another exporting house is paying each day. For the price mechanism to be monitored and 'calibrated' these social cues that arise from interactions are immensely useful. Similar to the studies of arbitrage in high finance, colocation and 'place facilitates sociability to make associations' and figure out what the market is doing at any given time (Benzua and Stark 2004:13).

For example, during the course of the interview with the operations manager of an exporting house, one of his staff members brought in a sample of coffee for cupping and grading marked 7:30 Kina. A farmer was at the door and was claiming that a competitor had assessed his bags of coffee to be worth 7:30 Kina per kilo and he wanted to know how much they were willing to pay.

> *The lady brought in a tray of coffee and she had asked if it is right? [Another exporting house] is paying 7:30 Kina and I asked [my colleague], I don't believe it is true. This is a good example of price negotiation. For us to export at a profit, we'd have to pay 6:50 Kina to buy. At the door, we are paying 7 Kina to export. We only make money if we buy at 6:50.*
>
> *The other exporting house will have overheads and costing similar to us.*
>
> *Where he [farmer] got that figure from… I believe he has written 7:30 himself to check how far he can go with it when it is not actually true.*
>
> *Managing Director, Exporting Company, Goroka, Interview 42, 13th June 2017*

Not prepared to buy at that misrepresented price, he added that they take pride in turning around the payment fast, so people can go to the bank the same day as there are no financial services in villages. In most cases, that wins the negotiation on the price for them and if they are prepared to go and pick up the bags of coffee, it makes the farmers happy. While not a purely price based transaction, analogous to notions of '*wantok'* price at the roadside parchment markets, the buying of green bean from large, regular farmers involved bonuses and a slightly lenient price premium, so that they feel that their produce is valued.

It is in this interactional and relational context that phone calls about current prices need to be seen.

> *People call up 3-4 exporters and ask what we are willing to pay. They have all our phone numbers. If we know them personally and the quality they produce and the reliability of their product, then it is fine.*
>
> *The big factor is... of 30 bags delivered, 5 bags are PSC (Premium Smallholder Coffee) quality and the rest are borderline Y grade quality which we assess at the door.*
>
> *Exporting Company, Goroka, Interview 45, 13th June 2017*

Variability of quality is a huge factor in price negotiations as are the subjective valuations of the credibility of trading partners assessed in an interactive manner. Therefore the potency of the mobile phone in the coffee trade does not lie in its ability to abstract market price information from its relational context. Neither is it in just the manner in which it facilitates non-proximate communications between previously disconnected, geographically dispersed farmers, traders and buyer. The capacity of the phone as a social device and a communication platform is what makes it useful in shopping for prices and arbitrage opportunities within a highly interdependent, thick socio-technical network.

When asked if the exporter trusts a nameless voice at the end of the phone I was told:

> *I usually take him [anyone on the phone offering to sell green bean to us] at face value. I will make an agreement on price and write it down but if he doesn't turn up that day I won't put the contract in.*
>
> *Exporting Company, Goroka, Interview 43, 13th June 2017*

Dealing with the price volatility driven by global markets, if the exporters put in a purchase contract with someone, the coffee is sold the same evening. They do not usually run a long or a short position and take a risk on the price because of the scale of the risks involved. If they were to buy coffee and hang on to it and not sell it, and in the next 2 days, if price drops dramatically, they would be in an untenable position. Even with a depth of experience (both personal and corporate as the MNC trading groups have been in operation for decades) they are able to pick up trends in the NYSE prices but there is no way to read market signals and predict what the closing price will be on any given day. They work off last nights' closing price, convert the US/metric measure to PNG Kina and after taking out overheads and costs, arrive at how much they can pay for it that day.

Coffee as a commodity with high liquidity and volatility is very popular with hedge funds who push around the price in the financialised economy. A hedge fund manager might want to get out of, say oil, as a result of which actuarial staff will move money to where they think would give them the most return. On the futures market on the 5 trading days in the year,

> *…4 to 5 times more than actual coffee produced is traded on the futures market. They are manipulating or playing the system - trying to profit from the bags trade. They don't care about the fundamentals of coffee or the farmers. It is about models and the charting…*
>
> *Exporting Company representative, Goroka, Interview 46, 13th June 2017*

There are 100-200 million bags traded on the futures market at all times based on the relative position of coffee commodity price as it factors into derivatives and quantitative models that assign them immaterial forms of value. Given how deeply entangled the sector is with the financialised economy, the variability in global market prices pose a large risk to the local exporter's business model and financial viability. An additional concern was US to Kina exchange rates - the CEO of an exporting company relayed a conversation he had with the Government of PNG Treasury Department that depreciated the currency based on what he felt were political rather than economic reasons. He said that they felt PNG banks were making too much money off exchange rates and decided to depreciate the Kina arbitrarily.

The coffee trade presents a large banking risk, as the asset is unsecured, and they need to make large advances to purchase coffee (it is secure only when coffee is in the warehouse). One of the coffee exporters recounted how it took them 15 years to get the trust of one bank to give them unsecured loans; before which they were allowed only up to 2 million overdrafts which was guaranteed by the multinational parent company. Since the majority of coffee sourcing occurs in 'volatile' developing countries like Colombia, Kenya and Indonesia, it is hard to get loans from international commercial banks that see them as an investment risk. Even the big local exporters get paid cash against documents after the contracted container of coffee has shipped out of Lae. To source from inaccessible locations and purchase the volume of (usually Y grade) coffee required to meet contracts, they borrow up to a 100 million dollars as advance payments each year (and have up to 40 million worth of stocks in the country). While the roadside buyer gets paid immediately, exporters typically face a 6 week turn around or 42 days of financing costs.

In addition to financial risks and the cost of borrowing money, changing requirements from multinational roasters who do not understand the context of PNG creates a lot of pressure. One of the major exporting companies in Goroka reported how in 2011, global coffee prices went from 200 cents a pound to 300 cents at the New York Stock Exchange. They were contracted to deliver 6000 tonnes of coffee over 12 months to Nestle, the multinational roaster. Owing to these global market movements the 26 million dollar contract turned into a 40 million dollar contract in a short period of time. As the prices continued to go up, Nestle wanted to push the financing costs on to the PNG exporting company and asked for agreement that it was ok to pay 120 days after shipping as opposed to the initial 'pay against 60 days bill awaiting' arrangement. This was then turned into a 180 day request without regard for the fact that it was so much costlier for the exporter in PNG to borrow that money. The role of these exporters in hedging these financial risks in the coffee trade is vital and is the reason why overseas buyers and roasters prefer to deal with them rather than smaller cooperatives without these financial instruments and formal expertise.

Therefore, when it comes to a coffee cooperative comprising of a group of smallholder farmers aspiring to export directly into overseas markets, even with real time price information, these institutional advantages are what they lack. Access to capital, financial expertise and volumes of coffee mediates the possibility of phone based arbitrage to provide enduring structural advantages.

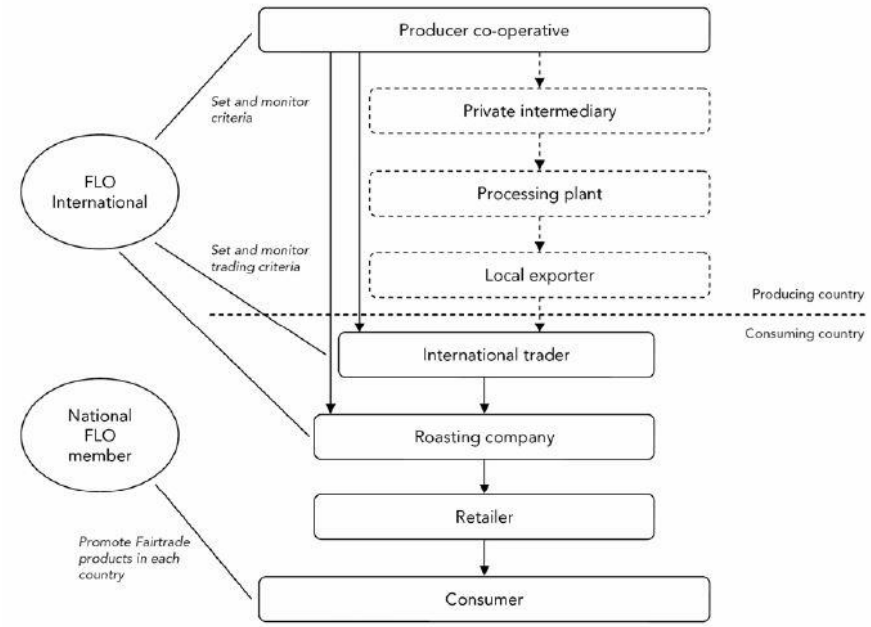
> *The most they can get together are maybe 5000 bags - no way can they produce the million bags PNG needs to export. They don't have the capacity to cater for the whole crop.*
>
> *No one trusts us because we have got the money but no one trusts them [farmers] with the money; because they always short change the banks.*
>
> *We have the capacity to hedge on futures contracts – they have no financial instruments to hedge, no expertise to manage currency. He [cooperative leader] collects coffee and then what? Where will it be forwarded to?*
>
> *CEO, Exporting Company, Goroka, Interview 41, 13th June 2017*

Even highly organised cooperatives of smallholder farmers do not have the market access or the relationship with an overseas network of traders and roasters as the exporters do. This detailed discussion of the price setting context foregrounds the limits of arbitrage and shows

that the significance of the mobile phone is in the manner in which it integrates into this network and services relationships.

An alternate sourcing arrangement tapping into the growing consumer preference for sustainable, organic coffee and the promotion of global social standards is represented by the Fairtrade network. By introducing a standard minimum price for coffee and a social premium, Fairtrade extends its 'ethical mandate to address the terms of the trading relationship along the entire commodity chain' (Blowfield and Dolan 2010). It aims to institute ethics and 'justice instead of charity' into the North-South trading relationships through direct and fair exchange (Tallontire 2000, Scholte 2003, Schmelzer 2007). It is often said that the coffee bean might change hands as many as 150 times before it reaches from the smallholder producer to the morning cup in the hands of the consumer (Milford 2004). Therefore the ability of the Fairtrade certification scheme to directly connect the farmer to the international trader or importer is an immensely significant value proposition (see figure 7 below).

Figure 7: Typology of the flow of coffee in a Fairtrade value chain from (Slob 2006)



As part of the research I was able to interview and spend some time living among the first community in PNG to be inducted into the Fairtrade network – the HOAC (Highlands Organic Agricultural Cooperative) group now producing single origin 'Okapa A' Fairtrade coffee. In addition to quality and training interventions, one of the first initiatives put into

place with this new group of Fairtrade farmers from around Purosa (Okapa District), was a dedicated development and communication technology initiative aimed at 'Linking farmers in Papua New Guinea to Fairtrade Markets'. In partnership with the International Fund for Agricultural Development (IFAD) smart phones were distributed to Fairtrade groups all over PNG (at least 2 per group) and mobile phones were put on a closed user group (CUG) to enable communication and market price information dissemination. Led by Fairtrade ANZ, the fact that a communication intervention was trialled in the crucial first few years of the partnership speaks to the potency of the expected benefits from mobiles. The next section showcases the key issues and lessons learnt from this 2 year programme as a brief case study.

5.3 ICT based Development Interventions in the Coffee Sector: Information Delivery and Access

While there is some criticism of the Fairtrade model of positioning businesses as development agents, the aim of this certification system is to create tangible financial rewards for development outcomes such as 'empowerment, capacity building and producer participation' (Blowfield and Dolan 2010:143). Initiated as a loose alliance of faith based and community organisations focussed on humanitarian assistance in the 1960s, the focus of the movement soon changed towards a structural reform of capitalism and terms like 'brewing justice' (Jaffee 2014) have been used to describe this shift.

Within PNG, a group of farmers from a licensed area function under a Fairtrade certificate number. There is a member list and individual farmers on that list bring coffee and HOAC organises the bags of parchment to transport them to a bulking point and from there to the mill to processing the parchment into green bean. The aim is to assure traceability from the bulking point to factory to exporter to the freight coordinator at the wharf in Lae and then the importer's office overseas. It is not possible to get coffee from outside the license area and each point on the value chain has a certification number. Okapa 'A' region sell their coffee to the exporter Coffee Connections which has a small organic coffee quota to meet and collect the Fairtrade price and social premium. This system of coordination is built to counter the weak market position of individual farmers.

> *[Exporters are] not interested in talking to small farmers with 2,3 or 5 bags... even 20 bags of coffee... he might be talking one thing in the office and might not produce the supply [as promised]. They are looking at hundreds of bags, 200-300 bags and then we are talking.*

Fairtrade Internal Control Systems officer/HOAC leader, Interview 55, 14th June 2017

Farmers in the region are free to sell as they wish but the aim is to instil in them the value of organising their produce and selling through the Fairtrade network so that they can collect the social premium which they in turn collectively decide to spend on something of value to the community. The Fairtrade price provides a safety net when the market price for coffee is low, but the converse of that is that when the local market price is higher than the Fairtrade price, those selling through the Fairtrade system cannot receive this higher price.

The Fairtrade price is set at the international level taking into consideration not just the local prices in the coffee producing countries, but is a sustainable production tariff to make sure the cost of living in all the producing areas is covered. Set on a FOB (Freight on Board) basis, the in-country producers or their cooperative leaders (or in this case the exporters) are responsible to put the product in the port or the ship heading to the overseas buyer after which it then becomes the responsibility of buyer. This price doesn't cover cost of transport from Purosa to Goroka and Goroka to Lae and the packing, the selection of beans and the like which is then shaved off as a further deduction from the price. The price that HOAC pays members covers the cost of coffee at farming gate and the other costs are deducted by the exporter. When Coffee Connections lands a contract with overseas buyers, they contact HOAC and they come to an agreement on the price with the stipulation that Fairtrade standards have to be met by the contract. There is a breakdown of the price of transport used to calculate overhead costs from which HOAC calculates how much they can pay for parchment to the farmer. The Fairtrade international minimum price moves with the NYSE market price – in August 2017, immediately after the peak coffee harvesting season, the market price was 125-127 cents per pound and the Fairtrade minimum price was 140 cents (which was 15 cents more than the floated price - the social premium would be calculated in addition to this).

As part of the mobile based 'Linking farmers in Papua New Guinea to Fairtrade Markets' project, Fairtrade distributed cell phones and entered into an agreement with Digicel to create a Closed User Group (CUG) of all HOAC registered farmers, so that they can make and receive calls from each other. When an agreement has been reached between Coffee Connections and HOAC, after careful consideration of the local prices, HOAC leaders send

out the price they can pay to all farmers. There is a yearly Fairtrade audit in place to check if this price meets Fairtrade standards. Before entering into a contract with the exporter, the in-country liaison officer would frequently ask the New Zealand office for the current Fairtrade price and then equip HOAC leaders with price information as bargaining power before the negotiation process. Even though the CUG has now expired, the HOAC leaders had positive things to say about the project.

> *When it was working we got the voice call, we got the text and we got internet service on two [smart] phones. It was very helpful, because we had farmers in the fields and we needed to communicate about our program and the world market price (it is going down you need to pay this much, if it is going up, you need to put up the price by so much)...*
>
> *...We communicated about problems too. We have road blockages, heavy rain there because of which we had to reschedule vehicle movements. It was very helpful.*
>
> *Fairtrade Internal Control Systems officer/HOAC leader, Interview 55, 14th June 2017*

The ICT intervention had broader goals and introduced charging stations where farmers can charge up to 20 mobiles per day in the remote Okapa regions where some farmers had to walk 3 hours (one way) to a village junction with electricity, or a trade store with a generator, to charge their phones. They supplied a computer per cooperative in the Fairtrade network and set up email addresses. Then, in collaboration with UniTech, they created tutorial videos on how to master the use of a computer so that the organisation could keep digital records. These videos were redone into an interactive format in Tok Pisin so that they can be run without personnel from the university explaining it to cooperative members. As the Fairtrade network took off, the program officers in New Zealand struggled to get in contact with cooperative leaders on the ground and therefore the point of introducing email and newer app technology like WhatsApp was to generate good channels of communication with them. Farmers were encouraged to use WhatsApp to share images of what they are doing in the organisation which is then used for promotions material. Going beyond discussions of soft monitoring when employer distributed mobile devices are used for professional purposes, I heard reports of the HOAC leader looking up images on Google and coming across useful, alternate coffee drying techniques.

HOAC was among the most efficient of the Fairtrade groups with a good structure drawing on family group networks who were historically involved with the coffee plantation in Purosa

and with the export of coffee from before Independence in 1975. They had well-coordinated system of trucks going around transporting bags after collection from communities around the region. Despite the historical strengths of the cooperative in laying the foundations for coffee marketing techniques that had already reached international/niche buyers, while the aims of the project were largely met, a key constraint was the limitations of Digicel as a development partner.

> *Digicel was continually charging us, when we told them to switch off the system...*
> *HOAC representative,*
> *Interview 56, 14th June 2017*

When a group forgot to pay the subscription fee, there were reports that Digicel locked out the entire network. At the end of the project, Digicel kept charging the phone number registered with HOAC even though the CUG was no longer in operation. I heard that the Fairtrade liaison officer had to finally change his number because Digicel kept deducting an amount from his top ups – this is despite entering into a formal agreement with the Port Moresby based Digicel corporate office that detailed the timeline and end points of the project. There was overall disappointment about not receiving the level of support they signed up for.

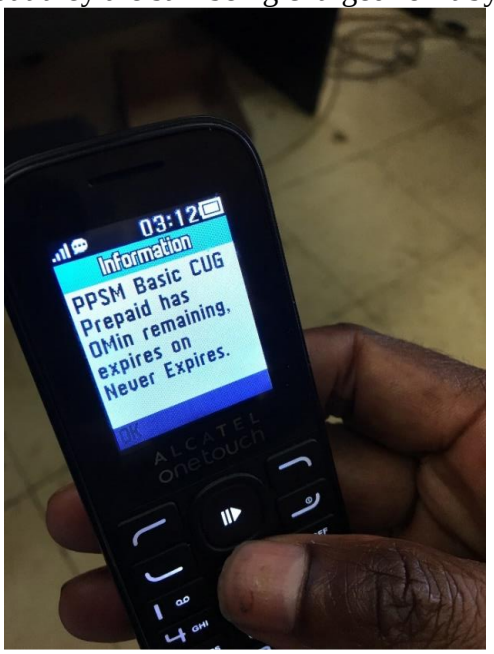
Another HOAC leader took out his Alcatel Onetouch handset (see figure 8) to show me how despite not being able to use internet on that handset and after repeated conversations with customer service, he kept getting charged 30 t each day for internet data. He knew enough about the phone settings architecture to try and turn the connectivity setting off but to no avail. There have been reports of several NGOs finding it hard to rely on Digicel. Following the acceleration of mobile connectivity, most service providers have tried to innovate by tapping into the affordances of the mobile phone. Especially if it is an international NGO, they have taken their cues from the success stories of mobile phones in Sub - Saharan African region without considering the political economy of Digicel in PNG. As will be expanded on in the following case study of the Fresh Produce Development Agency's engagement with a Digicel hosted Market Information System (MIS), the corporate profit principle, and the reality of the use of PNG as a captive new market, impinges on development programming efforts that rely on mobile solutions.

In a telecommunications ecology where any phone call on a Digicel number is accompanied by at least two marketing text messages aggressively advertising call bundles, relying on the private sector leads to uncomfortable bedfellows. Expecting a private entity to deliver development outcomes and partnership for government service provision in countries with the weakest institutional and regulatory systems means that the language of the private sector can often frame human and economic development. Development partnerships now form a new, untapped opportunity for corporate subsidy, as is evident from the allegations of digital colonialism made against Facebook rolling out its limited 'free basics' platform in developing countries.

The reason HOAC could utilise the mobile services was because a year or so before Fairtrade entered the remote Purosa region, Digicel had installed a tower there. The Digicel tower was powered by solar, since electrification had not reached the region yet. In 2015, just before the Fairtrade mobiles in coffee project was to begin, local labourers who were part of the construction process made allegations that they were not paid properly. Following another dispute over land compensation, they stole one of the solar batteries. This led to frequent outages and mobile coverage only during the day in the cloud-tipped mountainous region beyond the Kuru ranges. The altitude and chilly daytime temperatures meant that phone coverage could only be accessed when there were no clouds and it was sunny. These batteries have not been replaced to date and respondents spoke of 'network hotspots' along the mountains where they would walk to for better reception.

Even while driven by a strong ethic of collective redistribution, the reliance of the Fairtrade intervention on Digicel meant that it faced several hindrances. The Coffee Industry Corporation (CIC) in its large collaboration with the World Bank has a work programme called 'Productive Partnerships in Agriculture project'. One of the aims of the project is to utilise new online database technology to facilitate collaborative sharing and transparent procurement systems. In the spirit of technological innovation, they plan to set up a Market Information System that sends out the current coffee prices via SMS.

Figure 8: HOAC leader demonstrates the Fairtrade CUG interface on his handset that is now defunct (but they are still being charged for it by Digicel)



The Coffee Industry Corporation (CIC) already publishes the below parchment price schedule on its Facebook page (Table 7). It also had a 'Price offered at the door' table listing weekly prices at all major regional centres. They regularly disseminated this online, as well as through a now non-operational radio program, where the information was presented in a story format aimed at farmers. It was too costly for the organisation to continue with the radio program but the aim of putting this up on Facebook was to reach smallholder farmers and generate information transparency. The majority of smallholder farmers out of the urban centre of Goroka I interviewed had never heard of this weekly price schedule and a majority were not aware that this information was available publicly. The tacit familiarity required to understand some of the content in the columns underscores the literacy issues that come into play. For example, 730 means 7.30 Kina for green bean and not parchment and the system behind the grading of green bean is not known to majority of the farmers. Several farmers had Facebook accounts that they used primarily to keep in touch with social networks but no one had thought to go to the CIC page for '*bisnis'* related information.

Table 7: Coffee Industry Corporation Price list (Inter Office Memorandum)

COFFEE INDUSTRY CORPORATION LTD
INDUSTRY OPERATIONS DIVISION

INTER-OFFICE MEMORANDUM

				DATE:	1/05/2017
SUMMARY				SERIAL NO:	1-8-16/17
Average prices (t/kg) as at :		1/05/2017	Range	24/04/2017	Apr-17
ARABICA :					
Green Bean	Y1	695	670 to 730	689	731
(DIS LAE)	PSC-X	723	690 to 750	710	745
	PSC-A	757	710 to 800	750	796
	X	860	850 to 880	735	818
	A	933	820 to 1000	795	893
PARCHMENT :	Class 1	434	400 to 470	463	481
(Factory Door)	Class 2	415	390 to 440	375	406
CHERRY: (Factory Door)		123	105 to 135	110	117
ROBUSTA :					
Green Bean		0	0	0	0
Parchment		0	0	0	0
NEW YORK "C" CLOSING		28/04/2017		21/04/2017	
US cents/lb		126.70		129.85	142.21
One Kina=US$		0.3220		0.3220	0.3223
Toea/Kg:-					
Without discount/premium		867		889	973
With discount of 6 cents/lb		826		848	932
Y-grade (Gross F.O.B. Lae)* [1]		826		848	932
Levy on [1] [2]		10		10	10
Y-grade (Net F.O.B. Lae) [1-2]		816		838	922
* Indicative					

MARKET COMMENTARY:

New York.

Coffee prices hit new 2017 lows this week, with the rout being led by the robusta market, but as suggested last week , there was predictable rally later in the week which helped arabica to bounce back upwards but the robusta coffee price did not fare as well. In fact, while arabica showed a 0.5 cents/lb gain over the week, robusta coffee prices ended the week $44/ton (2.0 cents/lb) lower. In the absence of local market distortions, roadside parchment coffee prices in Papua New Guinea will probably remain virtually unchanged, although given the late recovery in International prices, the local market may be, at most, possibly between 5 and 10 toea/kg lower in the week to come.

Domestic.

Back home, prices for green coffee has improved while unprocessed coffee prices are mixed early this week. Green coffee prices averaged 695 (1% higher) toea/kilo for Y1,while factory-door prices averaged 434 (6% lower) toea/kilo. Traded differentials for Y1's remains at minus (-) 6.

NOTE: The computation of the FOB prices are based on the quoted future prices and exchange rate; actual FOB prices may vary from one exporter to another.

	Week commencing:	1/05/2017
PRICES OFFERED AT FACTORY DOOR (K/KG)		
	PARCHMENT RANGE	
	ARABICA	ROBUSTA
AREA	CLASS 1	CLASS 2	
NATIONAL	4.00 to 4.70	3.90 to 4.40	0.00
KAINANTU	0	0	
GOROKA	4.40 to 4.70	4.00 to 4.40	
KUNDIAWA	0	0	
MINJ/BANZ	0	0	
MT. HAGEN	- to 4.00	- to 3.90	
WAPENAMANDA	0	0	
LAE	0.00	0	NA
ASEKI	NA	NA	NA
MUMENG	NA	NA	NA
WAU/BULOLO	NA	NA	NA
PORT MORESBY	NA	NA	NA
MADANG	NA	NA	NA
ORO	NA	NA	NA
EAST SEPIK	NA	NA	NA

1. This format has been adopted by CIC Ltd's Industry Operations Division to present weekly Market Prices.
2. Exchange rate: Monday's US Dollar T/T buying rate against Kina quoted by BSP
3. 1 kg. = 2.20462 1b
4. Coffee prices for this week are based on Monday's prices given by exporters and processors and Friday's futures prices.
5. For further information contact Industry Operations Division of CIC on phone 532 1266/2466, Fax 532 1431.

Source: CIC Facebook page, accessed May 2017

The provision of market price information through innovative, technologically enabled ways has led to unusual coalitions between economists, database system developers, computer scientists, technologists and agricultural/development practitioners. While this emerging epistemic community within ICTD espouses the values of information transparency and unmediated grassroots reach, they overlook the situated realities of ICT use. These include the relational and socio-technical price setting context within which arbitrage opportunities are discovered and pursued. Uneven distribution of possibilities for arbitrage based on price along the value chain due to road access or power asymmetries, and the political economy of telecommunications providers in a newly liberalised market hinder the modernising impulse to transform markets with phone based price information. Local trading practices include price shifting using contestations and misinformation around weight and quality of parchment

rather than the real time knowledge of prices at an alternate market avenue. Therefore, the use, adoption and domestication of the phone in the coffee value chain needs to be understood with contextual depth, and an appreciation for it, as a social item and a communications device rather than an information delivery platform.

6 Information, Communication Technologies (ICTs) in the Fresh Produce trade: Imagined Affordances, mobile solutions and data for development?

If the income from selling coffee forms the largest part of the household income in the Highlands (83.22%), 60.84% of all households sampled said that they received an income from selling vegetables (*salim gaden kaikai*)[38]. It is generally considered to be women's money while the money from coffee is referred to as '*hevi moni*' or heavy/substantial money. Gender disaggregated data showed that the most common income generator for women was vegetables (38.45%), followed by coffee (24.48%) and the most common income generator for men was coffee (76.34%), followed by vegetables (30.53%). As the second most important livelihood activity, this focus on the interaction of mobile phones within the practices of the fresh produce trade helps foreground the role of gender in mobile use. As a perishable range of products with different storage requirements, the fresh produce trade has unique characteristics. Developing an ethnographic understanding of how mobiles are used to coordinate fresh produce trade will thus shed light on arbitrage possibilities across distances.

There is a large literature on the social construction of marketplaces in Papua New Guinea that locates the majority of the sale of fresh produce within 'informal markets' or open marketplaces found in every town, roadside and village. Alongside these unique spaces that vary in size, layout, social organisation/norms and are dominated by producer sellers, there exists a market arrangement that delivers food to restaurants and retailers directly from the producers. Benediktsson (2002:118) refers to this as direct bulk selling. Recent research on the various crop value chains shows a significant expansion of commercial production particularly since 2008 and various structural changes such as the emergence of middlemen, who are referred to as 'consolidators' by the Fresh Produce Development agency.

Anthropological accounts of pre-colonial and early colonial trade underscored the 'absence of the market situation' (Gell 1992), the moral economy of 'reciprocal generosity' (Sahlins 1972) and various *social* logics of exchange that coordinated transactions (refer to section 3.2). Even urban markets were said to be defined by 'the absence of bargaining, lack of apparent competition among sellers and uniform and largely inflexible prices' (Modjeska

[38] This sale of loose vegetables is separate to income from bags of garden produce (20.2%) that is predominantly sold by men and is grown on a dedicated and large scale for the market.

1985:156). It was noted that owing to the value represented by the goods being traded in an urban market, attempts to manipulate rates were not well received – in fact, 'many Tolai women vendors prefer to throw away their unsold lettuces than yield to the bargaining attempts by Chinese buyers…' (Epstein 1982:90).

Later work continued to map how contemporary trade represents a very different system while emphasising the continuing importance of social relationships characterised by 'diplomacy, solidarity and inequality' (Sharp 2012, 2015). However, there has not been enough socially informed research on market relationships that map emerging structural changes. A few crops like the sweet potato (*kaukau),* bulb onion, corn and broccoli have developed commercial value chains with distinct middlebuyers and long distance movement of food, such as from the Highlands to Lae to Port Moresby in the case of Sweet Potato. In urban centres like Mt Hagen, Lae and Port Moresby, the volume of crops produced specifically for the market is large and one can frequently observe attempts at negotiation of price ('*wanbel* price'). The term '*tok gris*' was used to indicate attempts to 'grease' sellers, or negotiate, to shift the price. It was once a conventional argument that all fresh food produced from the garden was for household consumption and subsistence needs with an unplanned surplus going to the market. There is now survey evidence and a growing 'grey literature'[39] that suggests that the low price for coffee, the predominant cash crop, has led to some coffee trees being removed and replaced with food crops intended for market. This is especially the case for those living near the Highlands Highway in the Western and Eastern Highlands provinces (Kanua and Bourke 2017). Harding (2014:4) estimated that about 5% of Arabica coffee in the highlands has been removed and replaced by food crops, such as pineapples and sweet potato (*kaukau*).

In this chapter I will explore mobile use within informal markets and then focus on the commercial long distance trade activity as it represents more opportunities for the mobile phone to be used at different points. The bulk of the chapter will draw on an ICT based intervention called MOMIS (Mobile Market Information Service) aimed at farmers and developed by the Fresh Produce Development Agency in order to demonstrate its assumptions and reasons for its limited success in transforming the conduct of trade and working practices.

[39] Commissioned research and unpublished reports by multilateral organisations with a policy/food security focus.

The FPDA is a semi-autonomous government agency mandated with creating a commercially viable and sustainable horticulture industry in PNG. Following a disappointing partnership with Digicel to deliver information on market price and supply status of all major urban markets[40], the FPDA was introduced to an open source database management software called CommCare through an Australian Aid funded Data for Development project. Interest in instituting more digital technology into their business processes and collaborating with a technology partner, that isn't as unresponsive as Digicel, led to ideas about trialling this platform to host the flagship MOMIS database and digitising FPDA's market data collection by equipping extension officers with mobile solutions. By distributing mobile devices to contact farmers, they planned to introduce end-to-end digital work processes into their routine Village Extension Worker (VEW) reporting system.

As a case study, I will elaborate on the cultural and organisational issues that emerged during attempts to embed this new digital technology into a bureaucratic institution. This digitalisation attempt was shaped by the stickiness of established paper based workflows, routines and a management hierarchy that was suspicious of junior staff with custody of mobile devices. By using ethnographic data from this current ICTD intervention, I conclude by tracing and making visible the ambivalent values that drive transitions to data driven development. Terms like 'datafication' (Mayer-Schönberger and Cukier 2012) and 'deep mediatisation' (Couldry and Hepp 2016) have been used to begin to understand the transformations wrought by connective technologies. When applied to developing contexts, does the 'datafication of the global South' (Taylor and Broeders 2015) and the 'informationalisation of poverty' (Carmody 2012) derive from a social vision, or the efficiency and commercial concerns, of technologists, investors and government officials? I interrogate the hidden private technology sector profits that go hand in hand with the current Australian Aid paradigm[41] of encouraging 'apolitical' problem solving and innovation based on digital and communications technologies.

[40] Goroka, Mt Hagen, Lae, Port Moresby, Kokopo, Madang, Wewak and Popondetta.

[41] For instance, InnovationXchange's Data for Health Partnership with Bloomberg Philanthropies to generate better health outcomes through record keeping, digital datasets and to 'start making poor people count.'

6.1 The Formal and Informal Fresh Produce trade

The institution of the marketplace was a colonial import that grew in tandem with the need for provisioning fresh food to urban areas[42]. The large Goroka market where fresh produce is sold today was instituted in 1957 (Epstein 1982: 23). It has been suggested that the growth of marketplaces in the Highlands correlates with the growing importance of the coffee industry accompanied by the agglomeration of its trading hubs in urban centres (Sharp 2012:88). Marketplaces were seen as administrative interventions aimed to prevent the unsupervised hawking of food. They were also treated as centrally located 'contact points' with the rural population 'enabling the diffusion of innovations related to cash cropping and other basics which were to form the stuff of development' Benediktsson (2002:139). The contemporary marketplace in PNG takes many forms - these include large urban marketplaces that may have over 1500 vendors on a busy day organised around a dedicated centrally located site, small house-front stalls (called *haus maket*) and corner markets (*kona maket*) along the edges of streets or bus stops where vendors gather in the late afternoon to sell to those heading home after work (Busse and Sharp 2019). Benediktsson (2002:140) points out that they are informal markets in the literal sense of the term because people use it as a meeting place and as arenas for 'social interaction as well as economic transactions'. They are neutral spaces for socialising in a 'suspicious world'. For example, while seeking to interview a *kaukau* commercial farmer, who was on that day selling betel nut instead, I was told to be careful around the notorious Kakaruk (chicken) market adjacent to the Goroka urban market. It was described to me as the local 'world trade centre', where all kinds of exchange for money takes place. While the interviewee intended that as an oblique reference to the sex trade, it underscored the co-evolution of the cash economy and the commoditisation of food; and the range of disparate actors brought together by a Melanesian marketplace. Epstein's field data from 1968 indicates that during any given week, of the 50,000 people visiting the Koki market in Port Moresby, only 25% had made a purchase from the 2500 vendors who were selling produce there (Epstein 1982:25).

The majority of vendors in the Goroka main market were women (referred to as *mama's market*) and only 20% of the respondents spoken to had their own mobile phones. Several women reported that while they did use mobile phones, they belonged to their husbands. As a female researcher conducting interviews with the help of another female research assistant,

[42] Although in some places, there were historical sites where bartering went on.

when asked about the use of mobile phones in their daily livelihood activities, we were told stories of intimidation and suspicion when it comes to women's ownership of mobile phones. This tallies with findings from Anderson's (2013) research on phone friend stories and the moral outrage that changes domestic relationship dynamics when an unknown number is displayed as an incoming call. Women are usually the lowest priority in their family for obtaining a phone and often get a used handset. Furthermore, their use of these devices are closely surveilled by family members (Burrell 2015). 17.58% of men and 3.13% of women in the village households surveyed reported that they argued over mobile phones. The higher percentage of men reporting this could be because of their controlling behaviour, as is evident from other research from the same population (Eves and Titus 2017a, Eves and Titus 2017b) that shows that a fifth, or 19.6%, of women reported that their husband had got angry with them in the last twelve months for speaking to another man[43].

A young female vendor recounted how she used her phone to contact a *wantok* to ask them to bring more produce when she ran out of the bulb onions she was selling. She sat in a row with vendors from Chimbu who all travelled the long distance to sell at the Goroka market regularly. They reported using phones to coordinate supplies and sometimes to hold their spot in the morning or when they went to collect these supplies. They would communicate about road conditions, or delays, to their kin, who were bringing more produce from their gardens in Chimbu. A male vendor who offered to accompany me, as I interviewed other vendors in the different corners and differentiated sections of the market, continuously played with his smartphone the whole time. Some vendors had numbers of the 'market authority' or the provincial government market caretakers who collected the entrance fee (a small tax that accompanies being able to sell from the market) and enforced the 'no chewing betel nut' rules. They would contact these men who were in charge of organising wheelbarrows between the PMV stop (where most vendors would arrive) and their allocated spot each day. Given the physically gruelling aspect of carrying bags of produce around, the usefulness of phones for logistical coordination helps save wasted trips. Most vendors who had mobile phones stressed their value and stated that it helped them a lot.

[43] When asked whether their husband insisted on knowing where they are, 15.04% of women said that this was always the case, 11.28% said it was frequently the case and 37.61% of women said that this had happened in the last twelve months.

Again, the use of mobile phones in the Goroka marketplace is clearly for the coordination of trade. It is also a very popular place for mobile phones to be stolen, as I found out when I returned from my first visit to the market without my iPhone. Ethnographic research in agricultural markets in other contexts shows that gender clearly mediates phone use. This research reiterates how rather than produce 'modern' calculative reasoning in marketplaces, the utility of the phones is best understood as 'enlivening trade networks as opposed to impersonally acquiring or exchanging information' (Burrell 2014). None of the vendors I spoke with reported using information about the higher price of produce in another market to relocate their day's sales. Perfect mobility between markets is not a possibility and it could also be that these vendors value income predictability and may not have the risk appetite to venture into unknown markets for a better price. I was, however, assured by the Market Information Officer at the FPDA that several vendors and farmers (even those who were not operating at a commercial scale) were excited about the mobile based price information system.

In addition to the Goroka market as an empirical site, I followed the circulation of sweet potatoes from the Asaro valley in the Highlands, as well as the composite fresh produce trade in one of the Sukapass coffee villages along the highway. The Sukapass village coffee cooperative related how they would send down their produce for sale in the Lae market unaccompanied after 'rigim' (ringing) and making arrangements with the truck drivers who travel on the highway. These are typically trucks carrying wholesale goods from the port town, Lae, to various retailers in different parts of the Highlands and then returning to Lae empty. As this village fell on this route, fresh produce growers used phone calls to coordinate pick up times and keep track of the movements of the drivers.

Table 8: Estimated rural population growing staple food crops in 2016 (Brown 2017, Kanua and Bourke 2017)

Crop	**Most important food**		**An important food**		**Grown for food**	
	Population	%	Population	%	Population	%
Sweet potato	4,456,008	66	1,014,066	15	6,628,051	98
Banana	617,197	9	2,147,075	32	6,456,613	96
Taro (*Colocasia*)	424,150	6	1,641,874	25	6,386,355	95
Greater yam (*Dioscorea alata*)	–	–	267,395	4	4,013,277	60
Cassava	68,555	1	824,224	12	3,709,645	55
Chinese taro (*Xanthosoma*)	206,498	3	1,247,653	19	3,590,677	54

Coconut	2,659	<1	2,381,698	36	2,456,106	37
Sago	735,730	11	233,125	3	2,195,206	33
Lesser yam (*D. esculenta*)	435,149	6	379,349	6	2,191,934	33
Irish potato	–	–	193,410	3	1,070,030	16
Taro (*Alocasia*)	–	–	–	–	504,246	8
Queensland arrowroot	–	–	–	–	294,934	4
Taro (*Amorphophallus*)	–	–	–	–	223,531	3
Swamp taro (*Cyrtosperma*)	1,088	<1	5,546	<1	50,557	<1
Aerial yam (D. bulbifera)	–	–	–	–	34,461	<1
Yam (*D. nummularia*)	–	–	–	–	11,826	<1
Yam (*D. pentaphylla*)	–	–	–	–	5,498	<1

Percentages are the proportion of the estimated total rural village population (6,732,700) in 2016 who grow each crop in each class. Column totals add up to more than 100% because people are counted more than once when they grow more than one crop in that class.

Source: Mapping Agricultural Systems of PNG database; Bourke and Allen (2009: Table 3.1.1); updated by Kanua and Bourke 2017 for population growth between 2000 and 2016 (NSO 2002, NSO 2013).

By way of a more formal marketing arrangement, there has emerged in the recent years a long distance trade route for sweet potato, the most prominent of which is from the Highlands to Lae and then to Port Moresby. Estimates show that the volumes of sweet potato being moved increased sixteen fold in the last 30 years (Kanua and Bourke 2017). These movements took place within grooved channels (Geertz 1978) so much so that when sweet potato is sold at the market in Port Moresby, people could identify where the bags had come from (down to the *hauslain* which produced it according to one respondent). The Asaro valley was one of the only places in the Highlands where large scale intercropping of sweet potato and coffee is done. Most of the commercial production of sweet potato is done in three areas of the Highlands: Hagen Central in Western Highlands, the Asaro Valley in Eastern Highlands and the Minj area in the Wahgi Valley in Jiwaka Province (Kanua and Bourke 2017). In addition to the small amounts sold at the local fresh food markets, many villages sell significant amounts of sweet potato each year, with a few households reporting the sales of tens of thousands of Kina per year in distant markets.

> *Asaro is known for kaukau... Every Tuesday, you will see along the road… farmers with 50 bags, 60 bags or 20 bags. They pile them up and send to Lae and offload to Moresby.*

FPDA Market Information Officer, Interview 58, 6th July 2017

The marketing systems for fresh food continue to evolve rapidly yet it has not been documented in detail despite some research being done on the changing role of tubers in PNG in the last 15 years (Ballard et al. 2005, Chang et al. 2013, Chang et al. 2013, Chang et al. 2013). The Australian Centre for International Agricultural Research (ACIAR) currently has a project on 'Supporting Commercial Sweetpotato Production and Marketing in the PNG Highlands' to address this critical gap in knowledge. Preliminary findings from this project show that in spite of the volume of sweet potato being moved and the complexity of the long distance movements, there were no formal arrangements with middle traders or end markets. Furthermore, feedback from end markets was rarely received by growers (Brown 2017).

There was a preference for face to face communications for arranging trade and the use of mobile phones were limited. There were some reports of villagers in Daulo District making transport and storage arrangements over the phone. They would leave their 20 bags of sweet potato to be picked up every week on the sides of the unsealed road that connects to the Asaro Bridge and then onto the Highlands highway. As a relatively new activity, with trade going into new markets, this value chain was not ‘smooth’ enough to function without personally ascertaining the credibility and trustworthiness of trading partners, at least at the onset, through unmediated conversations. As will be evident from the next section, middlemen walking away with the produce and not paying farmers what they had promised was a common occurrence in this value chain, which is considerably less regulated and established than the coffee trade (i.e in the case of coffee, at least those close to town knew the current price of parchment and the norms attending village buyer and smallholder farmer relationships). Since non-use of communications technology is important to understand, it is worth exploring its causes and the alternate forms of mediation used (Baumer et al. 2014).

> *Sweetpotato is being moved from Mt Hagen to urban centres and resource camps in Enga, Southern Highlands and Hela provinces, as well as to Port Moresby. This transfer from Mt Hagen to adjacent provinces has not been previously reported. Tubers from the Asaro Valley are sold in Port Moresby and, to a lesser degree, in Lae. Tubers from the Minj area are mostly sold at nearby roadside markets and in Kundiawa in Simbu Province, with small volumes going to Lae. Some tubers from Mt Hagen and Goroka are also being shipped to other lowland centres.*
>
> *Kanua and Bourke 2017*

Table 9: Long Distance value chain with new end markets and a differentiated role structure

Estimates of the volume of Sweetpotato being sold from the Highlands to various end markets in PNG (tonnes/year) (Brown 2017)

End Market	Minimum	Maximum	Best estimate	Source
Port Moresby	8,000	14,000	11,000	Based on interviews with wholesalers
Lae	4,000	9,000	7,000	Extrapolated from Chang and Irving (2013)
All other lowland towns	4,000	8,000	6,000	Best guess only
Enga, SHP, Hela (from Hagen)	4,000	9,000	6,000	Best guess only
Local sales in Highlands	10,000	40,000	20,000	Two large market places (Mt Hagen, Goroka); eight small to medium size urban centres; over 300 small rural non-village, village and roadside markets
Total	30,000	80,000	50,000	

Source: Kanua and Bourke 2017

Table 10: Price Variation amongst Major Urban Markets

Mean quarterly price of Sweetpotato in eight urban food markets, July 2015 to June 2016 (Brown 2017)

Quarter	Port Moresby	Lae	Goroka	Mt Hagen	Madang	Alotau	Kimbe	Rabaul
Sep-15	4.83	1.21	2.65	1.43	1.57	1.28	1.80	0.90
Dec-15	5.70	1.20	1.70	1.40	1.80	2.00	1.60	0.70
Mar-16	5.90	1.20	1.50	1.10	1.80	1.90	1.30	1.80
Jun-16	5.90	1.20	1.40	1.10	1.50	3.30	3.30	1.70
Mean	**5.58**	1.20	**1.81**	1.26	1.67	2.12	2.00	1.28

Note: The mean price for each market is not a true mean, but is the average of the mean quarterly price in the fresh food market surveyed in each urban centre (Source: NSO)

Around 50,000 tonnes of sweet potato are moved per year into the following markets which vary dramatically in price. Based on the National Statistical Office's Consumer Price Index bulletin[44], a kilo of Sweet Potato in the Port Moresby market would fetch 3 times what it would in the Goroka market (see Table 9). Estimates show that growers in the Asaro Valley were being paid 0.60 Kina per kg when the wholesale price in Moresby was 1.63 Kina per kg (37%). The remaining 63% is distributed throughout the middle of the value chain between middlemen, retailers, transport costs and losses on route.

6.3 MOMIS (Mobile Market Information Service) in the Fresh Produce Sector

> *[The project was initiated to help] farmers trying to access information.*
>
> *They are Highlands based and produce some crops that have high value. They are trying to take them to different market outlets in the country but they don't know the actual price out there... or what the supply is like at the market.*
>
> *Say someone from Western Highlands takes his produce down to Lae or Port Moresby. On his arrival he finds that he is not the only farmer taking his produce there. There is [a] big supply there so the price will be low.*
>
> *FPDA Market Information Officer, Interview 58, 6th July 2017*

In order to tackle the 'uncoordinated marketing system and the geographical isolation' (FPDA 2011) of the majority of producers, the FDPA partnered with Digicel to send out market price and the supply status of various crops at 8 markets. AusAID funded and initiated through the Agricultural Innovation Grant Scheme (AIGS) of the Agriculture Research and Development Support Facility (ARDSF), this initiative was taken over by FPDA after the funding period ended because they saw the value in it. There is a great diversity of Market Information Systems that are in operation today and they form a popular ICTD intervention which has almost become a shorthand for the transformative and empowering potential of mobile phones (Burrell and Oreglia 2015). The aim of this particular adaptation, which was held as a flagship project (publicised in every FPDA publication), was to increase 'market penetration into the more distant rural growing areas' which will in turn enable farmers to make an informed marketing decision leading to 'increased income' and 'improved living standards' (FPDA 2011). As we have seen, there has been criticism from a range of constituencies about the assumptions behind MIS interventions. While the promises of these

[44] This index is calculated by recording the price of one bundle of sweet potato on each sampling day. These figures have very high variability.

systems are large and all expansive with it held up to be a transformative technological innovation, the few impact assessments done of these global techno-scientific projects show low adoption rates and very little measurable improvements to income.

The Y1 Esoko MIS evaluation (Nyarko et al. 2013) based on data from Ghana[45] demonstrated a 6% household income gain on one crop type (yam) with no others showing any promise. Fafchamps and Minten's (2012) study of Reuters Market Light, the corporate SMS based agricultural information system, showed that while farmers associate RML information with a number of decisions they have made, the magnitude of these effects is small. They found no statistically significant average effect on the price received by farmers, 'crop value-added, crop losses resulting from rainstorms, or the likelihood of changing crop varieties and cultivation practices'. This has not kept media outlets from extolling the disruptive and potentially game changing potential of these systems that put a representation (in the case of the FPDA it is an average figure from a very limited sample) of the current market price in the hands of farmers.

From the Economist's (2007) coverage of Jensen's study on the fisheries sector that is often quoted in recent news items by outlets, such as the New York Times, selective evidence for the potential of the system gets presented in a 'disembedded' manner that is devoid of context and detail. The New York Times (2008) article claimed that Reuters had collected anecdotal evidence from farmers about how the service has influenced their decisions about crop sales. They asserted that 'one farmer from Maharashtra (India), held back the sale of 30 quintals of soybeans for 15 days after noticing that prices had been rising for several days' and he was able to get 400 extra rupees per quintal.

[45] Krachi West, Krachi East, Nkwanta North, and Nkwanta South districts of the Volta region of Ghana.

Figure 9: New York Times article on Reuters Market Light

Recent research that revisited this evidence found that the additional income was clearly not the result of a considered decision to wait for prices to rise on the basis of information obtained through Reuters' service, but due to price changes in the larger historical, geographical and economic context (Kumar 2014). Burrell (2014:1) argues that this counter evidence on the impact of mobile phones on market efficiency generated by 'economists employing the same empiricism' as the promising initial studies such as Jensen's demonstrates a serious lack of understanding at the core of the issue. She unpacks this by careful analysis of the practices of 'representation and knowledge building' in the interdisciplinary field of ICTD which she views as an epistemic community. Based on ethnographic engagement with farmers in rural China and Uganda, she argues that the ideal of market efficiency that activates informed marketing decisions in farmers misrecognises a wide variety of marketing and trade practices that do not fit this model and certainly are not based around price information. This has been found to be true in the case of the coffee trade (chapter 3-5) even within the socio-technical price setting context within which a range of actors interact.

Reflexive members of the practitioner community now admit the same. I was able to interview a Washington based technology entrepreneur, who founded and managed the first crowd-sourced agricultural market information system (with integrated SMS capabilities) in operation in several countries in Africa. In retrospect, he agreed that they did get carried away initially:

> *I agree with the notion that we created a myth of the magical market price being able to fix all ills and went with it without revisiting*
>
> *1) if that information was actually lacking and*
>
> *2) if it was useful, and that ICTD in this case tried to generalise agriculturalists into one giant group with market prices somehow levelling the playing field, wherein the free market could fill in the rest of the actions.*
>
> *MIS is an example of something perfectly prescriptive and low impact if done improperly… I do believe that MIS can work, just that they have to be appropriate to multifaceted interventions that allow the information to be leveraged.*
>
> *MIS Techpreneur,*
> *Interview 36, 28th Nov 2016*

In addition to the problematic premise of the system, FPDA's MOMIS (Mobile Market Information System) ran into a major hurdle. Its database, generated by a network of extension officers doing an expensive market survey on a weekly basis and then entering it into a Digicel template, was held by the telecommunications provider in commercial confidence. Digicel was not cooperative at all to requests for information on how many farmers access it, which outraged the FPDA staff who felt that Digicel was making money off it without providing any feedback on access and service coverage. Results from the initial years of the partnership show that in 2013 during the March to August period, between '2000-4000 farmers were accessing market information through their mobile phones' of which more than 600 used the system more than once. The below data is key to understanding the reach and effectiveness of the system. Digicel charges participating farmers 0.25 Kina or 25 toea per text and the ICTD intervention got co-opted into its commercial model. Soon Digicel was unresponsive to requests for support and even basic information on whether the system was being used in spite of the fact that the market data was collected at FPDA's expense on a weekly basis.

Table 11: MOMIS access data

MONTH	SMS COUNT	UNIQUE USERS	MONTH	SMS COUNT	UNIQUE USERS
JAN 2013	1234	186	JUL	2230	437
FEB 2013	1058	180	AUG	2603	422
MAR 2013	4019	495	SEP	1508	312
APR 2013	3891	642	OCT	896	195
MAY 2013	3429	587	NOV	879	166
JUN 2013	2898	533	DEC	434	104

Source: FPDA 2013 – Annual Report

Table 12: MOMIS access data disaggregated by crop information sought (by unique users)

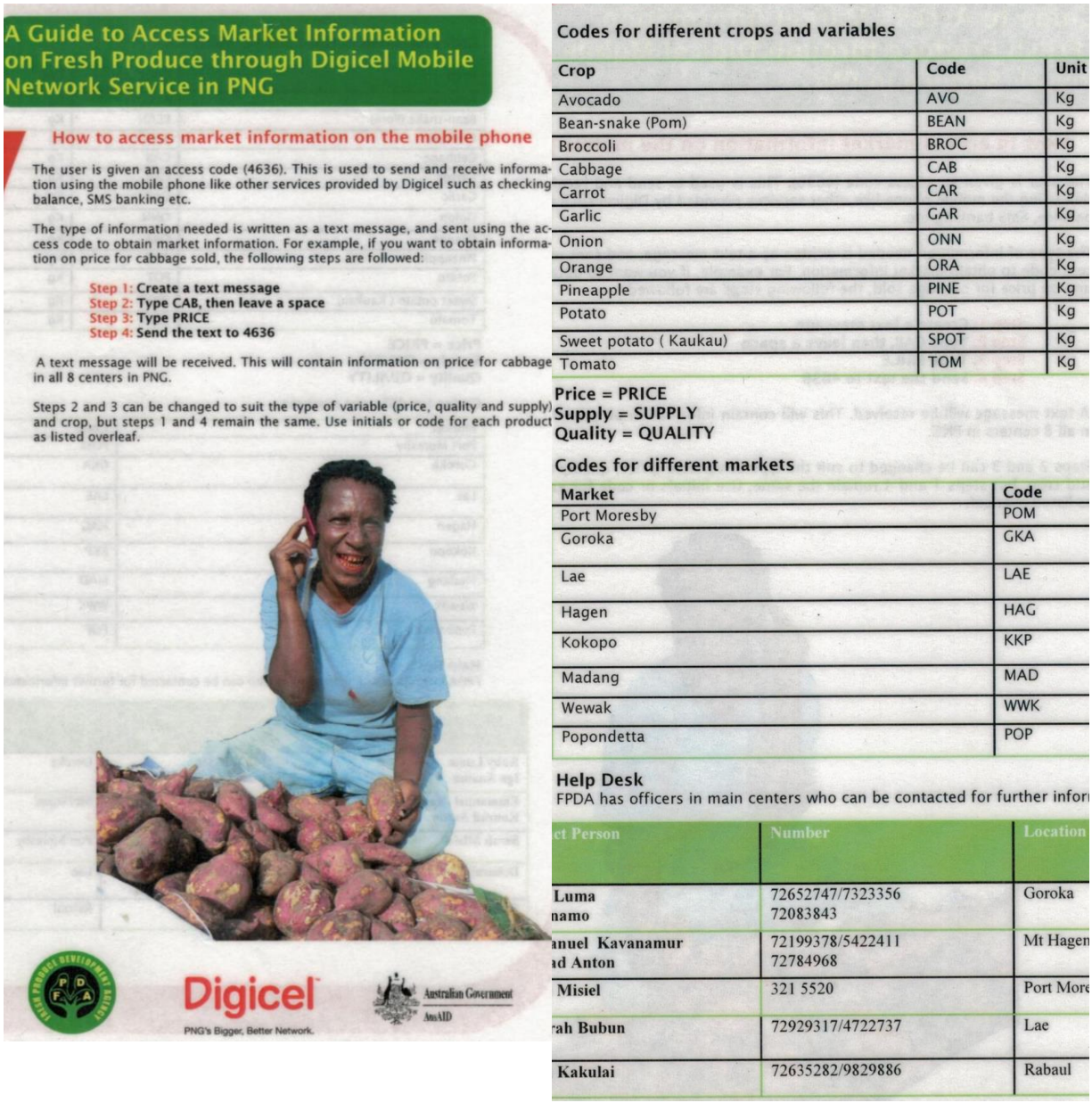
Crops	JAN	FEB	MAR	APR	MAY
Avocado	1	4	1	2	1
Bean	1	1	0	2	4
Broccoli	1	2	0	25	16
Cabbage	11	5	8	19	17
Carrot	0	0	0	3	0
Onion	4	6	2	21	24
Orange	0	0	0	1	0
Pineapple	2	5	1	6	3
Potato	**12**	**15**	**17**	**30**	**23**
Sweet Potato	2	4	2	7	0
Tomato	1	0	0	3	4

Source: FPDA 2013 – Annual Report

Therefore, in spite of a fairly sophisticated database design that takes into account price information, as well as how much of the crop was already at an urban market, MOMIS has been out of commission since 2015 owing to disagreements with Digicel. The operational costs of generating this weekly information is quite high and it is to the credit of individual champions within the organisation that it has continued for as long as it did. Collecting data from 8 urban centres, required the time and effort of 5 FPDA officers and 3 contractors who were trained on the methodology for collecting data. This shows a mature organisation that is trying to be data driven with a sustained management focus on building an evidence base and as such is doing infinitely better than other PNG organisations with low institutional appetite for evidence based policy let alone digital innovation (Howes et al. 2017).

> *I developed this form and then I had instructions on how to collect. I told them [extension officers] to study the form carefully. In PNG if you take a form out there, if you sit in the market, they will make fun of you. So I told them to buy the produce, take it to their office and then enter in price averages.*
>
> *Market Information Officer, FPDA, Goroka, Interview 58, 6th July 2017*

Figure 10: MOMIS (Mobile Market Information Service) flyer



A Guide to Access Market Information on Fresh Produce through Digicel Mobile Network Service in PNG

How to access market information on the mobile phone

The user is given an access code (4636). This is used to send and receive information using the mobile phone like other services provided by Digicel such as checking balance, SMS banking etc.

The type of information needed is written as a text message, and sent using the access code to obtain market information. For example, if you want to obtain information on price for cabbage sold, the following steps are followed:

Step 1: Create a text message
Step 2: Type CAB, then leave a space
Step 3: Type PRICE
Step 4: Send the text to 4636

A text message will be received. This will contain information on price for cabbage in all 8 centers in PNG.

Steps 2 and 3 can be changed to suit the type of variable (price, quality and supply) and crop, but steps 1 and 4 remain the same. Use initials or code for each product as listed overleaf.

Digicel
PNG's Bigger, Better Network.

Australian Government AusAID

Codes for different crops and variables

Crop	Code	Unit
Avocado	AVO	Kg
Bean-snake (Pom)	BEAN	Kg
Broccoli	BROC	Kg
Cabbage	CAB	Kg
Carrot	CAR	Kg
Garlic	GAR	Kg
Onion	ONN	Kg
Orange	ORA	Kg
Pineapple	PINE	Kg
Potato	POT	Kg
Sweet potato (Kaukau)	SPOT	Kg
Tomato	TOM	Kg

Price = PRICE
Supply = SUPPLY
Quality = QUALITY

Codes for different markets

Market	Code
Port Moresby	POM
Goroka	GKA
Lae	LAE
Hagen	HAG
Kokopo	KKP
Madang	MAD
Wewak	WWK
Popondetta	POP

Help Desk
FPDA has officers in main centers who can be contacted for further infor

ct Person	Number	Location
Luma namo	72652747/7323356 72083843	Goroka
anuel Kavanamur ad Anton	72199378/5422411 72784968	Mt Hagen
Misiel	321 5520	Port More
ah Bubun	72929317/4722737	Lae
Kakulai	72635282/9829886	Rabaul

The aim of the project was to provide information to offset the risks undertaken by farmers who have to transport their produce to distant markets. A farmer in the Highlands, by entering in the target market code and the crop code, could get a picture of the supply status and average price of sweet potato in Port Moresby before embarking on that long distance trip. In theory, they could decide whether to take it that far or offload it at the farm gate or at a nearby market. FPDA staff felt they could also take calculated risks about whether it would be worth it to offload to the 'big boys' (consolidators, traders, middle buyers) who have money to pay the farmer on the spot and take it to markets. This would shift the risk to the middle buyer and the 'farmer can just stay in his garden' and relax.

To underscore the transformation brought in by mobile phones, an FPDA officer said:

> *Now the farmer can just stay in his garden and call and a wantok will tell him about carrot supply*
>
> *Before, communication was really hard. They had to go to public post office phones and call their friends in Port Moresby, [and ask] what is the supply of potato like right now at the market? What is the price range? Or they could write letters. But now with the mobile phone... everything is at the tip of the fingers, press the button and you get the information.*
>
> *FPDA staff member, Goroka, Interview 35, 25th May 2017*

Concerns about the efficacy of the system relate to literacy issues, local attitudes to trading in bundles and volume (rather than kg) and whether this system meets the information needs of disparate markets. In most urban markets, some foods are sold as individual items, while leafy vegetables are sold in bundles and sweet potatoes are sold in piles. Pricing based on weight (expressed in kilograms) is less common. Recent research from Goroka's fresh food market documents interactions between customers who counted the number of items in a pile of sweet potatoes before purchase and vendors who sat behind the produce with small pieces of cardboard displaying the asking price (50 t, K 1, K 5) propped up next to the food items (Busse 2019). In this context, sending out notifications of price per kilo is unlikely to generate market efficiencies when the prevalent transaction norms and sales are based on volume and on the qualitative assessment of units of food on display.

> *If you want to sell in kilo, the farmer has to control the quality aspect of produce itself. When they have quality they can bargain to get good price in kilos [usually in wholesale or at the commercial level]. Subsistence farmers prefer to sell in singles…*
>
> *The farmers don't think of selling their produce in kilo like other developed countries do. Our farmers sell in singles and in volumes like in bags or in a big bilum or small [bilum]. [They have a] long way to catch up.*
>
> *…It is really hard to understand our farmers. And the market itself. We can provide this information but they have their own way. They can go 100% on top of that price and bargain with it. It is really tricky.*
>
> *Market Information Officer, FPDA, Goroka, Interview 58, 6th July 2017*

The FPDA staff member then went on to tell me that she expected the MIS project to help commercial farmers, as well as smallholder farmers who work seasonally to cater for school

fees or social obligations, such as bride price/compensation[46]. Despite informing me that strategic marketing and negotiations are not in the culture of Goroka market (but prevailed in large urban markets like Mt Hagen and Port Moresby), she said that if the farmer can see on his phone that the bulb onion is going for 1:50 to 2 Kina per kg, they can refer back to it during the day. If a buyer says that he will buy for 1 Kina, the farmer can respond that even by the standard of the singles that other vendors are selling, he has to pay at least 2 Kina for a kilo. Some of the possibilities of the project were framed against the spectre of the middleman who was seen as a new player in the market capitalising on the fact that farmers need money at farm gate especially because they are not consistent producers. The FPDA worked with middlebuyers who they referred to as 'consolidators' adept at getting a large volume of produce together.

> *These middlemen have seen an opportunity, they have seen the farmer struggle to go to market and then come back at a loss. The farmer wants the cash at farm gate. There are ad hoc middlebuyers too, only when they have money will they enter the trade. Some are more consistent and they buy every week.*
>
> *Middlebuyers sell to open markets. We also have 'black marketeers', men who have little sections in markets like Lae and Moresby. When farmers take produce [to market], they come and take the produce by force and then bargain.*
>
> *FPDA staff member, Goroka, Interview 35, 25th May 2017*

This sense of disdain towards 'black marketeers' or those who resell food (that they did not grow themselves) draws on broader cultural ideas about personhood, social relationships and the moral obligations to non-kin and strangers that are activated during exchange practices. Busse (2019:217) postulates that food items sold in the Goroka marketplace were only partially commodified and were not 'person-less items easily alienated' when money changes hands. This is particularly true in the buying and selling of food as an item that is intrinsically 'life giving and symbolically charged'. Drawing on an ethnographic tradition of inquiry among the Gehamo tribe that lives in and around the Goroka region, Busse claims that at least for Gehamo market vendors, success in gardening and food production is an indicator of good relations with ancestral spirits who inhabit the ground and a reflection of the gardener's morality, their good social relationships and stewardship of communal land through soil care and drainage. Therefore, rather than reflect supply and demand signals, field data from this

[46] 'If they know there is a social obligation coming up in December, it will take them 3-4 months to get kaukau ready before harvesting.' – Interviewee.

research shows that vendors believe that the asking price represents the value of the fresh food based on the work that they did to produce it (Busse 2019). It is what they thought would be a fair amount of money given the effort they had put in and what they wanted for the bundle of produce so as to enable them to pay school and hospital fees, buy basic store goods and contribute to bride-price and meet other community obligations.

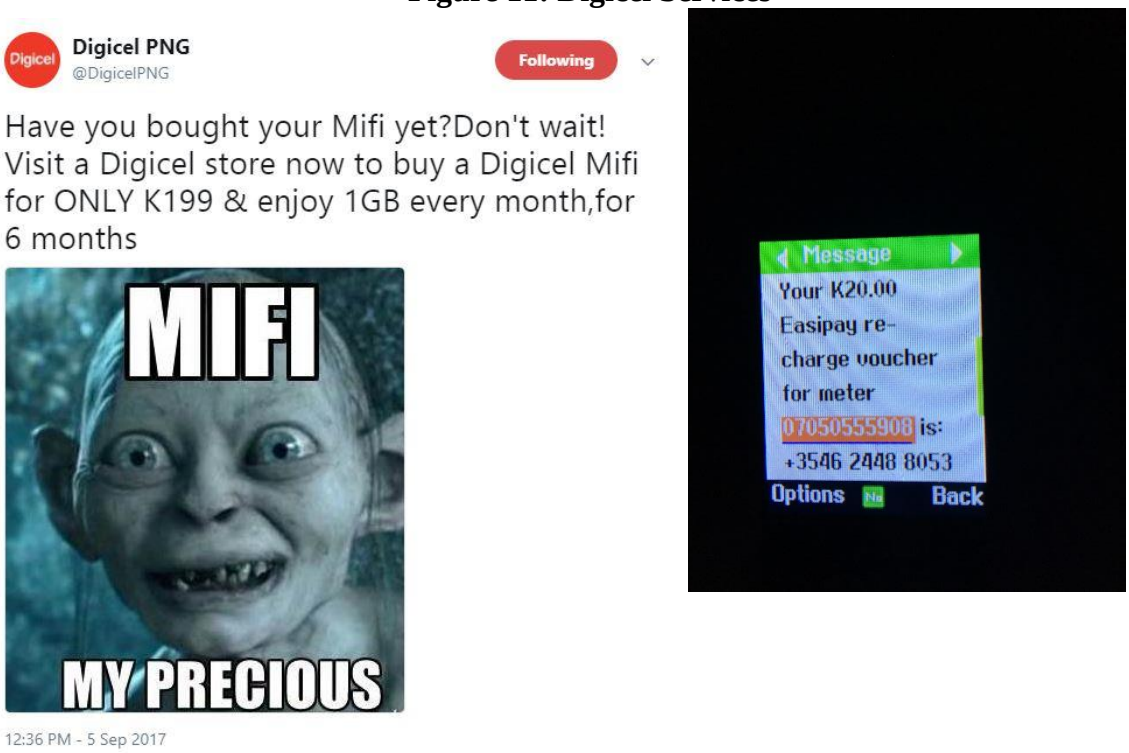
Findings from Busse's research (2019: 216) show that, in this sense, prices were not set by competition and vendors did not distinguish themselves from other vendors selling the same food items at the same time in the marketplace on the basis of price. Customers went to vendors they knew[47] or came to a decision not based solely on price differences but by counting the number of items in a pile and by looking at the quality of the produce. Market information systems imagine an abstract actor navigating an abstract market solely based on price information. Such interventions assume that price information is scarce, is actively sought after by vendors before making decisions about where or whom to sell to and that the use of mobile devices to deliver average price data in real time will cause the farmer to make rational, profit maximising, individual choices at the market. Especially in the context of economic activity around food which has a larger symbolic value, this focus on price information overlooks established trading practices, the social logic and the situated specificities of the Goroka fresh food market while also mischaracterising the social considerations, evaluations and judgements that underpin marketing decisions. The above discussion of an emerging body of literature based on sustained ethnographic engagement with Papua New Guinean marketplaces (Barnett-Naghshineh 2019, Busse 2019, Busse and Sharp 2019) shows the myriad cultural calculations that accompany attempts at establishing equivalences and setting a price for a food item at any given point.

It becomes evident that there is a poor fit between the economistic assumptions that drive ICT based interventions and the reality of trade in PNG. While the above findings confirm and contribute to research that maps the limitations of Market Information Systems (MIS) globally, there has been no research to date looking at what happens when it is such a popular part of ICT led development practice that telecommunications providers seek to benefit from it. Digicel is known for its aggressive marketing practices. Horst's (2014) definitive

[47] Similar to the practice of setting a '*wanbel'* or '*wantok'* price in the coffee trade, Busse (2019) documents instances where vendors try to encourage a relationship with a buyer or their continued patronage and reciprocity by the practice of 'giving extra' – whereby an extra onion or a food item would be offered to the customer for no extra charge so that they would buy from them again.

ethnography of Digicel's branding cultures in Jamaica shows the myriad ways in which identity, local aesthetic connections, and a sense of belonging is invoked to create a 'consumer-citizen'. With equal vigour, Digicel has entered the PNG market and made mobile enabled services indispensable in almost every field. By way of entry strategy, Digicel intentionally targeted 'high risk' countries with fairly small populations in the Global South that were being poorly served by state-sponsored telecommunications monopolies (Foster and Horst 2018). Now, with collaborations with banking operations for mobile banking and data packages that are so prohibitively expensive that only 10% of the population has access to internet (Yapumi 2017), Digicel currently seeks to expand into areas of service delivery that were traditionally well within the domain of the state. Since 2015, it has had arrangements with the State electricity provider so that consumers and businesses can purchase prepaid electricity units through their phone (which is quite 'handy' in PNG where electricity is expensive and units run out quickly). The Digicel Easypay '*Easipawa'* service that charges an additional overhead for the convenience of top ups on the phone, needs to be understood in light of how scarce electricity as a commodity is in a country where only 20.3% of the population has access to it (World Bank 2014). This is not just due to costs but due to limited infrastructural reach (these figures get better if only the urban population is considered - 76.4% of the urban population had access to electricity in 2014). Therefore, not only is the national telecommunications network for all practical purposes in the hands of a privately owned for-profit foreign company, essential service domains like electricity and utilities are increasingly being captured into the profit logic of Digicel.

Figure 11: Digicel Services



Note: The twitter snapshot on the left is a Digicel PNG advertisement for a new wifi service and the photo on right is of the author using the *Easipawa* service in the dark when electricity units had run out unexpectedly

This instance of a development initiative being held up demonstrates how FPDA's market survey data is being captured to drive Digicel's competitive advantage and is a good example of how supposedly neutral public sector data is repurposed for commercial gain. Reports from NGOs abound on the unsuitability of the company's corporate ethic to development partnerships despite widely publicised philanthropic initiatives (Watson and Mahuru 2017). As development interventions try to make market prices widely available, often lost in the discussions about the potency of mobile solutions is the fact that information scarcity helps enable the business models of technology and telecommunications firms. In this context, the new level of emphasis on data for civic problem solving glosses over 'new instances of corporate subsidy and commercialized capture… in a manner that blurs public, private, and civic services data' (Currie 2016).

We have seen how if these ICTD interventions are to work, they need to be embedded within local trading practices and approached with a socially informed perspective. Now, with increasing interest in these initiatives, development practitioners and policy makers need to get past the idealised image of communications technology, as a neutral, apolitical artefact that merely broadcasts (and amplifies development interventions) and is amenable to instrumental use. All parties need to seriously grapple with the reality of corporate subsidy and commercialized capture within technology enabled communications initiatives. Terms like 'data colonialism' (Couldry and Mejias 2019) have been used to critique and flag the scale of ambition represented by Facebook's attempts to expand into untapped markets at the bottom of the pyramid. Research that does not underscore the political and commercial interests entangled in technology solutions does a real disservice to the already disadvantaged populations whose disenfranchisement is now being digitally compounded.

6.4 Migration of Administrative databases online: Data for development, the future?

Following from the unsatisfactory engagement with Digicel, an ACIAR (Australian Centre for International Agricultural Research project) research project that partnered with the FPDA introduced a new open source platform that allowed users with a tablet, or a phone, to write into a web based database. This mobile technology, called CommCare, works well offline and has an award winning design meant to cater to underserved communities in 'low

resource' settings. In tandem with the preparation to use it to collect data for the ACIAR project, there were plans to roll out mobile phones to replace paper based reporting and as 'job aids' for frontline extension workers. Other applications for the user friendly mobile platform included using it to introduce end-to-end digital work processes into their routine Village Extension Worker (VEW) reporting system, migrating existing administrative databases online and digitising the MOMIS market data collection system.

FPDA's weekly data collection is currently done through a tiered network of paid and unpaid extension officers and 'influential' farmers, who collect data and file them using an inefficient carbon copy system. An extension officer would then go and collect these forms from the remote sites on a weekly basis.

> *If we didn't have to spend so much time on collecting forms, the extension officers could actually work on thinking about what training needs farmers have.*
>
> *Village Extension Worker Program Manager, Interview 34, 5th May 2017*

App based systems are especially popular in global 'mhealth' projects, introducing mobile phones to replace paper-based reporting from frontline workers in remote settings promises time and efficiency savings. For example, CommCare is embedded within the primary health care monitoring system in India, with over 90000 allied health workers using mobile devices to continuously record the health needs of remote communities. Also, they have recently released a Farmer Training App in collaboration with the Rainforest Alliance to support the large scale roll out of the recently revised certification standard set by the Sustainable Agriculture Network (SAN) in Africa, Asia and Latin America (Castillo and Vosloo 2017).

In an attempt to reach the agricultural services sector, the Boston based for-profit social enterprise responsible for creating the platform, Dimagi, provided pro bono licenses worth around 50,000 AUD to 5 projects in PNG that were trialling the system[48] to achieve the goals of commercialisation and intensification of agriculture. As a sterling example of the global policy mandate to harness the power of ICTs, and now the data revolution, for development monitoring, by digitally enabling frontline workers, such projects also create users who have been introduced to the internet solely through mobiles. A peculiarly developing country phenomenon, there is now a large cadre of users of the Internet whose "digital repertoires

[48] Of all the projects trialling the digital/mobile based data collection system, FPDA had plans to use it for broader organisational goals – these pro bono licenses also covered the requirements of 4 other ACIAR projects run in close collaboration with in-country partners in the Asia-Pacific region.

contain exclusively mobile devices' (Donner 2015). Unlike the trajectory of technological innovation in advanced economies, such use of the internet from midmarket mobile handsets 'leapfrogged' requirements, such as landline phone diffusion, access to computers, a traditional PC-based internet connection or even access to electricity. This section analyses what happened when such a novel digital culture and mobile based (in this case tablet) project was embedded within an existing set of institutional arrangements and contextual factors, such as established organisational routines, working relations and the physicality and familiarity of paper. Given the enthusiasm for harnessing the power of the mobile revolution to generate new market efficiencies, this discussion of attempts to change the way agricultural services are delivered highlights yet another aspect of what instituting a technology solution looks like in everyday practice.

While this technology has not been fully deployed by FPDA to restart the MOMIS and price information distribution, this case study is indicative of the cultural changes and digital implementation challenges stemming from institutional barriers. The term 'digital natives' is used by digital media researchers to talk about the generational and cohort effects of growing up immersed in a digital information environment (Boyd 2014). Initial impressions of first time app builders while they were introduced to customisable online tools for agriculture shows the analogies, perceptions and attempts to 'domesticate' the technology to suit local needs. The imagined affordances and expectations attached to the innovation are also instructive. Drawing on ethnographic data collected while leading the evaluation of the integration of digital processes into these ACIAR projects, I will conclude by touching on the implications of big data and data-driven development paradigms that are the future of ICTs in Development projects.

6.4.1 CASE STUDY: Mobile based reporting – Workflow and Organisational changes

The preponderance of mobile phones and smart phones has led to creative ideas to tap into their direct and ubiquitous reach into the households of farmers to provide extension advice and market information. The next generation of ICTD projects are invested in making mobile service platforms work for government and NGOs engaged in community level or frontline service delivery. Data entered on a tablet or a phone into a structured app which is downloaded and switched to offline use, can be synced to the server when within internet range. The data from individual cases can be linked over time and this enhances the ability to map the progressive health of households and their livelihood assets longitudinally. This can be made accessible to administrators in central offices or overseas NGO headquarters to view

in near real time thereby enabling storage and retrieval functionality, ‘instantaneous and multi-location access, and the virtual integration of data elements stored in geographically dispersed databases’ (Berg and Toussaint 2003:1)

Given how critical the MOMIS system is, and the manner in which it was held as first of its kind, network infrastructure issues that would usually be fixed by hiring a software engineer or through enterprise software solutions seem to not have been attempted so far. Even after signing an MoU with Digicel to renegotiate the terms of their access and interaction with the market price database, the initial training on CommCare sparked wider conversations about what the FPDA could do with an open source software platform that they could shape themselves. The Internet penetration in rural areas where majority of the population lives is low and there aren't that many software companies outside of Moresby - the national average Internet penetration rate for PNG is 9.38% (while Australia is 93.1%) according to World Bank figures. Therefore, the interest in the wider adoption of the technology for their organisational monitoring and evaluation processes was germane and driven by influential individuals within the organisation who championed it.

During the roll out of CommCare within the organisation, it emerged that within the work group, members who were most tech savvy were junior FPDA staff. However, in the period leading up to field level implementation with sweet potato farmers, they continued to be uneasy about making changes to the app on the web interface on their own. This was despite the enthusiasm and the requisite technical skills. Organisational norms that encourage hierarchical decision making, and a culture that valorises seniority, were not conducive to them taking ownership of the digital innovation and driving it. In addition to age hierarchies, even when technical issues are identified and communicated to decision makers, the incentives to make changes were not always there. Since communication in the organisation is layered and established routines are not completely participative and consultative, complaining might prove risky to the staff member at the bottom of the bureaucratic hierarchy. These institutional determinants of adoption were not apparent at the onset. There was a degree of status attached to the tablets that were bought for the project and some of the senior staff got control over them while the junior, technically minded staff actually doing the work had trouble accessing them.

One of the key value propositions of this ICT initiative was that data collected in the field could be uploaded in real time for project managers to view and download. During the course of the ACIAR project, the team uploaded 50% of the data captured and was then made to stop because the middle level manager wanted to check the work of field staff. Once sent off to the server, he was unsure if they would be able to retrieve and correct errors. There was a degree of incomprehension and unease with the back end of IT architecture; and conceptualising data storage on a server overseas and the intangibility of network architecture emerged as a key digital literacy issue. For instance there was confusion when the term 'CommCare HQ' (the web platform from where the app can be edited, reviewed and downloaded) was used. Some of the FPDA team asked if that meant that the team would have to post someone to the US to get the data as it comes in. During training sessions with other teams, the mention of cloud storage made participants look out of the window at the sky. In addition to the effort required to immerse oneself in a new digital information environment, what is most significant is how these innovations aimed at improving service delivery and efficiency disrupt existing 'organizational, professional and spatial orders' (Halford et al. 2010:457).

Detailed ethnographic research on data collection and reporting from a rural Sub-Saharan health district network to the central office shows similar cultural disruptions. In that instance, following the introduction of an ICT initiative based around mobile data collection to replace paper-based reporting, established inter-professional relationships and bureaucratic reporting lines were disrupted. App adoption and use in this project clearly shows that while there is an overall enthusiasm for digitisation within the FPDA, some members of staff were still trying to adjust to how it might be used and the changes involved.

Findings from a research project (called 'MobiHealth') analysing the uptake of mobile based data collection tools in Health Information Systems in Malawi show how within organisations, individual tasks are part of a larger system of tasks. Manda and Herstad (2015) examine the workflow for the compilation of weekly reports across rural health facilities by statistical clerks and other district level officials before it can be signed off and submitted to the Ministry of Health. Requiring collaboration between different administrative levels across different paper registers, the introduction of digitised reporting mechanisms produced several benefits such as remote data communication, data validation checks and smoother transportation through rough terrain. However they underscore the historical coevolution of

paper based systems and tacit organisational routines. This means that for the digital interventions to work, there needs to be 'ongoing adjustments to technology and practice, within a changing context of use' (Manda and Herstad 2015:443).

> *…The use of paper-based reporting forms also better supports organizational processes such as report verification and signing-off, by senior officers at health facility level. Such processes would be difficult to support using only mobile phones, which in most cases are in the custody of junior officers (Manda and Herstad 2015:457)*

Unease with integrating CommCare into lines of reporting resulted in the pausing of real time upload of data which is a key feature of digital data capture systems. Therefore a system that was meant to radically transform the aggregation, storage, transmission and analysis of data, in a trial leading up to at-scale deployment across the organisation proved to be socially charged. The organisation also found that the version of the browser on their desktop computers was not compatible with CommCare HQ and not ideal for making edits to the app and that using expensive looking tablets with sweet potato producers in the boisterous market of Mt Hagen would be challenging. There has been considerable debate on why the majority of ICT based innovation initiatives do not move beyond the pilot stage. Since many such projects in low resource settings are seeded as 'short-term, donor funded pilots', scalability and sustainability concerns have not always been at the forefront of the design phase (McNamara 2003, Curioso and Mechael 2010, Lemaire 2011, Kumar et al. 2015). Recent reviews (Sanner et al. 2012) of the impacts and benefits of app use among field level workers (FLWs) especially in mhealth projects, confirm this to be a serious, continuing problem. The short half-life of ICT pilots and their limited uptake derives mainly from the expectations and assumptions attached to them that are rarely unpacked or combined with a cautious appreciation for its potentiality.

6.5 Conclusion: From an 'ICT revolution in the digital islands' to a data revolution?

Techno-centricity of ICTD projects continues to be a core issue and researchers have repeatedly pointed out the limitations of the 'assumption that technology, alone, can be sufficient to generate development; and the failure to recognise the wider contextual factors that govern the impacts of technology' (Heeks 2014). There is a growing body of evidence[49] (Halford et al. 2010, Bhavsar and Grijalva 2013, Dell et al. 2015, Ghosh et al. 2015) based on

[49] Majority of this research is based on digitalisation and electronic records management (ERM) in health service delivery, the move to eliminate paper through mobile money transfers in rural microfinance networks and the paper-digital workflows in global development organisations in low resource contexts.

case studies of organisational change following the introduction of mobile phones to replace paper-based reporting that cautions against over emphasising the potential of mobile solutions at the expense of everything else.

Particularly in the current aid environment, demonstrating value for the dollar and post-implementation evaluation is important in Overseas Assistance Programs**.** Donor communities are pressed to explore newer models that work and a strong value proposition is offered by private technology companies with novel ways to wrangle data that is being produced by new communications and database technologies in developing countries. What started as a cost efficiency need, grows into a process that imports the values and ethos of commercial entities into human development and aid efforts. This propensity to trust in technological innovation as a panacea overlooks the political, commercially motivated and conscribed logic of the private sector actors involved in the 'datafication of the global South' (Taylor and Broeders 2015).

Recent research has traced the trend to empower public-private partnerships around datafication in the global South. Taylor and Broeders (2015) argue that commercially generated big data, useful as they are, function as 'data doubles' that compensate for the 'poor numbers' (Jerven 2013) coming out of national statistical offices in Africa. This in turn amplifies the role of 'corporations as development actors' (Taylor and Broeders 2015:229). For example, the flagship Project Lucy in Kenya is run by IBM to 'solve Africa's grand challenges' including 'healthcare, education, water and sanitation, human mobility and agriculture' (IBM, 2014) using artificial intelligence and big data analytics. After aggregating all available economic and social data from African countries, IBM's supercomputer 'Watson' uses machine learning techniques to data mine for answers. Any organisation that can pay can ask questions of the Lucy database leading to concerns about how the proliferation of such analytics projects that generate proprietary data can 'distribute the power to govern to anyone who can afford it' (Taylor and Broeders 2015:234). The increasing comfort threshold for private, profit driven entities (with novel big data solutions) to operate in this development space is evident in the technocratic and commercial discourse used by new multilateral coordinating bodies in the post-2015 SDGs era like the UN Global Pulse and the Stanford Peace Innovation Lab. The director of the Peace Innovation Lab at Stanford is quoted to have said that:

> *If you can measure something, you can design for it; if you can design for it you can create new value; if you can create new value you can monetize it. Our aim is to create peace businesses.*

Similarly, the Global Pulse lab's director has said that Global Pulse is 'trying to track unemployment and disease as if it were a brand' (Taylor and Broeders 2015:234). Discourses that resonate with this valorisation of technological innovation circulate within the new 'economic diplomacy paradigm' of the Australian Aid program. For example, the Department of Foreign Affairs and Trade (DFAT) have over the last few years invested in developing an 'innovation incubator' consortium called InnovationXchange managed by AECOM, the global consulting contractor. In 2015, following the Pacific Humanitarian Challenge aimed at generating new ways of responding to Humanitarian disasters in the Pacific region, 10 entrepreneurial tech pilots were chosen as finalists (with the final grant awarded to 5 from these). Using the hashtag #rethinkingresponse created for the application process, InnovationXchange chose to announce the results for the best approach to crisis response using twitter 'trading cards'.

> innovationXchange [dfat_iXc]. (2016, Mar 17). Trading cards of our top 10 #RethinkingResponse finalists! https://twitter.com/secondmuse/status/710457391532404736 [Tweet]. Retrieved from https://twitter.com/dfat_iXc/status/710590403305574400

> secondmuse [secondmuse] (2016, Mar 17) We made trading cards of the first round winners of #RethinkingResponse! Stay tuned to collect them all and share! http://buff.ly/1RovVkZ%20

Aside from the appropriateness of using 'trading cards' to talk about something as serious as humanitarian crises that in the Pacific region are merciless and devastatingly frequent with climate change, the twitter responses to this media release underscores the problems of this approach.

> Vanuatu Digest vu [VanuatuDigest]. (2016, Mar 21). Sounds interesting… here's a thought: Pacific has +3K yrs experience of disaster response– maybe include us on team? https://t.co/pikoKilzr5 [Tweet]. Retrieved from https://twitter.com/VanuatuDigest/status/711846929102057473

> Vanuatu Digest vu [VanuatuDigest]. (2016, Mar 21). @Asha_Titus more for domestic audience – when will DFAT stop giving FIFO 'experts' preference over actual local expertise? [Tweet]. Retrieved from https://twitter.com/VanuatuDigest/status/711854299257507840

The gamify ethos from start-up culture and cyber libertarian thought that invariably accompanies data innovation obscures deeper structural and persistent inequalities that create issues in the first place. To assume that engineering logic and communications technologies can solve these long term problems (what Morozov 2013 has termed 'solutionism') is misinformed at best and dangerous at worst. Valorising the raw resource of data and the interpretative flexibility of technological platforms obscures the political nature of civic problem solving and the contestations that surround how data is constructed.

These technological innovations need to be driven by a social vision rather than the efficiency and commercial concerns of technologists, investors and government officials. Using the exponential increase in the volume and types of data available from emerging technologies is a core priority of the post 2015 development agenda (UN Data Revolution Group 2014). Every practitioner conference/communication technology development conference I have attended in the last few years have echoed this sentiment.

The Crawford Fund (an initiative of the Australian Academy of Technological Sciences and Engineering - ATSE) organised an agenda setting conference in 2017 aimed at harnessing the potency of the data revolution for smallholder farmers in the developing countries that the food security portfolio of the Official Development Assistance programme engages with. A key feature of the development programming direction set out at this defining event was the fact that it, drew heavily from tech-preneurs and the private sector. There was a reiteration of language such as 'overlaying agricultural transport and logistical data to generate a 3D augmented reality' for decision makers to interact with; and using Artificial Intelligence (AI) techniques to optimise and classify data for actionable insights. The emphasis was on using innovation and digital technology to create efficiencies and better outcomes because asking the resource-poor frontline worker to do more is unfeasible.

Authors writing about the post-2015 emphasis on the data revolution[50] point out that if there is no recognition of the political nature of counting and the underrepresentation of the agency of disadvantaged groups in official statistics, then even with a data revolution, 'the same people and the same things will continue to go uncounted' (DLP 2015). Jerven (2013) makes the same point by weighing in on the data for development debate through an ethnographic engagement with the UN system of National Accounts and African statistical officers and their measurement practices. He documents the poor data quality of statistics, national income accounting and the role of political pressure from donor communities and local political leaders in the production of 'poor' numbers and indicators about Africa. By historicising agricultural statistics, which weren't collected before agricultural extension services began in the postcolonial period, he argues that the data for development impulse

[50] 'The UN Secretary General was told two years ago by the 2012–13 High Level Panel of Eminent Persons on the Post-2015 Development Agenda that any follow-up to the Millennium Development Goals (MDGs) had to include a data revolution' (DLP 2015).

isn't new. An alliance of western experts who feel that governance problems can be solved by gathering more data about developing countries has been documented by Tilley's (2011) exploration of the concept of Africa as a 'living laboratory' for the creation of economic knowledge. New economic sociology and economic anthropological conceptual clarifications of the role of economic models in making or 'performing' the economy, trace the origin of statistics in the US to problem of the 'speculator' in agricultural markets (Didier 2007). This villainous figure, similar to that of the middleman or '*namelman'*, profited by misrepresenting price information to farmers isolated in the middle of their fields in the period between the two world wars. By manipulating the asymmetric access to information caused by the farmers isolation and his own vantage point, he 'misled farmers and got rich by lying, but committed a much worse offense, according to the U.S. government: he distorted the whole market' (Didier 2007:277)[51]. Didier concludes by delineating how Statistics transform their object as they describe it through a notion of 'weak performativity' (refer to chapter 3). This performative role of economic expertise certainly resonates in our case studies. It is especially true given the current confidence in apolitical technological innovation and the attempts to co-opt communications technology into providing market prices to distribute the role of the 'speculator' and modernise agricultural markets.

[51] *"You know, mister farmer," he said, "yields have been fantastic this year. I just got back from nearby Oklahoma, and I can tell you that I never saw as much corn in the fields. And in fact, prices have dropped catastrophically. But since I'm on your side, I'll buy yours one cent above the going rate, which is 12 cents a bushel this year."*

And they clinched the deal, to the satisfaction of both parties.

Until the day when the farmer went to town or had a visit from a city cousin, who said to him: 'Well, I guess things are going well this year, with corn at 25 cents a bushel.' (Didier 2007:277)

7 Conclusion

The recent adoption, diffusion and exponential growth of mobile phones in Papua New Guinea has left no sphere of life untouched. Commentators and development practitioners are yet to fully grasp the impact of these technologies on livelihood activities and economic practices. There is currently a wide ranging policy imperative for ICTs in development and a renewed focus within the post 2015 SDGs agenda on harnessing the 'digital provides' or the capabilities of these new devices. In addition to delivering development outcomes to the 'bottom billion', calls to tap into the new possibilities for enhancing productivity through mobile devices have been made. These ideas about the advantages of unprecedented mobile access for the remotest communities in the global South are gaining currency within influential policy circles that set priorities for the aid sector and at gatherings such as the World Economic Forum. Terms like the 'fourth industrial revolution' (Schwab 2017) are being used to evocatively describe the paradigm shift implied. The World Bank's World Development Report 2016 in the crucial agenda setting year post MDGs was devoted to the new 'digital dividends' generated by these mobile platform technologies and the upcoming World Development Report 2021 will foreground the role of digital 'data for better lives' indicating that these narratives will continue to gain currency within policy frames.

This thesis aimed to identify and condense the discourses used to articulate the expectations and optimistic forecasts surrounding the coming of mobile phones in the context of agricultural markets in Papua New Guinea. Of the arguments used, the ones that predict enduring structural changes to returns from livelihood activities revolve around the potency of ICTs to improve the circulation of price information and generate new arbitrage opportunities. In addition to this utility of phones to reduce search costs and allow growers to benefit from the price differences for the same produce in different markets, the other expectation is that it can change the structural advantage of middlemen. By connecting growers directly to buyers in a process referred to as disintermediation, new communications technologies have the potential to displace middlemen who, until then, had a unique vantage point and a better picture of the price system in contrast to farmers in remote, isolated locations. While mobile phones have integrated into every level of the coffee value chain, chapters 4 to 5 discuss how existing economic practices and the material conditions of their use circumscribe their transformative potential. Chapter 6 reports on the relevance of these claims on the fresh produce value chain and calls attention to the political economy of

telecommunications providers such as Digicel who seek to benefit from the enthusiasm for ICT based development interventions.

A considered exploration of whether the predicted impact of mobiles bear out on the ground shows mixed results. However, the clearest observable change was in the way the advent of mobile phones reconfigured the communications landscape and bridged the barriers of distance in an unprecedented manner. By making voice communications portable, mobile phones lift social interaction out of the face to face context and amplify the scale and reach of contact. In contrast to the fixed line phone which changed the connectivity between places, mobile technology connects people, who could be anywhere during the call thereby transforming distance, time and space and relative positionalities. In this process, familiar distinctions between the 'public' and 'private' and notions of 'local', 'regional' and 'global' that have fixed definitions based on place are blurred and reconstituted (Meyrowitz 1986, Schulz 2004, Livingstone 2009).

The significance of this moment of mediation cannot be overemphasised as it has wider implications as evidenced by the development of new SMS codes that function as an adapted language register and a shorthand for various tasks. There is a long tradition of research that documents the historically significant changes set into motion by other processes of mediation such as language, money and the circulation of goods in the Melanesian context. Previous research has demonstrated how through the introduction of text messaging users are 'creating a connection to English at an orthographic level that has not been seen since the early colonial' shifts in Tok Pisin spellings (Handman 2013:277). Linguists (Dutton 1976, Mihalic 1986) put a lot of weight on the post-Independence modifications in Tok Pisin such as the development of consonant clusters and interpreted them as an effort to establish 'nationalist autonomy' through the distancing of the language from English. Therefore, equally noteworthy are the current recalibrations of communication norms that draw on the affordances of the Digicel text based free request systems and combine it with local relational structures of exchange and obligation. Chapter 3 described how in a short period of time, user-defined codes evolved to signify an emergency, phone credit being low (and thereby activating obligations from the recipient) or even the coffee price being low. Echoing Livingstone (2009:9), the paradigm shifts produced by mediation processes are significant because these new 'semiotic potentialities encode the world in particular ways'. Furthermore, interviews revealed how phones are used in the coordination of the movement of coffee from

the village to airstrip to exporter and in other routine, logistical tasks that media scholars class under 'phatic communication' or 'micro-coordination' (Ling 2004, Miller 2008).

We have seen how through the 'softening of time' and the 'dissolving of distances', mobiles have only partially smoothed the geographic frictions and challenges presented by the distance to market. While coffee growers expressed concerns about middlemen, the role of the mobile phone was not to displace them and connect growers directly to end markets. The way the phone was being used was to lubricate the coffee value chain and navigate between existing arrangements rather than to structurally subvert them. The utility of the phone was in enabling growers to place calls to middle buyers to come at their expense to pick up the coffee when the community has organised a large enough volume of parchment. A majority of interviewees did use the phone to contact *wantoks* near the Goroka roadside market to get them to look at the prices for the day. In cases where they are able to directly ring traders, it was to a '*save fes',* or a known buyer or trader, rather than use phones to initiate new trade relationships.

The role of the middle buyer cannot be abstracted from the context of the relationship and the disintermediation thesis misrecognises their social role in this case. The proposition is that a quick call to a list of buyers to shop for the highest price will produce market knowledge and bargaining power and let the smallholder bypass middlemen over time. We have seen how people are keen to ascertain the veracity of price offers being made and the commitment to a particular price and how information is rarely seen as independent of its source. The only instance in my sample of instrumental phone based buying arrangements where a new buyer (based in Lufa, a different district) was contacted, was in the Gehatiga hamlet of Gotobe plantation in Unggai Bena. As a community with an unusual composition that had migrated from Lufa, they were alerted to the prices being offered by a *wantok* there.

During the 2017 coffee season, they called a few buyers before deciding to sell to the exporters, Coffee Connections, in Goroka - it soon became apparent that this sale too was crucially mediated by familiar ties. The role and utility of the middle buyer cannot be abstracted from the context of the trading relationship and atomised price information is rarely of use. Therefore, the idea that phones can be used to do away with middlemen is not only ill founded but also misrecognises their advantages, the relational content of trade and the situated sources of asymmetrical power in the coffee value chain. We have seen how the

relative advantages of these intermediaries lie in their access to credit from exporters and their assets and infrastructure for moving coffee that the grower does not have. Disputes and points of negotiation in the coffee open market in Goroka are around parchment quality and the weight displayed on the scale and are rarely informational issues that can be leveraged by a phone call. Fieldwork also revealed that most of the benefits of the phone (and the differentiated access to ICTs) were being reaped at the upstream end of the value chain. Processing factory owners described the use of phones to extend credit to their buyer network and exporters reported that they had provided phones to truck drivers so as to coordinate logistics over long distance routes.

Therefore, rather than generate structural changes, the introduction of mobile phones has produced process improvements in the coffee trade for the benefit of those already benefitting most. The other key expectation within development informatics is that within a typically information inefficient market in a developing context, the coming of the phone produces opportunities to find out about prices in distant markets and thus new arbitrage opportunities. Keeping with the argument that mobiles create 'digital provides' rather than digital divides, the expectation was that unhindered circulation of price information would reduce price dispersion and increase the welfare of producers and consumers regardless of phone ownership.

Empirical evidence shows that even though there is some easing of spatial frictions when it comes to the distance to market and significant savings on time and transport costs, perfect mobility or the complete decoupling of market from place is not a possible outcome. Given the relational, sticky content of trade and the manner in which sociality mediates where and who you can sell to, even with real-time information on current market prices, lateral movement into any new market is not easy. This throws into question the easy predictions about mobile phones producing opportunities for arbitrage and better market prices for smallholders. Developmentalist approaches that valourise impersonal information and the use of the phone as an 'information delivery platform' (Wyche and Steinfield 2015) for market prices draw from a tradition of computational logic that is replete with cyber utopianism and uncritical, linear notions of progress. Critical media studies perspectives (Mansell 2017) have traced the historic basis of a persistent imaginary surrounding the technological innovation process that assumes that aggregated information is knowledge. Such assumptions proceed with very little consideration for the tacit and codified features of knowledge and the fact that

contextual experience, judgement and familiarity is required to put bytes of disembodied information such as market prices to use. The inevitability of linear pathways of innovation within this way of thinking was reinforced during the post War period by mainstream economists and proponents of cybernetics[52] who placed a lot of hope in information as an unusual economic good that can be can be reliably codified, reproduced and exchanged with others (Stigler 1961, Arrow 1962). This dominant technological imaginary combined with the developmentalist impulse to intensify and commercialise smallholder farming invariably produces a potent discourse with the rationalising mobile device at its centre.

In order to better understand what actually drives price formation within the coffee industry, chapter 5 reviews the price setting context from a socio-technical perspective. The existence of terms like '*wantok'* and '*wanbel'* price, as against a standardised, unitary market price helps elucidate the diversity of processes that create different price forms based on interactions between traders and growers. We saw how the volatility of global prices affects exporters based in Goroka and how their co-location and the physical arrangement plays a role in structuring competitive prices.

The alternate sourcing model provided by Fairtrade is based on moving specialty coffee into ethical, niche markets. One of the first interventions implemented after Fairtrade entered PNG was an ICT program aimed at connecting cooperative groups to markets through the distribution of mobile handsets and the setting up of closed user groups (CUGs). HOAC which was the first group to be incorporated into the Fairtrade network was able to use mobile phones only after a new Digicel tower was installed in Okapa the previous year. Findings from the ethnographic engagement with the cooperative revealed several disruptions to the network service because of compensation disputes and stolen solar batteries. This led to community members having to identify and travel to spots where the network is strong in order to even use their phones. This shows how the materiality of the telecommunications architecture is important to consider, as the informational is always underpinned by a range of processes that are physical and material in nature.

[52] To understand the values that underlie information processing and traditions of thought that valourise machines and computing devices for the way in which they unproblematically augment human capacities for indexing information refer to this review by Mirowski (2002:19) – 'if there was one tenet of that era's particular faith in science, it was that logical rigor and the mathematical idiom of expression would produce transparent agreement over the meaning and significance of various models and their implications'.

Several respondents reported problems with having Digicel as a development partner in this initiative as they were unresponsive and kept penalising the entire network when individual cooperative groups forgot to pay the subscription fee. The commercial imperatives under which the telecommunications provider operates means that PNG is used as a captive market and development programming efforts are yet another untapped means to extract revenue. As the interest in using mobile solutions increases, it becomes important to consider the implications of Digicel as a private entity co-opting development programming into its profit rationale.

This is further demonstrated by findings from the fresh produce trade where a Mobile Market Information Service (MIS) was initiated in 2011 with support from the Australian Aid programme through the Agriculture Research and Development Support Facility. After a disappointing partnership with Digicel, the organisation implementing the SMS based dissemination of market price and the crop supply status - the Fresh Produce Development Agency - trialled an open source mobile platform to digitise their reporting process and host the MIS database. Chapter 6 detailed the organisational and cultural hurdles faced while trying to replace established paper based workflows with mobile systems.

Within the emerging long distance and commercial fresh produce trade, mobile phones are used more for coordination than for marketing purposes. On following the movement of sweet potatoes from the Asaro valley in the Highlands to urban markets, it became evident that the use of the phone was mainly to coordinate transport and make storage arrangements. While the volumes of sweet potato being moved increased sixteen fold in the last 30 years, there are only estimates of the exact current volumes being sold at various end markets. Within such an emerging marketing system where the long distance movements are increasingly complex, mobiles are used to coordinate with truck drivers about the collection of the sweet potato bags left along the road every week.

Fieldwork revealed the existence of price variation amongst major urban markets with growers in the Asaro Valley being paid 37% less per bag than the wholesale price in Port Moresby. Respondents revealed that in large markets like Mt Hagen and Lae, it would be common to negotiate over price (‘*tok gris*’) and that the bags that end up in the Port Moresby markets can sometimes be identified to the region and even the *hauslain* they originate from. In keeping with Geertz’s (1978) concept of ‘grooved channels’, Theodore Bestor (2004:51)

talks about how traders negotiate relationships 'again and again through familiar settings' to engage with 'regular partners in accustomed arenas of trade'. When it comes to how commodities pass from hand to hand and location to location in the emerging commercial trade, despite the existence of opportunities for price based arbitrage, the fresh produce value chain does not seem to be smooth enough to do away with the preference for face to face communication and conduct majority of marketing over the phone. Furthermore, the Consumer Price Index bulletin reveals that if a kilo of sweet potato was to be taken to the Port Moresby market, it would fetch three times what its sale at the Goroka market would. While the preconditions for the fulfilment of the disintermediation thesis do exist, with the middle of the value chain being populated by middlemen, retailers and transport coordinators, there is very little evidence of phones bypassing the role of intermediaries.

There is much evidence for the manner in which various practices are being transformed and reconstituted by the coming of the mobile phone and the processes of mediation it represents. These changes do not, however, correspond to the linear, instrumentalist paradigm of the developmentalist imaginary. Therefore, development interventions that misrecognise the relational content of trade and treat the phone as an 'information delivery platform' are unlikely to get very far. It is necessary to pay heed to how places like Papua New Guinea in the Global South, that are newly being inserted into global networks of connectivity, are being represented within the subfield of development communication. Given the politics of knowledge production, it is important to ensure that the priorities and voices of the grassroots users of these technologies are not eclipsed by instrumentalist ideas about what they should be using their phones for. This is particularly relevant as this newfound connectivity is invariably bound by the institutional rules of private IT/telecom conglomerates. If the rich usages of communication technologies in these resource constrained contexts are not predominantly utilitarian, then it is necessary to develop a localised understanding of the different cosmologies and priorities that define their use.

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