

The London School of Economics and Political Science

ICTs in Medium-Sized Farms in Developing Countries

A Case Study in Mexico: Conventional Banana and Organic Rice Cultivation

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A thesis submitted to the Department of Management of the London
School of Economics for the degree of Doctor of Philosophy

London, September 2017

Declaration

I certify that the thesis I have presented for examination for the MPhil/PhD degree of the London School of Economics and Political Science is solely my own work other than where I have clearly indicated that it is the work of others (in which case the extent of any work carried out jointly by me and any other person is clearly identified in it).

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I declare that my thesis consists of **50,272** words (excluding references and appendices).

Acknowledgements

The completion of my PhD is the outcome of a long journey, of years of preparation in several interdisciplinary studies that would shape my concept of ICTs and the agricultural business. This doctoral thesis is perhaps a minuscule contribution to Social Sciences, but I hope it captures the essence of some voices from the field in an evolving industry. This accomplishment was only possible with the support of many individuals, to whom I would like to express my gratitude.

First and foremost, I wish to thank my supervisor Professor Chrisanthi Avgerou for guiding me on the right path through a complex research area, always helpful and offering advice for the various and serious challenges I faced. She joined me on fieldwork in Mexico, shared her academic experience and knowledge, and gave me the freedom to develop and express my own ideas. For her belief in me, I offer my sincerest gratitude.

Special thanks to my examiners Dr Amany Elbanna and Professor Gianluca Miscione for genuinely thoughtful and insightful comments on my research and for helping me to improve this thesis.

I would like to express special appreciation to Professor Emeritus Colin Lewis at the LSE (Economic History) and Dr Elizabeth Gemmill at the University of Oxford (Department for Continuing Education) for their encouragement and support.

I gratefully acknowledge staff and colleagues in the Information Systems and Innovation Group in the Department of Management at the LSE for making this journey a memorable experience. My special thanks to Dr Shirin Madon for her advice and expertise in Development and for allowing me to share my work as a Guest Lecturer at the LSE

Department of International Development, to Dr Carsten Sørensen and Dr Daniel Beunza for their invaluable assistance on my MPhil/PhD upgrade, to Professor Jannis Kallinikos for sharing his passion and knowledge in this field, and to the fellow PhD students I was blessed to meet on this path: Atta, Kari, Kanchana, Antti, Kyung, Laura, Dana, Angeliki, Wifak, Roser, Maha, Silvia, Beatriz.

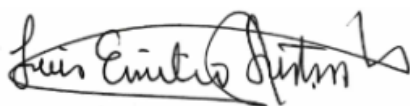
And I would like to thank Dr Richard Duncombe, Director of Teaching and Learning at The Centre for Development Informatics (CDI) at the University of Manchester's Global Development Institute. He provided feedback for my first paper based on this PhD: "The Effects of ICTs on Agricultural Distribution Channels in Mexico", which will be published in his book "Digital Technologies for Agricultural and Rural Development in the Global South" in collaboration with the Centre for Agriculture and Biosciences International (CABI).

Special thanks also to the Mexican institutions that provided insights into context and development programs, including The Office of The President of the Republic of Mexico, the Secretariat of Agriculture (SAGARPA and SIAP), the Secretariat of Economy, the Secretariat of Education (INEA), the Secretariat of Communications and Transport, the "Mexico Conectado" programme, the telecoms regulator IFT, telecoms operators Alta and Telefonía Rural, the Institute of National Statistics (INEGI), Central de Abastos (La CEDA) Ciudad de Mexico and Villahermosa, and the NGOs "Produce" and "Ayuda para Ayudar". I am grateful to gatekeepers who enthusiastically volunteered their support and trusted me, granting access to this fascinating industry. Special thanks must go to Dr Natalia Volkow, to Mauricio Mora, to Sister Aurora del Rivero, and to the farmers I have maintained contact with - Jose, Ruben, Miguel, Emilio, Jorge, Cesar.

I will forever be grateful to former colleagues at Nokia Bell Labs, where I began this academic research. Obtaining a deeper understanding of the logic and business processes in rural areas and how ICTs enable global connectivity was, in essence, a personal development goal. Thank you Michel, Fani, Laurent, Jean-Paul, Mark and Markus for your support and motivation.

My sincere and immense gratitude to Dr Daniel Bakowski. Sharing his experience in scientific research was a source of inspiration, pushing me beyond my previous reasoning limits and lightening me up. He and my friends and my family were always there to offer motivation, affection and reassuring words: Macky, Hal, Jackie, Brian, Helen, William, Ruth, Simon, Ben, Florence, Jemimah, Elizabeth, Prue, Jacqueline, Caroline, John, Gill, Adelina, Angela, Jose and Rosy del Valle, Gloria, Esgrer, Gustavo, Leonardo Antonio, Leonardo Emilio and Melissa.

And finally, I owe my passion for equality, learning, freedom of thought, honesty, and, most importantly, working hard to my parents Emilio and Rita: for in the end this is the only way to reach our goals. Many thanks!

A handwritten signature in black ink, appearing to read 'Luis Emilio Lastra Gil', with a stylized flourish at the end.

Luis Emilio Lastra Gil

25th September 2017

In memory of Suey

Wherever you are, thank you for your company on this voyage. This is the best possible place to honour your faithfulness and loyalty. I will never forget you.

Abstract

This research examines how farmers working medium-sized farms in Mexico have adopted and enacted Information and Communication Technologies (ICT), and how these ICTs have impacted work practices. The effects of ICTs on farmers' economic relations are explored from a business process perspective using a framework that combines Transaction Cost (TCT) and Social Embeddedness theories. A single case study in Mexico with two embedded units of analysis from different crop sectors, a cluster of banana producers from Tabasco and an organic rice grower from Campeche, provide an in-depth understanding of the adoption of ICTs and their impact. We examine issues of learning and co-operation, and how ICTs have affected production and distribution and the positioning of farmers in the context of their work practices and economic relations.

The thesis discusses the ICTs used in the business process cycle of farming and their impact on business development and economic exchange. The research elaborates on and confirms the existence of network forms of organisation that operate in the farmers' communities and analyses their social embeddedness.

The findings show that information technologies bring improvements to the agricultural business process, facilitating not only the collection, collation and analysis of data to support informed decisions, but also innovative farming and business practices through learning and co-operation. We find that ICTs complement and support social relationships, both pre-existing (traditional community connections and business links) and novel (virtual contacts and social media) to stimulate business development. The significance of social context is corroborated and should help inform development policy.

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Abbreviations

Abbreviation	Expansion
ANT	Actor Network Theory
CCTV	Closed-Circuit Television
CDI	Centre for Development Informatics at the University of Manchester
CDMX	<i>Ciudad de Mexico</i> (Mexico City)
ERP	Enterprise Resource Planning
EDI	Electronic Data Interchange
FCA	Free Carrier
GDP	Gross Domestic Product
ICT	Information and Communications Technology
ICT4D	Information and Communications Technology for Development
IFT	<i>Instituto Federal de Telecomunicaciones</i> (The Federal Telecommunications Institute; Mexico's telecommunications regulator)
INEA	<i>Instituto Nacional para la Educación de Adultos</i> (Institute for the Education of Adults)
INEGI	<i>Instituto Nacional de Estadística y Geografía</i> (National Institute of Statistics and Geography)
ISP	Internet Service Provider
KPI	Key Performance Indicators
CEDA	<i>La Central de Abastos</i> (wholesale market)
NAFTA	North American Free Trade Agreement
NGO	Non-Governmental Organisation
PPP	Purchase Power Parity
RFID	Radio Frequency Identification
SAGARPA	<i>Secretaría de Agricultura, Ganadería, Desarrollo Rural, Pesca y Alimentación</i> (Secretariat of Agriculture, Livestock, Rural Development, Fisheries and Food)
SARL	<i>Société à Responsabilité Limitée</i> (Limited Liability company)
SIAP	<i>Servicio de Información Agroalimentaria y Pesquera</i> (Agricultural Market Information System)

Abbreviation	Expansion
SNIM	Sistema Nacional de Información e Integración de Mercados (National System of Information and Integration of Markets)
TCT	Transaction Cost Theory
UARSETPP	<i>Unión Agrícola Regional de la Sierra del Estado de Tabasco Productores de Plátano</i> (Regional Agricultural Union of Banana Growers in the Sierra of the State of Tabasco, an association of banana growers in Teapa)
URL	Uniform Resource Locator
VoIP	Voice over Internet Protocol
2G/3G/4G	Second, Third and Fourth Generation mobile phone technology

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Chapter 1. Introduction

1.1 Research Background

Agriculture in developing countries employs a considerable fraction of the rural workforce and provides food security for a growing population, but it is an economic sector where there is significant poverty and marginalization (Halewood and Surya 2012). Our understanding of ICTs as an instrument of economic and social change is becoming increasingly sophisticated (Duncombe 2016; Walsham 2010) and rural areas of developing countries are witnessing an impressive diffusion of ICTs (Wiggins 2014, p. 513). Their impact on farming, where principles of family, kinship, and social connectivity are historically powerful, is of great interest.

Of 570 million farms worldwide, 475 million are smallholdings of fewer than two hectares (Lowder et al. 2014). Defining farms by acreage may mislead because economy and efficiency of scale depend on the quality of the available land, on prevailing agro-ecological and market conditions, and on any off-farm income-earning opportunities available to farmers (Hazell and Rahman 2014, p. 527). Smallholdings can instead be defined as a social and economic construct operated by farming families using largely their own labour. Smallholding “subsistence farmers” who derive a large fraction of their household income from non-farm sources, including non-farmer employment, remittances, as well as cash and in-kind social welfare support (Berdegué and Fuentealba 2014b, pp. 117-120) were the intended subject of my fieldwork, but I found during pilot interviews that their use of ICTs is often limited to only occasional use of 2G mobile telephony, largely because of a weak rural telecommunications infrastructure that offers inadequate service coverage. Larger farms are more immediately amenable to ICT research as they are much more likely to invest

in and enact technologies to organise business practices and maintain socio-cultural interactions. There are powerful economies of scale in agriculture (Dethier and Effenberger 2012; Evans 2014) and farm size correlates strongly with access to education, training, finance, and markets; larger farms invest more in agricultural technologies, negotiate more successfully, and form better collaborations (Ali and Kumar 2011; Alvarez and Nuthall 2006; Dorfman 1996; Molony 2008; Taragola and Van Lierde 2010; Tey and Brindal 2012).

The largest farms and agribusinesses play a dominant role in controlling access to urban integrated retail markets and are often preferred suppliers (Hazell and Rahman 2014; Reardon et al. 2003). However, medium-sized producers, defined as working between 50 and 200 hectares of land, are the subjects of this research. They comprise just two percent of Mexico's 5.5 million farms but are of disproportionate importance for their economic participation, and work 16 percent of total agricultural land (INEGI 2007). While they may employ a large labour force and one or two permanent non-family employees, much of the farm's management is usually by family members (Berdegué and Fuentealba 2014a, p. 118), typically relatively affluent and better educated, and with reasonable ICT expertise. They are better able to afford ICT infrastructure than smallholders, more robust to diversification, and more likely to appreciate (and benefit from) the potential advantages that ICTs offer (Ali and Kumar 2011; Alvarez and Nuthall 2006; Dorfman 1996; Madon 2009a; Taragola and Van Lierde 2010; Tey and Brindal 2012; Walsham 2010, 2013).

The overall framing of this research is to understand how farmers working medium-sized farms in a developing country have adopted and enacted ICTs in the context of their work practices and economic relations. The World Bank's 2012 report on Information and Communications for Development has argued that ICTs can help farmers to increase productivity, improve income and reduce poverty. It is recognized, however, that transformation of farming by ICTs has been at best limited, and my motivation is to

understand why technologies have failed to help farmers in developing countries more fully. The two units of study (conventional banana and organic rice cultivation) in my interpretive embedded case study demonstrate that ICT adoption and enactment in work practices has brought change to medium-sized farms, with direct (and sometimes profound) effects on both operational and relational elements of the business process cycle. They have facilitated learning and co-operation, complementing and supporting economic relations in the complex social context that arises out of evolving local and distant social ties and business relationships, physical and virtual. Relationships are no longer restricted to the farmer's village but can be enriched with acquaintances acquired through social media. Suitably exploited, they can contribute to the growth and survival of the farmer's business.

1.2 The Agricultural Business Process Cycle

The agricultural business process cycle is the complex of interdependent activities that comprise production and distribution, a sequence of interactive exchanges of property rights that ultimately results in delivery of produce to a customer (Figure 1). Appropriate and adequate information and knowledge are essential for optimal decision-making in every transaction, from seed buying to selling (Ali and Kumar 2011; De Silva and Ratnadiwakara 2008). Growers must identify customers and suppliers, negotiate terms and conditions, deliver to specification, and be responsible for the end-to-end operation of their businesses. Most decisions concern **production**, primarily yield, efficiency, and planning. They include selecting appropriate crops, allocating land, arranging working capital finance, preparing land using internal or external labour and machinery, and planting, irrigating, spraying and harvesting (Aker 2011; Mittal et al. 2010). **Distribution** decisions include post-harvesting activities like freight and logistics and selection of distribution channel, and have historically been relatively neglected by farmers, left instead to traditional market-driven intermediaries.

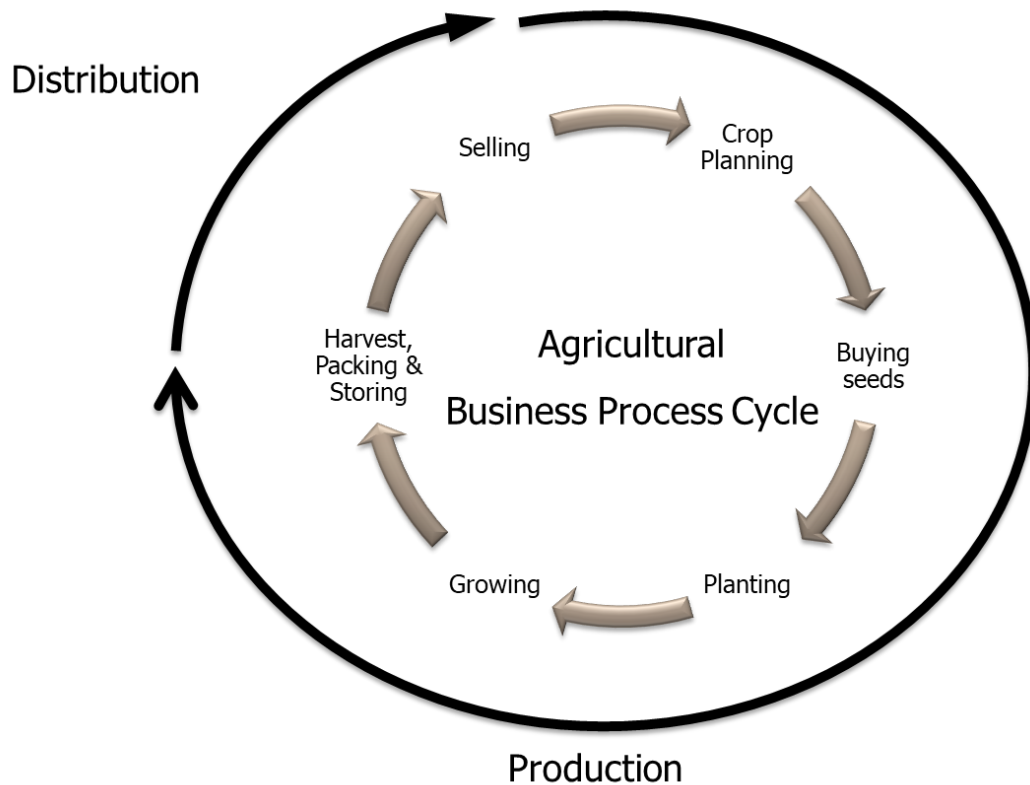


Figure 1 The agricultural business process cycle

I have modelled the agricultural business process cycle (and its related decision points) within a framework that accommodates a complementarity between economic relations and social interactions.

1.3 ICTs and The Agricultural Business Process Cycle

Most studies have focused on the adoption and use of more obvious or discrete ICT artefacts (mobile phones and the internet) and agricultural mechanisms to access information (extension services and co-operatives), under the general expectation of rational behaviour. Fewer studies have investigated *how* growers discover, adopt and enact different typologies or forms of ICT, or how these have impacted work practices. That is the subject of this research.

In farming, access to markets is still largely through traditional distribution channels. While electronic marketplaces for bartering, commodities trading and auction over virtual platforms (Banker et al. 2011; Bao et al. 2012; Baumüller 2012; Boadi et al. 2007; Halewood and Surya 2012) have successfully penetrated other economic sectors such as manufacturing and services, doubts persist over their suitability for the agricultural sector. Seitz (2013) identifies several factors that have stalled the development of B2B e-commerce platforms in this sector: supply chain complexity, a shifting industry structure (principally integration into agribusiness and retail), and rapidly evolving production technologies and consumer preferences monitored through big data analysis. Scale of production is an important factor for the adoption of e-commerce (Brush and McIntosh 2010), and other infrastructure challenges include financial and physical barriers to reliable internet access, variable user proficiency, and perceived security risks to both supplier and purchaser.

Few e-marketplaces are found outside of the cattle and dairy sub-sectors, and empirical research on them is correspondingly scarce (Brush and McIntosh 2010; Cloete and Doens 2008). Nevertheless, innovation hubs have emerged in several developing countries. Google Trader is a collaboration between Google Inc., the Ugandan network operator MTN and the Grameen Foundation, and actively links buyers and sellers across mobile and internet-based platforms. It is expected to become self-sustaining in the long term (Baumüller 2012). In India, internet kiosks or e-Choupals installed by the Indian Tobacco Company (ITC Ltd) provide farmers with access to an online trading platform, with the goal of reducing soybean transaction costs through lower search costs and disintermediation. This was a sustainable intervention because it was profitable for both growers and the private company (Goyal 2010); however, the likelihood of its adoption by farmers varied with caste, political affiliation, and scale of production (Walsham 2010). In China, e-commerce company Alibaba.com has become a vital agricultural business information platform, a B2B platform

providing services for small and medium enterprises across the agricultural ecosystem (Bao et al. 2012; Chunmei and Weijun 2011; Yanyan 2015). Collaboration, better transparency, and sophisticated relational services (supplier information services, customer ratings, post-transaction tracking) have reduced market complexity, information asymmetry, opportunism and adverse selection, shifting contractual power between buyers and sellers.

Despite optimism for e-commerce, ICTs have not yet engineered an integration of the agricultural sector in developing countries (Duncombe 2016). Many platforms remain at the proof-of-concept or scalability stage and few have achieved sustainability. Much traditional intermediation survives.

I will argue that adoption of ICTs has not transformed (revolutionised) economic exchange in agriculture. These technologies have relatively modest effect on accessing new markets and dis-intermediating distribution channels. They mostly bring improvements to the agricultural production process, through facilitating not only data collection and analysis, but also the implementation of actions through learning and co-operation. Farmers enact technology in their production process on recommendations from social ties. They consult and support each other.

Farmers continue to act as individuals selling their own produce through traditional and non-traditional distribution channels, using ICTs to position themselves and survive in the industry.

1.4 Research Question

Literature on ICTs in the agricultural business process has been quite narrowly focused on certain artefacts like the mobile phone, and the benefits they can bring to farmers. It has examined both economic exchanges as transactions with costs and information requirements

for efficient decision-making (De Silva and Ratnadiwakara 2008; Mittal et al. 2010) and growers' relationships and connections (Molony 2008, 2009; Oreglia et al. 2011). In this research, I began with a broad research question to identify how farmers working medium-sized farms in a developing country have adopted and enacted ICTs, and how these have affected work practices: **What role does technology play in medium-sized farming in developing countries, and how do farmers accommodate information technologies to improve work practices and reach the market?**

To address this question and the nature of farming's economic relations, this thesis will answer the following research sub-questions:

1. How do farmers come to know about ICTs and make decisions about their adoption and implementation?
2. What type and form of ICTs are used by farmers?
3. How do ICTs impact farming? Who are the beneficiaries? Are there losers?

1.5 Thesis Structure

This thesis is structured as follows:

Chapter 2 explores existing work on ICTs and exchanges in the agricultural context.

Chapter 3. The theoretical framework: Transaction Cost Theory (TCT) is used as a starting point to identify network relationships as a mode of exchange distinct from market and hierarchy. Powell's influential 1990 paper on organisational practices concludes that a network economic mode allows actors to complete transactions efficiently and reduces the hazard of opportunistic behaviour through principles of reciprocity and relationships. This mode of exchange represents a form of collective action in which co-operation can be

effectively sustained over the long term. Networks create incentives for learning, permitting knowledge to be translated into action, and enable dissemination of information that can strengthen tacit knowledge and encourage technological innovation when resources are variable and the environment uncertain. Conditional to the formation and sustainability of these collaborative arrangements, however, is a complex legal, political and economic context with relaxed antitrust standards and national policies that promote research and development with links to academia and industry.

I discuss Powell's network economic mode in some detail and extend it to include the Social Embeddedness perspective (Avgerou and Li 2013; Granovetter 1985; Uzzi 1996), to better understand the adoption and enactment of ICTs in farmers' work practices. I will argue that in the context of agriculture in a developing country, regulation is ineffective mostly because of feeble state policies and weak institutions, and that social relationships instead determine the ease with which transactions and economic collaborative arrangements are formed and sustained. The complementarity of the network mode operations and the logic of embeddedness theories is demonstrated by the influence of culture and communitarian support. The existence of social capital, norms and social ties enables farmers to co-operate on an intermittent ad-hoc basis. In the rural Mexican context described in this thesis, a combination of formal and informal safeguards through ad-hoc co-operation may deliver a superior exchange performance than a social network mode of operation in isolation.

Chapter 4. Methodology, organised into Research Design, Execution, Analysis and Ethics.

The research design is for a single case study in Mexico with two embedded units of analysis from different crop sectors, a cluster of banana producers from Tabasco and an organic rice grower from Campeche.

Chapter 5. An overview of the Mexican economy and an outline of the units of study and the differences between banana and organic rice growing. This chapter concludes with an introduction of the effect of ICTs on the agricultural business process.

Continuity and family tradition are especially important in Mexico's banana industry. In Tabasco, growers conduct transactions individually but operate through the local association *UARSETPP*, which provides assistance in using technology formally and informally to deal with domestic and export clients, track competitors, reduce hazards, and mitigate opportunistic behaviour.

The second unit of study describes a single organic estate that has reinvigorated rice growing in Campeche through its pursuit of more radical and innovative production and distribution strategies. Their use of (and benefit from) ICTs is more obvious, and novel distribution channels have been of clear importance in establishing a network outside the region and local demography.

Chapter 6. A comparison of themes identified in the literature review with the research findings from the embedded case study, introducing the contribution of this research to theory.

Chapter 7. A discussion to substantiate theory.

Chapter 8. Potential policy implications, limitations and further research.

Chapter 2. Literature Review

The ongoing penetration of ICTs into rural areas of developing countries provides a unique opportunity to study their adoption by the agricultural sector (Aker 2011; Munyua and Adera 2009; Sigrimis et al. 2001). Their academic study has been surprisingly limited and biased towards Africa and Asia, with Latin America relatively neglected. My research is guided by the following central question: How do farmers working medium-sized farms in a developing country adopt and enact information technologies, and how do these impact work practices?

Investigating the adoption and impact of ICTs from a broader business process perspective, describing the end-to-end activities that entail production and delivery of goods or services, is an atypical strategy in a field where most literature follows a bottom-up approach.

A review of existing literature identifies six themes: First, the theory of technology, socio-materiality, and enactment versus alignment. Second, the evolution of ICT adoption in economic interactions, and its limited discussion in the literature. Third, the effect of ICTs on distribution channels. Fourth, the culture of connectivity. Fifth, development theories and disruptive versus transformative progressive development. And sixth, economic mechanisms versus social processes. This review is not restricted to a single research methodology, or to a single journal, or to a single geographical region. It is sufficiently broad and recent to include current theoretical and empirical discussions, and gaps are identified to generate a research question.

2.1 Theories of Technology

Avgerou et al. (2016) argues that while ICTs have sometimes failed to bring socio-economic benefits to developing countries (Heeks 2010; Toyama 2011; Walsham 2013), we cannot rule out their capacity to improve people's lives. Indeed, ICT efforts have succeeded in producing benefits (Hayes and Westrup 2012) even in environments hostile to economic success (lacking innovation-friendly regulations and with inadequate digital expertise or complementarity of management capacity). Theories of technology that elaborate on the creation of socio-technical phenomena through constructing technology artefacts and socialised human action (Avgerou et al. 2016, pp. 329-332) offer possible explanations as to why.

Socio-technical or socio-material research on technology and organisation has been a largely two-sided debate between determinism and voluntarism/social constructivism (Leonardi and Barley 2010). Deterministic theories assume causality between technology and societal structures (Avgerou 2002, p. 56), while constructivist theories consider the social interactions and constructions that arise during design and implementation (Grint and Woolgar 2013; Leonardi and Barley 2010), with users determining how they will use a technology and shaping the changes that emerge from ongoing encounters with it.

Studying processes demands that attention be paid to what a technology permits a user to do and what it does not, and the workarounds that users develop to address the latter (Leonardi and Barley 2010, p. 35). Analysis should consider both *artefact* and *practice* to explain how the material constrains the social, and how the social and the material become entangled.

2.1.1 Socio-Materiality: The Artefact

The *technology of the artefact* concerns the symbol and material properties that are packaged into a socially recognizable form such as hardware, software, or techniques (Orlikowski and Iacono 2001). Artefacts only have meaning and effects when they are enrolled in social practice (Leonardi et al. 2012, p. 2).

A consensus has recently formed on the importance of ICTs for innovation and the influence of artefacts on the socially embedded capacity of people to act (Avgerou et al. 2016; Kallinikos 2011). Theorizing about ICT artefacts can take different approaches. Orlikowski and Iacono (2001) identify five main premises: Firstly, they are designed, constructed and used by people, shaped by the interests, values and assumptions of a wide network of developers, investors, and users. Secondly, they are embedded in time, place, discourse and community – that is, their materiality is bound up with the historical and cultural aspects of their ongoing development and use, and these conditions cannot be abstracted or assumed away. Thirdly, they comprise a multiplicity of components whose interconnections are typically provisional or incomplete and which require integration to work together. Fourthly, they emerge from ongoing social and economic practices. Artefacts undergo various transitions over time, coexisting and coevolving with multiple generations of the same or new technologies. Finally, artefacts are dynamic. Even when they seem to have stabilized, new materials will be invented and different features developed, existing functions will fail and be corrected, and new standards will be set. Users continually adapt artefacts for novel and different uses (Orlikowski and Iacono 2001, p. 131).

Orlikowski (2007) has argued that researchers should accept that the social and material are inextricably linked in everyday life. Materiality identifies the constituent features of a technology that are available to all users in the same way, “*the arrangements of an artefact’s*

physical and/or digital materials into particular forms that endure across differences in place and time and are important to users". This appreciation is important because people in different organisations may use the same new technology differently and, consequently, change informal organising in distinct ways (Leonardi et al. 2012, p. 31). Materiality allows scholars to demonstrate a social effect if it is constant in the organisation under study. For example, the materiality of many social media tools is editability and persistence of text, images and sound. Social media differ from technologies like email, which offers a high degree of editability, because their materiality enables broadcasting to a much larger and unknown audience, a distinction that means people who use social media must contend with the fact that sharing is public. Greater visibility to others means this materiality may have consequences for organising (Leonardi et al. 2012, p. 28-31).

New technologies enable or facilitate access to information, bringing change to the tasks people conduct or providing a new means to accomplish old tasks. In so doing, they create the need for communication about new topics, leading people to seek new communication partners (Leonardi and Barley 2010, p. 28). However, just as we should not expect a causal effect from technology itself, neither should we expect determinate effects from the social environment (Avgerou et al. 2016, p. 330).

Research shows that it is the interaction of users with computerised information systems in work contexts that produces observable effects, both positive (more productive work practices) and negative (resistance to the new technology) (Avgerou et al. 2016; Markus 1983). Information technologies may be an amplifying or fixed additive force, exerting a positive or negative effect irrespective of context (Cairncross 2001; Toyama 2011). If technology is simply an amplifier of underlying human forces and institutional intent and capability, ICTs may reinforce existing weaknesses rather than encourage development.

2.1.2 Socio-Materiality: Technology of Practice

The *technology of practice* is the use of a technology. That is, it defines what people actually do with the artefact in recurrent, situated practices (Lave 1988; Orlikowski 2000). It has been argued that the boundary between the social and the material is not predetermined, but rather enacted in the practice of work (Díaz Andrade and Urquhart 2010; Mähring et al. 2004; Robey and Boudreau 1999). It is incorrect to say that a technology causes a particular change when people decide how they will let it influence their work (Leonardi et al. 2012, p. 33). The social and the material are inextricably linked in everyday life.

2.1.3 Technology Enactment versus Alignment in Work Practices

Enactment studies examine how people employ technologies in their work practices (Schultze and Orlikowski 2004). They offer insight into the everyday working relationships that are situated and maintained as social and economic actors interact with ICTs in their work practices. Changes in work practice emerges as individuals solve issues and fold technology into everyday life (Schultze and Orlikowski 2004).

The technology alignment perspective examines how organisations adapt new technologies as drivers of strategy, and how new roles and relationships are created or existing ones reinforced (Davidson and Chismar 2007; Leonardi and Barley 2010, p. 7).

In compliance with socio-materiality studies, the fundamental ontological view is that technologies do not directly determine organisational structure, but rather technological changes are linked to social dynamics that vary across contexts (Leonardi and Barley 2010, p. 30). Through its engagement in a social context, information becomes dynamic and acquires meaning – and therefore the ability to transform organisations (Leonardi 2007).

Studies on the implementation of technologies have typically concentrated on micro-social dynamics and their findings might tempt one to conclude that every implementation results in a unique socio-material order. However, macro-social dynamics of technological change are required to satisfactorily explain the micro-social, or what Kallinikos has called moving from static to dynamic patterns of analysis (Kallinikos 2011, p. 14-19). Here resides the importance of conceptually merging the social and the material to understand how each contributes to the whole. Researchers can identify how and when the material constrains and affords the social, as well as how and when the social shapes the material (Leonardi and Barley 2010, p. 30-35).

Avgerou et al. (2016, p. 330) notes that one corollary of theories of technology is that they discredit the a priori expectation of specific effects of ICTs and predictions of implementation outcomes on the basis of people's capacity for shaping ICTs to pursue goals or to obstruct change that does not comply with values and habits. Socio-technical or socio-material theories of technology posit that ICT innovation neither imposes behaviours driven by what ICT artefacts are built to do, nor derives goals from available technology artefacts. However, theories of technology cannot easily explain why human-technology interactions during innovation unfold differently and produce different outcomes in different contexts. It is precisely these different effects of human-technology interactions in different contexts that will be a subject of this research; this thesis will therefore emphasise socio-materiality, the views derived from people' encounters with a technology as they strive to improve production and distribution work practices.

2.2 The Evolution of ICT Adoption in Economic Interactions

Our understanding of the influence of ICTs on interactions between economic organisations has evolved quite considerably (Koch and Schultze 2011, pp. 123-125). Historically, most

research has been conducted in non-agricultural industries, adopting one of three principal positions:

2.2.1 A Move to the Market

Adopting ICTs should change the relative advantageousness of different co-ordination mechanisms. Early literature concluded that markets with arm's-length transactions would become the preferred economic mechanism for transactions, with reduced communication costs encouraging brokerage: an ICT-induced "move to the market". According to market theory, "*selfish, profit-seeking behaviour motivates action in arm's-length relationships. The transaction itself is limited to the exchange of data on price and quality because it contains all the information needed to make efficient decisions*" (Uzzi 1996 p. 676). It was predicted that the cost of information processing would fall and adjacent steps in the value-added chain would become integrated: firms would outsource more and conduct transactions through open electronic markets to reduce their vulnerability to opportunism (Malone et al. 1987). However, this overlooks the tendency of firms to favour hierarchical relationships with fewer, reliable suppliers, an organisational mode that also protects against opportunistic behaviour (Koch and Schultze 2011). Malone's hypothesis has also been criticised for ignoring weak price transparency and the requirement for minimum purchase order quantities to participate in supplier networks (Soh et al. 2006).

2.2.2 A Move to The Middle

More recent work has served to somewhat uncouple the effect of ICTs on exchange from risk, proposing instead an integration effect: a "move to the middle" (Clemons and Row 1992; Clemons et al. 1993) where ICTs and co-operative relationships are mutually reinforcing. This predicts that firms will tend to choose long-term co-operative agreements

with a limited number of suppliers (Bensaou 1997; Choudhury et al. 1998; Grover et al. 2002; Holland and Lockett 1997; Koch and Schultze 2011; Kraut et al. 1999).

The middle nevertheless continues to present considerable structural and operational uncertainty. An organisation can perform transactions under a variety of exchange mechanisms: buyers and sellers face unexpected changes in demand requiring a variety of transaction designs, and the lowest cost exchange might be either the market spot price or a negotiated price with a trusted supplier (Kambil et al. 1999).

Literature on “move to the middle” in agriculture has been limited. One supply chain reengineering project that has been studied in detail is India’s eChoupal, a significant rural ICT initiative (Kumar 2004; Walsham 2010). Its goal was to provide better access to market prices, removing middlemen and enabling farmers to sell produce directly to the India Tobacco Company (ITC). Optimisation of the supply chain quickly generated good outcomes for the ITC but the benefit for growers was less clear. Access to and use of eChoupal was determined predominantly by farmer caste, political affiliation, and the scale of production. Further research would be needed to understand the effect of ICTs on peoples’ lives, on medium-sized farms, and on agricultural labourers and the destitute.

2.2.3 All-in-One-Market

The aggregation of multiple transaction modalities with market-oriented functionality (e.g. quote handling, cataloguing, inventory management, and customised marketplaces) through ICTs can facilitate electronic brokerage and provide an all-in-one-market exchange mechanism (Kambil et al. 1999; Koch and Schultze 2011). This more modern concept of exchange mechanism integrates new and existing ecosystems of buyers and sellers. E-commerce company Alibaba.com operates a business-to-business (B2B) model and has become a vital business information platform, helping small and medium enterprises identify

potential trading partners through the internet. Through the provision of supplier information, post-transaction tracking, and customer ratings, e-marketplaces can reduce market complexity and asymmetry and improve efficiency and trust: goals often ascribed to ICTs (Avgerou and Li 2013).

2.3 The Effect of ICTs on Distribution Channels

A distribution channel is the chain (usually of intermediaries) through which goods or a service passes until it reaches the end consumer. *Traditional intermediaries* match a producer with buyers in a traditional market structure (Chircu and Kauffman 1999); *non-traditional intermediaries* conduct transactions over a virtual marketplace (Bakos 1998, Chircu and Kauffman 1999).

2.3.1 Traditional Intermediaries

Trade fairs (trade shows, or expos) are B2B exhibitions where firms showcase and demonstrate products and services, meet with current or prospective business partners and customers, evaluate potential agents and distributors, study rivals, and examine market trends and opportunities (Cateora 2011).

Brokers arrange transactions between a buyer and seller for a commission when the deal is executed. In contact with multiple potential buyers and suppliers, they help match one party to another by filtering possibilities, reducing substantially the need for buyers and suppliers to contact a large number of alternative partners individually (Malone et al. 1987). Acting on behalf of the producer, brokers do not take ownership of products or services. In Mexico they tend to avoid formal contracts and have earned the pejorative label “*coyote*” (Keys 2005; Pedroza 2013).

Distributors are commercial entities that buy produce from growers and warehouse it for resale to retailers or end customers. They often offer additional services to both suppliers and customers, including credit, product information, quotes, and after-sales technical support (Cateora 2011).

Wholesale is the resale or sale without transformation of goods to retailers, institutions and other wholesalers like Mexico City's *Central de Abastos* (Reardon et al. 2003; Schwentesius and Gómez 2002).

Retailers are economic actors that sell consumer goods and services to end consumers through multiple distribution channels. They include street markets or *tianguis* that change location from day to day (Schwentesius and Gómez 2002), and supermarket operations that offer increasingly sophisticated online and home delivery services.

2.3.2 Non-Traditional Intermediaries

ICTs promise better communication and integration, a facilitation of links between farmers and markets that should optimise their distribution channels. **Electronic marketplaces** connect buyers and suppliers virtually, an electronic brokerage and integration effect where a central database fulfils the role of the traditional broker. Arm's-length ties improve transaction efficiency because firms can disperse business among many competitors, sampling prices widely and avoiding small-number bargaining or entrapment in inefficient relationships (Malone et al. 1987).

2.4 The Culture of Connectivity

ICTs help exploit knowledge from outside the firm's boundaries for collaboration and relationship management (Koch et al. 2013; Van Dijck 2013). Web 2.0 provides an opportunity for alternative approaches to interaction and collaboration among individuals,

groups and organisations, collapsing traditional barriers of formal organised activity (Shirky 2008; Souter 2009b).

The development and rise of social networking has allowed the creation and exchange of ever more sophisticated user-generated content, the basis of a new type of networked communication that has both positive and negative effects on human interactions. Van Dijck (2013) describes four types of social media: social networking sites (e.g. Facebook, Twitter, LinkedIn), user-generated content (e.g. YouTube, Wikipedia), trading and marketing sites (e.g. Amazon, eBay), and gaming sites. Analysing the development of social media from a historical and cultural perspective, she concludes that the rapid diffusion and adoption of social media is the result of a more than century-long maturation of media technologies. The telegraph, telephone and postal system encouraged novel communicative routines and cultural practices, such as chatting on the phone and sending short messages by telegram or by mail. Previously casual or private human habits and manifestations of social life have been permeated by social media, e.g. showing holiday pictures or checking on a friend's well-being. Casual spoken interaction has turned into formalised inscriptions that take on a different value once they are embedded in the wider public economy: social media represents an area where norms are reshaped and rules continuously challenged:

“The power of norms, in the area of sociality, is much more influential than the power of law and order.” (Foucault 1980, p. 89)

Traditionally existing in an offline physical sociality, norms are increasingly sociotechnical in an online environment. The norms for sharing private information in a social space have gradually changed through adjustments in technologies' features and terms of use, a largely imperceptible evolution of user habits and changing levels of acceptance. Norms diffuse and have different effects across generations, and as users increasingly accept social media for

social interaction, their use has become embedded in people's lives (Van Dijck 2013). Social networking especially has become the basis of a new type of networked communication. The study of social media is important because "making the web social" has turned into "making sociality technical" via platforms that manage and engineer daily human interactions. The back end of social media is far from silent: activities are catalogued, processed and sold to paying customers (Van Dijck 2013). Information is utilized in various ways, for example to personalize advertisements, as big data output, and for systematic personal profiling by data brokers. It is this new unregulated territory of information sharing that has been called the culture of connectivity.

In the context of medium-sized farms, research on the adoption of social media in agricultural work practices and how it contributes to improving farmers' lives has been very limited.

2.5 Theories of Development

Theories of development provide guidelines for intervention, helping to identify actions to transform socio-economic conditions and improve people's lives in less well-off countries (Avgerou et al. 2016).

2.5.1 ICT for Development (ICT4D)

Research on ICTs in developing countries acknowledges and addresses the distinction of context that arises from a technology's birth in an advanced economy and subsequent adoption in developing countries. Avgerou (2010) identifies two pillars in the literature regarding the nature of context of ICT innovation in developing countries: *transfer and diffusion*, the process of transferring artefacts from advanced economies and their adaption to the different conditions of a developing country, and *socially embedded action*, which

traces the cognitive, emotional, and political capacities that individuals bring to bear on innovation. She shows that, despite theoretical capabilities for the study of technology innovation and socio-economic context, ICT4D literature offers only weak arguments for ICT-enabled socio-economic development.

ICT contributes to two aspects of development: *disruptive transformation* and *progressive transformation*.

2.5.2 Disruptive Transformation

This perspective considers that development have hidden intentions and power dynamics that serve to sustain or worsen wealth or opportunity inequality, rather than providing instruments for social and economic gain. Unequal effects can occur across the population and trigger conflict, bringing into question the effectiveness and indeed the intentions of ICT development policies like e-government projects for state government control. The disadvantaged in any socio-economic regime are often those most at risk of losing out to (or not benefiting from) ICT development initiatives (Avgerou 2010).

2.5.3 Progressive Transformation

ICTs are often optimistically described as instruments of economic and social gain, a view promoted since at least the mid-1990s by major international agencies including the World Bank (1999) and the United Nations Development Programme (2001). It has been argued that the current rapid expansion in the range and role of ICTs is a step change, amounting perhaps to an “Information Revolution” that will have a pronounced impact on developing countries (Halewood and Surya 2012). Progressive transformation has been applied to qualitative and quantitative studies of the mechanisms through which, for example mobile phones affect economic development, including job creation, improving communication

within social networks, and encouraging new services such as mobile banking, health, and education (Walsham 2010).

Some academics argue that while empirical evidence suggests ICTs can serve as tools for economic development, it has failed to translate into macroeconomic or social gain beyond minor cost savings, e.g. from reduced transport or postal costs (Souter et al. 2005). There has been a tendency for development agencies and donors to follow information technology trends without assessing their effects, and too often the assumption that ICTs improve socio-economic variables has been accepted without testing (Molla 2000). Some studies have identified concerns about the appropriateness of ICT for poorer countries, pointing out the pressing need to provide for the basic needs of a large part of the population (Mbarika et al. 2007). ICTs must be accompanied by organizational change to deliver productivity gains (Dedrick et al. 2003; Draca et al. 2006), and they cannot replace investment in public goods such as education, power, roads and water, especially if access to ICTs remains out of reach for the poor (Aker and Mbiti 2010, p. 224).

ICT4D has had powerful proponents for alleviating poverty and improving livelihoods in rural areas (Donner 2008; Duncombe and Heeks 2002; Duncombe 2014; Duncombe 2016; Souter et al. 2005). Recent studies of ICT4D in agriculture have concluded that ICTs can improve farmers' lives, but that their uptake is altered and influenced by socially embedded context. Mobile apps provide useful effective extension services and marketing information if they are delivered through a trusted community knowledge worker. ICT4D should build on existing social habits rather than try to transform them (Oreglia et al. 2011; Van Campenhout 2013), for instance by supporting existing information sharing among rural residents through face-to-face encounters, even if cheaper or more convenient alternatives exist.

Madon (2009c) has argued that technology projects with development goals should be studied alongside and in the same context as evolving historical processes of development (Walsham 2013). Theoretical assumptions about the nature of development, both overt and covert, lie behind any policy intervention aimed at improving welfare.

2.5.4 Historiography of Development

Over recent decades there has been considerable debate over the definition, explanation and practising of development. *Modernisation theory* states that “traditional” countries can be brought to “modern” development by following a path similar to that taken by more developed countries; *structuralism* stresses the importance of political and institutional factors and government intervention; *neoliberalism* sees privatisation, open markets, deregulation and reduced government spending as necessary to promote the private sector; and *post-neoliberalism* argues that a combined effort from both private and public sectors is necessary for effective execution of development programmes.

Modernisation theory prescribed economic growth through applied science, capital investment, mechanisation, a need-for-achievement mentality, and vastly increased labour productivity (Rostow 1960). The proposition: a transformation of stagnant traditional subsistence cultivation through foreign aid, technology and information to release the rural masses for a simultaneously reinvigorated urban industry. Knowledge disseminated through mass communication would enhance people’s lives by raising their aspirations and modernising their lifestyles (Madon 2009c, p. 10). One such technological driver of this Green Revolution was the tractor. However, Netting (1993 p. 22) argues that in Africa at least, modernisation ignored successful indigenous solutions to farming problems, a neglect of local ethnoscientific knowledge of soil, rainfall, crop varieties, and pests that could not be easily replicated on experimental farms or in laboratories, such that the costs of technological

innovations and manufactured inputs greatly exceeded what disappointing yield gains would ever recover.

Hirschman's structuralist approach considers the relevance of policy and regulation for the transformation of a country and concludes that a trickle-down of "northern progress" should be possible with appropriate public regulations. Economic growth does not occur evenly across a nation, but differentially in space and time. For this reason, governmental intervention is particularly important for development in the more backward regions of a developing country. "*The government will, to the best of its ability, attempt to counteract in part the polarisation effects that result from the operation of market forces*" (Hirschman 1958, p. 194). In his (1963) book *Journeys Toward Progress*, Hirschman argues that policy-making is possible within the existing social-political framework and contrasts with the "mass-mobilisation" revolutionary social transformation approach.

Agricultural structuralism was presented by Theodore Schultz in his seminal book *Transforming Traditional Agriculture* (1964). He concluded that many farmers are poor not because they are "backward", but because government offers too few technical and economic possibilities, and that the farmer's apparent unwillingness to innovate is in fact a rational response to artificially low crop prices and heavy taxation. He stressed the importance of investment in human capital for transformation: input availability, education, technology, and local knowledge, but he did not specify which institutions might facilitate the adoption of new technologies.

In the 1980s, free market and neoliberalist private sector-generated growth was increasingly promoted as a means to improve both productivity and living standards for the poor (De Soto 1989; Lal 1983; Lusk 1992). It soon became clear, however, that marginal disadvantaged farms could not adjust to new market rules, and a "de-institutionalization" contributed to the

failure of many small farms. Private provision of services simply could not replace public provision due to the small size of markets and communication failures that limited access to price information. Inadequate transport networks, inappropriate agrarian legislation and an unstable macroeconomic context limited secure, equitable access to land. In many countries, domestic agricultural production was superseded by international trade: there were multiple market failures in developing countries, especially in credit and insurance markets. Missing markets is a major barrier to the adoption of new technologies by small farms (Dethier and Effenberger 2012).

In post-neoliberal thought, capacity building and ICTs are considered important for development. Capacity building is an important factor as described in Sen's Theory of Human Development (Sen 1999), which highlights a political dimension of development focused on "freedom" and the capacity of individuals to pursue what they value in life, including economic and social arrangements such as freedom to engage in economic transactions, political liberties, healthy living and education. Defined by the UN Millennium Development Goals as a long-term continual process of development that involves all stakeholders (ministries, local authorities, non-governmental organizations, professionals, community members, academics, and so on), capacity building improves management in organizations. It takes place at three different levels: the *individual*, allowing participants to build and enhance knowledge and skills; the *institutional*, modernising existing institutions and supporting them in forming sound policies, organizational structures, and effective methods of management and revenue control; and the *societal*, where an interactive public administration learns from its actions and population feedback (United Nations 2006).

One form of capacity building has been telecentres. Through knowledge sharing, these should help farmers decide what is best to grow, when and where to buy seeds and fertilisers, and where to sell produce for the best price (Kumar 2004; Madon 2009c; Souter 2009c) and

exploitative intermediation should be suppressed (Eggleston et al. 2002). International agencies have welcomed improvements in internet connectivity to bridge the “digital divide” between developed and developing countries (Heeks 2010). Government- and NGO-subsidised rural telecentres and entrepreneurial internet cafes were anticipated to offer communication services and training in ICT and non-ICT subjects that would empower citizens and increase their ability to create opportunities for themselves. However, their impact on local rural communities and development has been limited. The young, the educated, and the well-off are far better represented among users than the poor and marginalized (Souter 2009c, p. 111).

Currently, there is a consensus that policies to alleviate poverty in rural areas should:

First, strengthen the institutions essential for markets to work, including credit markets, contract farming, market information systems, commercial rules and laws, property rights and land titling, warehouse receipt systems, and producer and trader associations (Dorward et al. 2005).

Second, provide public goods such as education, transport infrastructure, and research and development (World Bank 2007 p. 120). Traditional education and training systems need to expand their repertoire to stimulate agricultural innovation (Spielman et al. 2008). Extension services, the different activities that provide information and services needed for farmers to develop their own technical, organizational and management skills and practices, can be provided by public, private, or civil society sectors (Sulaiman and Davis 2012) for delivery through ICT artefacts. The state must take the initiative, providing incentives for their provision and regulating providers. Consortia and public-private partnerships can be created for projects to be publicly financed but provided by the private sector. This can increase efficiency of public provisions, but can also lead to high public spending (Engel et al. 2013).

Third, encourage income redistribution and alleviate socio-economic difficulties faced by the vulnerable rural poor by offering cash transfers or work for food programs (De Janvry et al. 2002; Lastra-Gil 2011; López-Calva and Lustig 2010).

Fourth, co-ordinate efforts between actors in the rural economy. Markets may be inefficient because agents are disconnected by a weak transport or communications infrastructure, or because complementary investment by other agents in the supply chain is neglected. This is one reason why market liberalization has often not been successful (World Bank 2007). Investment should target ICTs, support farmers' associations, and offer inputs, credit subsidies and extension services (Kydd and Dorward 2004).

2.5.5 Agricultural Co-ordination Mechanisms

The literature describes four major typologies of agricultural co-ordination. In *co-ordination without contract*, the farmer buys inputs from suppliers and transforms them into agricultural produce for sale on the market, providing freedom to the farmer but generating uncertainty in both buying inputs and selling produce (Rehber 1998). Under *ownership integration*, farms lose their individual identity and become a company-owned farm. The company owns or leases land, buildings and equipment, and has its own employees. The *farmer co-operative* is incorporated, owned and controlled by agricultural producers for mutual benefit (Rehber 1998). It gives farmers a collective voice and greater visibility in the agricultural value chain (Halewood and Surya 2012), providing institutional links to large-scale suppliers and distributors.

In *contract farming*, the production and supply of agricultural produce occurs under formal agreements (Allen and Lueck 2005; Eaton and Shepherd 2001). Contracts vary in length, scale and scope and impose duties on both parties: a commitment from the farmer to provide a specific produce in quantities and to standards determined by the buyer, and a commitment

from the buyer to support production by purchasing the produce (and often also by supplying inputs or technical advice). Contracts can offer considerable advantage to the farmer, who may benefit from agricultural inputs, additional working capital, and advanced advisory services and technology provided by the buyer. While exposure to risk is lessened by specifying price in advance, it is not eliminated entirely: market failure can occur, the harvest may fail, and the farmer remains vulnerable to manipulation by an unreliable or exploitative buyer. Indebtedness is not eliminated. Contracts also bring benefits to the buyer. Purchasing from several producers can overcome land constraints, avoids the uncertainties and inconsistencies of open-market purchases, and eliminates responsibility for production. However, the farmer may be unable to produce to specification, and poor management or insufficient consultation can lead to discontent, and weak security of tenure will jeopardise sustainable long-term operations. The farmer may also sell outside the contract or divert buyer-supplied inputs and credit for other purposes.

While ICTs are clearly an important element that can facilitate market integration, they are but one piece in the puzzle of rural development. Because it is wrapped in human capital, development is more complex than a simple infrastructure supply issue. It is part of a complicated process that far outstrips simple definitions of “rural” and “urban” (Madon 2009b).

2.6 Socio-Economic Complementarity

Farmers are not isolated but live within complex social relationships, which they both leverage and contribute to in their day-to-day lives and economic activities (Henriques and Kock 2012). Economic actors rely on connections, business relationships and social institutions to work and tackle challenges together (co-operation).

2.6.1 Economic Mechanisms

The economics literature assumes that individuals are independent and can access all relevant information to select the most appropriate of any options available to them. An optimal decision means maximising utility through purchasing and consuming goods within the constraints imposed by their available means.

Research within the economic perspective comprises mostly quantitative studies that reflect the position of international agencies (World Bank 2012, 2016). A principal argument is that investment into ICTs triggers economic growth and enhances standards of living. Certainly, the rapid dissemination of mobile phones has had an especially pronounced impact in developing countries, improving accessibility and affordability of communication and amounting perhaps to an “Information Revolution”. This is reflected in a commensurate volume of research on mobile phones. With access to better information, farmers might transform their livelihoods (Halewood and Surya 2012; Qiang et al. 2011). I have identified three themes that relate to this economic view: diffusion, economic mechanisms, and production.

2.6.1.1 Diffusion of ICTs

Several studies have analysed the diffusion and penetration of ICT artefacts within the rural context, applying the classic “diffusion of innovation” approach of Rogers (2004) to understand market segmentation. Aker and Mbiti (2010) reported that the first adopters of mobile phones in Kenya were primarily male, educated, wealthy and urban, because the initial cost of handsets and services was relatively high. Secondary adopters spanned the demographic spectrum far more broadly; young and old, rich and poor, urban and rural, encouraged in part by the introduction of lower-denomination airtime cards. The adoption

of mobile telephony was geographically correlated with mobile phone coverage and poor landline services.

Souter et al. (2005) reported a mixed effect of mobile phone diffusion on economic activities. While many users considered mobile phones helpful for saving money (transport or postal costs), few considered them useful for earning income.

Drones (unmanned aerial vehicles) are growing in popularity and have potential applications for agriculture: after all, a flying camera is cheaper than a manned helicopter (The Economist 2017). This technology is intimately linked to the mobile phone, depending on the same miniaturisation of processors, batteries and optics, and using the same communications technology and leveraging the same physical and market infrastructure for market viability (World Bank, 2016). Economists have lamented the challenges faced by drones in farming: the agricultural market is fragmented and conservative, with subsidies, distortions, and social barriers (The Economist 2017).

2.6.1.2 ICTs and Economic Mechanisms

A recurrent theme in the literature is that ICTs support farmers by facilitating access to information, including market price (Aker 2008, 2010; Banker et al. 2011; Goyal 2010; Jensen 2007; Mittal et al. 2010; Muto and Yamano 2009; Van Campenhout 2013; Zanello 2012) and climate and disease data for better disaster and risk management (Halewood and Surya 2012; Henriques and Kock 2012; Mittal et al. 2010; Qiang et al. 2011). Virtual extension services can improve yields (Aker 2011; Baumüller 2012; Goyal 2010; Halewood and Surya 2012; Henriques and Kock 2012; Mittal et al. 2010; Van Campenhout 2013) and optimise networks and distribution channels (Aker 2008, 2010; Banker et al. 2011; Baumüller 2012; Donner 2004, 2007; Halewood and Surya 2012; Henriques and Kock 2012; Mittal et al. 2010; Qiang et al. 2011; Van Campenhout 2013; Walsham 2010; Duncombe

2016). Record accounting and traceability increase efficiency, predictability, quality, and reduce administrative costs and fraud (Baumüller 2012; Halewood and Surya 2012; Qiang et al. 2011), and access to finance, rural payments and insurance facilitate diversification (Aker and Mbiti 2010; Halewood and Surya 2012; Munyua 2007; Qiang et al. 2011; Hayes and Westrup 2012; Souter 2009a; Walsham 2010).

Many papers have argued that ICTs reduce transaction costs, but it is important to recognise that the effect of any given ICT artefact is a function not only on any benefit it brings to a transaction, but also of the cost it simultaneously incurs. This cost typically presents as additional co-ordination demands, capital or human, that must be satisfied for the transaction to occur (Wigand, 1997).

Information search costs are incurred throughout the agricultural cycle. ICTs can provide alternative channels for information (e.g. input availability) that impose much lower time and travel costs than physically visiting a supplier (De Silva and Ratnadiwakara 2008; Mittal et al. 2010; Overå 2006).

Negotiation costs are incurred in setting up and carrying out an exchange. Better price information not only reduces information asymmetry and search costs, but also improves the farmer's bargaining power (Baumüller 2012; Halewood and Surya 2012). Both Aker (2008) and Jensen (2007) have reported weaker price dispersion in areas where mobile telephony has been adopted.

Enforcement of a transaction imposes control costs. Logistics demands co-ordination between producers, truckers and warehouse owners or shops: barcodes and radio-frequency identification (RFID) facilitate tracking from farmgate to market (Halewood and Surya 2012) and e-payment services enhance operational efficiency (Walsham 2010), helping both parties fulfil the transaction's terms and conditions. Because many agricultural transactions

are made remotely, there may be no physical means to check the product, and software/hardware vulnerabilities may lead to disruption of transactions. There is an unfortunate paucity of studies on ICT security.

Better market information can reduce information asymmetries (Aker 2010; Jensen 2007), eliminate intermediation (Munyua 2007), and help growers negotiate better terms, but it does not eliminate every disadvantage, especially in local markets with limited numbers of buyers. Knowledge of prices across markets might enable producers to negotiate better terms with intermediaries, but they are rarely in a position to sell directly to consumers (Souter 2009a).

Price dispersion caused by information asymmetry and opportunistic market behaviour is common in developing countries (Aker 2010). One highly cited study of fish prices in Kerala, India found that the arrival of mobile phones brought a significant and immediate reduction in price variability and waste (Jensen 2007). Muto and Yamano (2009) also argued that information asymmetry is greater in the absence of mobile telephony. However, intermediation and information asymmetry survive even in its presence. This resilience of traditional face-to-face communication has gone largely unremarked; moreover, it is not clear whether effects on market prices make a tangible difference to farmers' lives.

ICTs provide opportunities, but the extent to which farmers can take advantage of them depends on many factors. Some studies have shown that farmers and businesses may lack the necessary capital, skills or bookkeeping experience to make ICTs useful without significant support from government or other agencies (Souter 2009a, p. 152). Even proponents of the notion of an "Information Revolution" recognize that ICTs build on pre-existing information and communications patterns and are influenced by human behaviour and technology. Change occurs much more slowly in human behaviour than in technology,

and it is this slower pace of change that ultimately determines the rate at which new technologies are adopted by and integrated into society.

2.6.1.3 Production

Most existing literature concerns the use of ICTs in production planning, the period of most significant decision-making by growers, usually in the context of how it influences access to external knowledge. Up-to-date information and the standardisation of knowledge across producers should permit more efficient decision-making and reduce information asymmetry, improving choice, enhancing agricultural yields and enabling more effective collaborations to improve rural income (Walsham 2010; Duncombe 2016). Extension and advisory services are a critical component of rural development, particularly for production, and farmers who lack access to information risk greater losses to disease and climate shock (Halewood and Surya 2012; Henriques and Kock 2012). Aker (2011) and Baumüller (2012) describe mechanisms through which ICTs can facilitate provision and adoption of extension services in developing countries, including voice, text, internet and mobile money transfer services. However, contradictory conclusions have been reached regarding the impact of virtual agricultural extension service programs (Aker 2011), which have been criticised for their limited scale and impact, with some studies reporting a reluctance of farmers to act on information received via mobile phones.

Farming organizations and co-operatives provide farmers with specialised local information. Collective purchasing can be mediated by ICT services to create economies of scale (Poulton et al. 2006), and there is ample literature on the utility of co-operatives in cutting transaction costs (Holloway et al., 2000). South American co-operatives sell directly to end consumers via online platforms (Romero 2000), and mobile apps provide real-time agricultural

information and extension services in Uganda (Van Campenhout 2013) and add value and transparency to Indian farming (Bhatnagar 2008).

Farmers are more likely to act on information that is delivered in a traditional social context, whether through face-to-face communication, as recommendations from neighbours, or through general community dialogue (Aker 2011; Banker et al. 2011; Henriques and Kock 2012; Mittal et al. 2010; Souter et al. 2005; Zanello 2012).

2.6.2 Social Processes

What economists investigate as “mechanisms” are referred to by sociologists and anthropologists as “processes” or “practices,” a term that emphasises a deep sense of agency in the work carried out by human actors (Knorr-Cetina et al. 2001). The social institutions and culture that follow traditional patterns of communication play an important role in the agricultural context: it is these social relationships that people rely on for much of the advice, information and co-operation that underpins their lives and livelihoods. I have identified five main themes: usability in social and occupational lives, social interactions, long-term relationships, internalised norms, and co-operation.

2.6.2.1 ICT Usability in Social and Occupational Lives

Technology modifies or shapes human activity by offering new opportunities and constraints, but it can also be modified during appropriation or used in ways not envisaged by the original designer. For example, in the developing world miscall alerts have been appropriated to reduce communication costs (Rashid and Elder 2009). People associate meanings with technology to create a perceptual construct: mobile phones are perceived as simultaneously a fashion product and a means to ensure personal safety (Campbell 2007).

Probably the most important aspect of the mobile phone is that it affords the possibility of “perpetual contact” (Tenhunen 2008; Wajcman et al. 2007; Wajcman 2008). The boundary between farming’s economic and social activities are already blurred as many farmers work from home (Dey et al. 2011): the mobile phone facilitates social communication and supports discussion about farming issues. Dey (2011; 2013) investigated the use of mobile phones in one Bangladeshi farming community, reporting that users who engaged with the technology develop cognitive and affective perceptions and accommodate its functions, utilities and difficulties. To explain how technology is adapted to the user’s needs and becomes embedded in daily life, they explicitly looked for unintended uses, new practices, and modifications of existing practices and structures. Despite financial constraints and other barriers (poor farmer literacy, unfamiliar English terminologies, and inaccurate translation into Bengali), social, occupational and psychological benefits motivated appropriation through inventive use and adaptation, and differently across generations. Elderly farmers would borrow mobile phones from neighbours to discuss financial and agricultural issues with relatives and friends, and younger family members found psychological comfort, independence and better self-esteem from owning a mobile phone.

2.6.2.2 ICTs and Social Interactions

ICTs tend to help farmers and buyers obtain information, and they improve co-ordination and collaboration more through existing relationships than de novo connections (Burrell and Oreglia 2015; Molony 2008, 2009). Pre-existing informal modes of communication are the foundation of rural information systems (Duncombe and Heeks 2002; Duncombe 2016). Existing long-term relationships (Burrell and Oreglia 2015; Molony 2006, 2009; Srinivasan and Burrell 2013), kin relations (Palackal et al. 2011; Tenhunen 2008), and co-operation and community bonding are inextricably linked to culture (Madon 2009a; Molony 2009; Sreekumar 2011; Tenhunen 2008; Watson 2011) and have with powerful consequences for

trade practices and market transactions. Market activities are embedded in the social relations that exist between actors, with trust generated over a history of transactions (Burrell and Oreglia 2015; Molony 2006, 2008, 2009; Sreekumar 2011; Tenhunen 2008). The social ties of rural producers continue to be mediated predominantly mediated and maintained through face-to-face communication, a traditional practice but which can be supported by ICTs (Burrell and Oreglia 2015; Molony 2009; Oreglia et al. 2011; Watson 2011).

2.6.2.3 ICTs and Long-Term Relationships

ICTs facilitate exchanges not only by matching transacting parties, but also by supporting future interactions through service engagement. Profiling the export of blackwood carvings by Tanzanian businesswomen, Molony (2008, 2009) found that ICT applications and especially email were crucial tools for expanding connections and maintaining trust with wealthy foreign buyers. Businesswomen could stay in touch by “keeping up appearances” at a social level, despite being at a distance. They succeeded where institutions have often failed: transitioning from a personal to an impersonal exchange. Internet media can transform the dispersed into the immediate, a virtual face-to-face availability of commodities, families, music, and cultures across religious and ethnic diasporas. People are part of a global environment – they are exposed to the internet, but not disembedded of relationships with particular places (Miller and Slater 2000). Traders have become more mobile because they are no longer restricted to a single landline or location, and entrepreneurs can venture further afield.

2.6.2.4 ICTs and Internalised Norms

Goal congruence, “*a habit that shapes intuitive actions*” (Lyon 2000, p. 666) and commitment within a community can be considered forms of trust. Most interactions within a market are routine rather than with strangers; we buy weekly groceries from the same stores

and through the course of our dealings become acquainted with their employees, even their owners (Storr 2010, p. 203).

While Molony (2006, 2008, 2009) rightly notes the importance of ICTs in making a person more contactable, he argues that the ability to communicate with ICTs has not significantly affected trust relationships between agricultural producers and wholesale buyers. Farmers who lack credit must often rely on informal contracts with buyers to obtain agricultural inputs. They must accept the price they are told their crops are sold for, irrespective of the mechanism used to convey this message, because their buyers are also their creditors. They are unable to exploit ICTs to seek fuller information on prices and buyers in other markets; should ICT marketplaces connect farmers to other credit providers, it might permit escape from such exploitative buying.

Tradition and the perceived reliability of information play important roles. The most traditional medium for information sharing, face-to-face communication, is still important for communicating and passively receiving specific information within the agricultural network in rural areas. Van Campenhout reported successful delivery of mobile phone app extension services through face-to-face communication with trusted community Knowledge Centre Workers (Van Campenhout 2013). The information they disseminated helped connect subsistence farmers to markets (post-production) and encouraged the growing of higher value crops such as coffee and maize. In a 2011 study of virtual technologies and traditional communication mechanisms in rural Northern China by Oreglia and colleagues (2011, p. 1435), ICT users were classified into three categories. The *independent* are younger people who can use mobiles and/or computers without help from outsiders, a demographic poorly represented among farmers because of urban migration. The *dependent* use mobile phones and sometimes computers, but only under the tutelage of others, typically their children or spouse. Finally, *proxy users* do not own computers and have never used the

internet directly, but are aware of its existence and the possibilities it offers. This study demonstrated a deep diffusion of ICT devices but a paradoxically limited accessibility to information, and a correspondingly powerful dependence on “information brokers” such as agricultural extension workers and shop owners. ICTs have the potential to expand opportunities for rural residents, but many semi-literate middle-aged farmers are unlikely to learn to find and evaluate this information by themselves.

ICTs should build on existing social habits even if they are less than ideal, rather than try to transform them. Existing social practices are usually based on partially mediated access to information, and if information brokers act as gatekeepers, they can also enable people who are not able to access information to at least partially do so.

2.6.2.5 ICTs and Co-operation

Douglas (1986, pp. 24 - 25) anthropological perspective on co-operation shows that in a “*community individuals can disinterestedly collaborate with one another and construct a collective good (system of knowledge). Within such a community the dictates of rational choice do not apply... the basic principles of a community are mutual trust, participation in its decision-making process, members hold beliefs and values in common and conform by virtue of a network of reciprocal exchanges; a form of society where rational self-interest does not dictate the outcome of decisions*”. These characteristics of community can help to solve the problem of how social order emerges.

ICTs contribute to co-operative engagement among economic agents. Several papers have considered the concept of culture and co-operation from a micro-level perspective, finding that individuals tend to appropriate ICTs in ways that maintain a traditional collectivist ethos (Burrell and Oreglia 2015; Madon 2009a; Molony 2006, 2008, 2009; Sreekumar 2011; Tenhunen 2008). Studying the same marginalised Kerala fishing community that was

studied by Jensen and where co-operation has long been ingrained into culture, Sreekumar (2011, p. 174) showed that “*mobile phones have amplified this impulse and enabled new modes of co-operation*” such as sharing information. Srinivasan and Burrell (2013) revisited Kerala and, using an ethnographic approach, found that those who work in the fishing industry use mobile phones to maintain trade relations, and reduce risk and vulnerability during difficult times through greater co-operation. This “collectivist machine” contrasts with the individuality-enhancing device that mobile phones have historically been portrayed as, for example in Jensen’s more parsimonious study, which had reported efficiency gains and improved welfare from better sharing of market price information (Jensen, 2007). As previously highlighted, context is important in social studies: Kerala’s prevalent credit relationships provide fishermen with the flexibility to optimize profits by selling at different markets. Srinivasan and Burrell warn that a more perfect knowledge of market price information may not always improve market efficiency or bring benefits to every income level. Molony (2006, 2008) found that it is not price information, but rather the exchange of supply and demand information between farmers and intermediaries where up-to-date information dissemination via ICT artefacts holds the greatest benefit. Overly parsimonious studies risk too simplistic models and unjustified assumptions or extrapolations when applied to broader contexts.

Market prices are often subordinate to other relational factors in trade-related decision making (Burrell and Oreglia 2015; Srinivasan and Burrell 2013). The potential for rejecting the most rational choice illustrates the tension between economic and social approaches.

Traders rely on co-operation with other traders (Overå 2006, p. 1302). In a commercial context characterized by imperfect information and a paucity of formal legal mechanisms, “*economic agents need to play by the rules of social institutions and co-operation in order to reduce transaction costs and survive*” (North 1995, p. 20-26). Institutions are made up of

formal rules, informal norms and the enforcement characteristics of both. The combination of rules, norms and enforcement determines economic performance, and societies that adopt formal rules of another society will have different performance characteristics than the original country because accompanying informal norms and enforcement will differ. These institution characteristics suggest that the development of policies that are perceived to be equitable could transform and shape economic performance in developing countries, because they define and enforce economic rules.

Technology matters in agriculture, and ICTs can influence the efficiency of the production process by imposing or relieving constraints on what can be produced. Advisory services delivered through ICTs offer the possibility for growers to acquire virtual knowledge (Aker 2011; Baumüller 2012; Halewood and Surya 2012; Henriques and Kock 2012). As discussed above, however, the literature recognises that adoption of virtual services may be limited unless they are rolled out through face-to-face meetings with trusted subject matter experts (Van Campenhout 2013).

The existing economics literature on ICTs and agriculture assumes that principles of economic individualism and rationality apply; that is, that growers will use ICTs to find the best exchange deals and ultimately maximise profits (De Silva and Ratnadiwakara 2008; Halewood and Surya 2012; Mittal et al. 2010; Overå 2006). Many studies have focused on market transactions, for example on platforms for commodities trading, where better and more current information through ICTs should yield easily discernible benefits (Banker et al. 2011; Bao et al. 2012; Baumüller 2012; Boadi et al. 2007; Halewood and Surya 2012). One problem is that ICT programs seek to connect farmers to markets rather than to each other (Henriques and Kock 2012). Although these platforms offer the opportunity to connect farmers with suppliers and customers, farmers continue to rely on existing relationships who

can support them in difficult times. Farmers must choose between disrupting existing business relationships and making one-off transactions.

It is also important to recognise the distinction between macro- and micro-level decision-making. Most literature has failed to consider macro-level economic organisation in analyses of how or why specific ICTs are selected by growers. Another relatively neglected matter is why certain farmers succeed better when exchanges are predominantly governed by informal relationships of trust, and how ICTs have contributed to this uneven success.

Despite enabling impersonal market relations, ICTs remain largely subservient to the historically powerful and traditional community principles of family, kinship and social connectivity. Farmers often work with other farmers to solve issues and learn from other people experiences. Social studies show that it is not the rational, but rather the relational view that matters most for agricultural exchanges (Molony 2008, 2009; Srinivasan and Burrell 2013). People can be simultaneously economically rational and social in their decision-making, and I will argue that analysis from the agricultural business process perspective offers a means to understand farmers' adoption and enactment of ICTs, and how ICTs have impacted their activities.

2.7 Research Question

My research question considers several elements. A broad central research question asks how farmers working medium-sized farms in a developing country have adopted and enacted ICTs, and how these have affected work practices: **What role does technology play in medium sized farming in developing countries, and how do farmers accommodate information technologies to improve work practices and reach the market?**

To address this question, this thesis will answer the following research sub-questions:

1. How do farmers come to know about ICTs and make decisions about their adoption and implementation?
2. What type and form of ICTs are used by farmers?
3. How do ICTs impact farming? Who are the beneficiaries? Are there losers?

Chapter 3. Theoretical Framework

Alongside neoclassical economics, two principal perspectives have been applied to the study of economic exchanges: Institutional Economics and New Economic Sociology. Institutional Economics (in this research, largely Transaction Cost Theory) emphasises the importance of information and communication in co-ordinating and simplifying economic transactions via contracts, organizational structure, language, culture, and human behaviour (Coase 1937; Williamson 1985). New Economic Sociology (in this research, largely Social Embeddedness Theory) argues that individual choices and actions are instrumental but ultimately constrained and enabled by the networks in which individuals are embedded (Granovetter 1985).

My theoretical framework evolved from TCT and the dichotomy of market versus hierarchy organisation, which fails to satisfactorily capture the logic of Social Embeddedness in my units of study. I acknowledge similarities between Powell's Network (hybrid) mode of organisation and Social Embeddedness. His influential 1990 paper on organisational practices concludes that the network economic mode allows actors to complete transactions efficiently and reduces the hazard of opportunistic behaviour through principles of reciprocity and relationships, a form of collective action in which co-operation can be sustained over the long run. Networks create incentives for learning, permitting knowledge to be translated into action and enabling the dissemination of information that can strengthen tacit knowledge and encourage technological innovation. The open-ended nature of networks is most useful when resources are variable and the environment uncertain. Conditional to the formation and sustainability of these collaborative arrangements, however, is a complex legal, political and economic context where antitrust standards are

relaxed and national policies promote research and development with links to academia and industry.

I discuss Powell's network economic mode in some detail and extend it to include the Social Embeddedness perspective (Avgerou and Li 2013; Granovetter 1985; Uzzi 1996) to better understand the adoption and enactment of ICTs in farmers' work practices. While Powell describes co-operation as an effective long-term arrangement that is sustained through appropriate regulation, I will argue that in the context of agriculture in a developing country, regulation is ineffective because of feeble state policies and weak institutions, and that social relationships instead determine the ease with which transactions and economic collaborative arrangements are formed. In the organisational forms we find in the units of study, co-operation remains opportunistic and may not be sustainable over the long run. How does the logic of Social Embeddedness complement the network mode of operations? Empirical evidence provides a possible answer.

3.1 Transaction Cost Theory (TCT)

The transfer of property rights between at least two parties is a transaction, the fundamental unit of human economic interaction (Williamson 1985). As an interdisciplinary approach from economic and organisation theories, TCT attempts to identify the institutional form that provides the most efficient exchange under conditions of utility maximisation, bounded rationality and opportunism. According to this theory, three attributes of a transaction (asset specificity, uncertainty, frequency) determine the optimal mechanism of exchange. An understanding of the biases and explanatory capacities of TCT should provide the conceptual foundation for an understanding of how farmers in a developing country adopt ICTs, and of how ICTs impact their work practices.

Asset specificity (AS) refers to a dependence created through transaction-specific investments. Value arises either from the investment made by parties in the exchange, or through the cost that is incurred by terminating the relationship for another exchange party (Collin and Larsson 1993, p. 4). Asset-specific exchanges require unique equipment, processes or knowledge, and encourage co-ordination between parties. In their analysis of French viticulture, Traversac et al. (2011) found that asset specificity is the principal source of contractual hazard (Williamson 1985), and Malone has proposed the existence of temporal asset specificity (Malone et al. (1987, p.486). An asset is time-specific if its value is highly dependent on reaching the user within a limited time (compare the perishable banana with rice, which can be stored in silos for years). Asset specificity creates dependence: a contractual relationship is more costly if one party threatens a contract breach or seeks renegotiation with more favourable terms (Alchian and Woodward 1987). A partner can choose to integrate sourcing or marketing in anticipation of opportunism (Traversac et al. 2011, p. 841).

Uncertainty (U) arises from situations in which bounded rationality makes humans unreliable at predicting the future (Collin and Larsson 1993, p. 4) and is a fundamental challenge for economic organisation because business environments are rarely stable or predictable. Customisation combined with uncertainty requires safeguarding exchanges to reduce behavioural uncertainty that ranges from honest disagreement to opportunistic behaviour (Jones et al. 1997, p. 917). The agricultural sector is a complex network of producers and chain systems. Competition pushes calculative agents towards adopting a mode of organisation that minimises transaction costs. Vertical integration has reduced transaction costs in many industries, bringing benefits that include efficiency, better risk management, and market and power balancing (Traversac et al. 2011) and which may guarantee a transaction should enforcement otherwise fail (Williamson 1985, 2005).

Traversac found that the likelihood of integration increases for firms that have a steady outlet for stable profits. Crop and livestock production face substantial natural constraints that generate marked seasonal variations in activity (and hence uncertainty). Here, lateral integration can control moral hazard (Allen and Lueck 2005).

Transaction frequency (F) facilitates the transfer of tacit knowledge “*deeply rooted in action, commitment, and involvement in a specific context*” (Nonaka 1994, p. 16), particularly for specialised processes. It powerfully influences reputation (Collin and Larsson 1993; Williamson 2005, p. 7) and helps establish the relational and structural embeddedness that provides a foundation for social mechanisms and network constructs to adapt, co-ordinate and safeguard exchanges and provide efficiency through specialised economic mechanisms (Jones et al. 1997, p. 917). Highly time specific, bananas are harvested continually and therefore see high purchase frequency, while rice is harvested only once per crop and readily stored.

Together, the attributes AS, U and F determine the overall cost that accompanies discharge of a transaction (Ménard 2005, p. 285). The ideal economic actor will execute an exchange after assessing its equity to identify the optimal co-ordination mechanism, i.e. that which imposes the lowest transactions costs. These costs manifest in various guises. They include *information search costs*, for example in identifying opportunities for exchange, and which unsurprisingly are often proposed as an agency for ICTs to reduce the cost of transactions. *Negotiation costs* are incurred in setting up and carrying out an exchange, and *enforcement costs* are incurred as contracts are monitored and enforced to the satisfaction of an unhappy buyer or seller, and can be considerable if one exchange party breaks the contract (Ciborra 1993; Cordella 2009). Should costs exceed a threshold, it may be more convenient to re-organise the exchange under an alternate economic mode that more adequately addresses asset specificity, frequency and uncertainty (Ciborra 1993; Williamson 1979, 1985). It is

important to recognise, however, that transaction attributes are abstract constructs and extremely challenging to quantify (Ménard 2005, p. 285).

3.2 Economic Organisations

Economies employ various mechanisms to co-ordinate the flow of goods and services and safeguard against opportunistic behaviour. Three basic forms of organisation exist: markets, hierarchies, and hybrids/networks.

3.2.1 Market

Markets co-ordinate through supply and demand forces with norms of self-interest, opportunism and utility maximisation (Bailey and Bakos 1997). Market forces determine the design, price, quantity, and target delivery schedule for a given product or service that will serve as an input into another process. Potential buyers compare sources and make a choice based on the best combination of these attributes aligned to their expectations (Malone et al. 1987; Wigand 1997). In a distributed system of information, it is assumed that consumers have all necessary information to make informed rational, independent, and individual decisions about which goods or services to purchase. Price searching, comparisons, and one-off transactions with lowest-cost suppliers are considered superior, and exchange parties tend to enter explicitly negotiated, short-term agreements. Technology is primarily seen as a means to rationalise market transactions and reduce costs (Koch and Schultze 2011, p. 129).

3.2.2 Hierarchy

Hierarchies co-ordinate the flow of goods and services by controlling and directing it at a higher level in the organisation. Information and decision-making are centralised such that managerial decisions rather than market forces determine design, price, quantity and delivery

schedules (Malone et al. 1987; Wigand 1997). In evaluating and selecting partners, the focus is on maximising value. Technology is used to integrate the business processes of trading partners, which facilitates co-ordination and allows monitoring of performance and process compliance (Koch and Schultze 2011, p. 129).

TCT predicts that the market should govern exchanges characterised by a low level of transaction-specific investment: that is, of items with weak asset specificity and a simple product description. When there is significant investment in transaction-specific capital and high uncertainty, market transaction costs can be prohibitive. It becomes difficult to anticipate all contingencies (bounded rationality) and there is the risk of catastrophic opportunistic behaviour: negotiation and enforcement costs are high. Instead, hierarchical organisations often preside over high transaction-specific investments (Bensaou 1997; Clemons and Row 1992; Collin and Larsson 1993; Malone et al. 1987). Highly customised products are more likely to be produced in-house or by a sole supplier (Holland and Lockett 1997; Kraut et al. 1999). Occasional exchanges are more likely to be conducted through the market, while hierarchical structures are more appropriate for frequently recurring transactions. The lower the transaction frequency, the weaker the benefits of routinisation and hence the greater the incentive for buyers to use the market to obtain the best price each time (Choudhury et al. 1998). In other words, the mode of transfer of resource-tangible items, such as equipment, services and patents depends on the frequency and the distinctiveness of the times that are exchanged (Powell 1990).

3.2.3 Neither Market nor Hierarchy

Williamson (1975), 1985, 1991) extended the binary institutional framework of market versus hierarchy by introducing the **hybrid** as an intermediate form of organisation, where reciprocal trading, regulation, franchising and long-term contracting occur (Collin and

Larsson 1993). This compromise mode works relatively well in both autonomous and co-ordinated adaptation respects. The viability of this mechanism is important for the efficacy of credible commitments (Williamson 2005). Technology is enacted to automate transactions, reducing uncertainty in ordering, shipping, inventory control and invoicing (Grover et al. 2002) and for interfirm monitoring, resulting in efficient outsourcing processes (Clemons and Row 1992; Clemons et al. 1993).

3.2.3.1 The Network Form of Organisation

Organisational sociologist Walter Powell proposed the **network** form of organisation as a hybrid, but distinct and nonintermediate mode that demonstrates complementary, relational and reciprocal characteristics of communication and economic exchange. Transactions occur under neither a market nor hierarchical governance, but rather through networks of individuals engaged in preferential, mutually supportive actions that arise from the dependence on and control of resources among parties. As Hennart (1993, p. 532) has suggested, some tasks are best achieved through a pooling of efforts where individuals have different skills that can be exploited through exchanges. This mode of organisation can be productive and has become increasingly prominent in the modern business environment.

In his analysis of the sociological and economic literature on economic exchange, Powell showed that network forms of organisations may be short- or long-term. Short-term networks occur between loose collections of individuals who maintain impersonal and constantly shifting exchange ties (e.g. the market can be conceived of as a network with one-time relations), while longer-term networks arise when exchange partners maintain close and stable social relationships. Because they shape expectations and opportunities, the structure and quality of exchange ties are key. When firms keep arm's-length ties with one another, the pattern of exchanges produces a market-like structure; when they maintain embedded

ties, the pattern of exchange favours a network. In essence then, every economic organisation contains elements of the network.

The rise of network forms of operation is explained by a number of considerations, including offering access to critical resources or skills that cannot be reproduced internally, a reduction in uncertainty, better and faster access to more reliable information, the existence of favourable national and supranational policies, and the capacity to resolve issues that other forms of exchange cannot handle. These motives align with a broad view of self-interest and while they may increase rather than decrease the cost of transaction, they can provide intangible benefits that are at least equally as valuable (Powell 1990 pp, 322-3).

Powell argues that networks are advantageous in several contexts. First, when there is a need for the reliable information that is best provided by close ties. Second, they are useful in commodity exchanges where value resides in qualitative features rather than quantitative elements, and where only the relational features of a network can facilitate its transmission through learning processes and trust (consider know-how and innovation). Knowledge creation is more effective in the dynamic, evolving socio-cultural context of community trust than in more formal and bureaucratically rigid structures, and often where firms, research foundations, suppliers, and customers converge (Powell 1990 pp. 314 - 316). Thirdly, when there is a reliance on reciprocity. Reciprocity, or indebtedness and obligation, can be conceptualised anthropologically as a conditional action based on norms that sustain exchange rather than from a game-theoretic equivalence where actors' interests are enhanced through co-operation. Reciprocity is enhanced by adopting longer-term strategies, and reliability and safeguards in relations promote learning, trust, and co-operation.

Powell describes a variety of often sophisticated network forms of social organisation that vary from the traditional to the highly technological. The pattern feature observed at the

macro-level is a blurring of boundaries across organisations to encompass a larger community of actors and interests. For example, crucial to the success of spatially concentrated production has been the support and co-operation of local government, proximity to centres of higher education, access to a highly skilled labour pool, extensive ties to research institutes and trade associations, and co-operation with firms that offer specialised skills and overlapping interests (Powell 1990, p. 313). At the micro-level of the firm lies tacit knowledge of a variety of activities. Roles and responsibilities are rarely defined and, like the boundaries between organisations, often overlap with close ties between teams and members of other organisations.

One example network described by Powell is decentralised manufacturing in Emilia-Romagna, where firm size is small and there exists a unique combination of political and social institutions. Production is conducted through extensive, collaborative subcontracting agreements. Compared to larger vertically-integrated organisations, smaller production units appeared to be “idiosyncratic to the Italian case”. Union strength and the rigidities of larger firms restricted job opportunities for young educated people; smaller firms showed greater salary dispersion, with skilled workers (“artisans”) earning more and unskilled labourers less than in a large factory. A combination of familial, legislative (local political authorities controlled by the Communist party), ideological and historical factors have contributed to local economic success. The extended family provides economic relations based on co-operation and trust and facilitates finding new employees through family and friendship ties. Co-operative artisanal associations have been established to exploit economies of scale, and collaborative networks help small firms collate new ideas and deliver products faster than larger enterprises.

Firms may be bound together for mutual benefit and the security that a stable relationship can provide. In post-war Japan, the business group *keiretsu* developed through loose

informal ties following abolition of the tightly centralised *zaibatsu* by the U.S. Occupation Authority (Powell 1990). Drawing upon an anthropological analysis of traditional family hierarchy, Bhappu (2000) argued that the institutional order of the family is the origin of corporate institutional logic in Japan, with business relations characterised more by trust and personal ties than explicit contracts. Japanese economic relations do not seem to have the features of opportunism, short-term profit-maximisation and distrust associated with capitalist enterprise (Dore 1983; Powell 1990), and expectations are more predictable and monitoring costs lower than in the West (Gerlach 1992, Smitka 1991). Close supplier-manufacturer relationships are useful for the level of detail involved in exchanges (Helper, 1990), and successful entrepreneurial business networks are characterised by knowledge transfer and learning (Lazerson, 1995).

Technology-based organisations may seek to combine their strengths and overcome weaknesses through collaboration. Co-operative relationships may be with suppliers, between firms, or as entrepreneurial start-ups with large firms, and their goals will vary. They may be in the pursuit of access to new technologies, markets and distribution channels, to facilitate research and product development, to benefit from economies of scale in joint research and/or production, to access tacit knowledge outside the boundaries of the firm, or to share the risks for activities that are beyond the scope or capability of a single organisation. The form of these agreements is usually individually tailored to the needs of the partners and local tax and regulatory considerations. The separate identities of the companies involved are preserved rather than deleted through merger and acquisition. While collaborative agreements will ideally sustain conditions for innovation and co-operation, they are not always successful. They may create management problems due to hidden agendas and ineffective industrial policy, and convergence of purpose can be difficult to achieve due to high expectations and a pressure to perform successfully (Powell 1990).

Powell concludes that the network is useful for activities based on know-how because it fosters lateral communication and mutual obligations, for those that demand speed because it helps disseminating and interpreting new information, and for exchanges based on trust because co-operation and reciprocity can suppress and control opportunism.

A network can be a source of dependency and conflict. Enduring patterns of frequent trading can restrict newcomers' access to the network. The open-ended quality of network forms of organisations is limited when resources are more substitutable and within a competitive environment. The likelihood of future collaboration in networks is determined by its durability, performance liability and network participation and the extent to which economic actors rely on market, hierarchy, or network forms of relational contracting is determined by state policies (Powell 1990).

3.2.4 Limitations of Transaction Cost Theory

TCT has been criticised as an incomplete unit of analysis because it neglects contextual issues that influence sourcing decisions, including organizational learning (Dietrich, 2008), human capital (education, training, experience, habits; the firm is a place for the selection, treatment and use of knowledge), and the differences in entrepreneurial ability that lead to firms adding value independently rather than through alliances (Teece et al. 1997; Teece 2010, 2014). It is, critics complain, a static mode of reasoning that fails to consider elements of power (Collin and Larsson 1993).

3.3 Social Embeddedness Theory

While TCT (Williamson 1985) and Social Embeddedness Theory (Uzzi 1997, 1999) make sometimes contradictory assumptions about economic behaviour (Granovetter 1985), they should be considered as complementary (Adler 2001). Early ICT research drew on TCT to

predict that network technologies like the internet would lead to a transition from embedded to arm's-length relationships (Malone et al. 1987), but more recent research has concluded that network technologies and co-operative relationships are in fact mutually reinforcing (Holland and Lockett 1997).

The embeddedness approach is associated with the “substantivist” school of anthropology that originated in Karl Polanyi’s book *The Great Transformation* (1944), where he argued that economies are embedded in social relations and institutions, both economic and non-economic. Embeddedness Theory aims to describe innovation and the diffusion and adoption of technology by individuals and communities within the socially embedded context that influences the uptake and use of ICTs – and which is therefore fundamental to socio-economic interaction of business behaviour (Granovetter 1985). Social Embeddedness refers to the extent to which all human actions, including commercial exchange, take place within a web of social attachments such as friendship and kinship (Uzzi and Gillespie 2002). Granovetter (1985) has argued that social relations, rather than institutional arrangements, are principally responsible for generating trust in economic life. However, while often necessary conditions for trust and trustworthy behaviour, social relations may not guarantee them; moreover, they can instead provide the occasion and means for misbehaviour and greater conflict.

In the context of interfirm relations Uzzi (1999, p.482) defines Social Embeddedness as the “*degree to which commercial transactions take place through social relations and networks of relations that use exchange protocols associated with social non-commercial attachments to govern business dealings*”. Analysing relations between apparel manufacturers in New York City’s garment district, he compared short-term arm’s-length subcontracting and long-term network-embedded relationships (Uzzi, 1996), revealing that embeddedness is an exchange system with unique opportunities over markets, and that firms organised into

networks survived better than those that maintained arm's-length market relationships. He showed, however, that networks are not necessarily the superior mechanism: while embedded ties offer considerable advantages under stable conditions, in periods of change they may lock firms into dysfunctional relationships that inhibit adaptation. Arm's-length ties might lack the benefits of trust but they permit greater flexibility when change is needed.

Economic behaviour is tightly coupled to or dependent on actions or institutions that are noneconomic in content, goals and process. Social Embeddedness links institutions and defines much economic behaviour, but has often been neglected.

“The interpersonal relational ties highlighted in Granovetter’s and Uzzi’s notion of Social Embeddedness are co-constituted with the institutions in their milieu. They are shaped by and contribute to the constant changing of their historical, spatial and cultural setting of economic activity. In contemporary economies, the social context of economic activities comprises behavioural norms that stem from local cultural and institutions that structure economic exchange in markets and hierarchies. Thus, observed over-reliance on interpersonal relations in developing countries has been explained by the existence of weak institutions for market exchange and business relations among strangers.” (Avgerou and Li 2013 p. 5)

Interactions in a socially embedded network are governed by the social capital expectations and norms that are associated with that web of social attachments.

3.3.1 Social Capital

Social capital is a currency of economic activity that can be exchanged for other capital, both human and economic (Bourdieu 1993). For example, customers in an embedded relationship may use a supplier's sense of obligation to obtain special treatment such as discounts or

expedited service (Schultze and Orlikowski 2004), and prospective employers and employees prefer to learn about one another from personal sources whose information they trust (Granovetter 2005) . Social capital differs from other forms of capital because it is embedded in the relationships between actors. It is neither a property of individual actors, nor can it be traded as a commodity (Coleman 1988), and it tends to deteriorate if the relationship is not maintained (Nahapiet and Ghoshal 1998). Customer friendship is an important mechanism of trust, and in some cultures it is the personal relationships that form through meeting in person that matter most (Trulsson 1997). In embedded relationships social capital tends to take the forms of trust, goodwill, obligation and reciprocity (Portes and Sensenbrenner 1993; Portes 2014). Embeddedness creates economic opportunities that are difficult to replicate through markets, networks, or vertical integration.

3.3.2 Norms

Norms are part of the social capital in any social setting (Coleman 1988; Schultze and Orlikowski 2004), and have been defined as “*what actions are considered acceptable or unacceptable, and can be seen as the basis of building and maintaining personalized trust. They can also be relied upon to stop some forms of opportunism where the exchange is a one-off transaction with no previous contact between parties and no expectations of future interaction*” (Lyon 2000, p. 665). Norms shape skills and productivity: in the social work of craftsmen, “titles are not important, *avoir faire* is”. This status system leads workers to cooperate. Employers have reason to recruit through social networks, as they feel confident the prevailing culture supports their own goals. Similarly, a loyalty system built on commitment to a profession benefits from socialisation, prior screening of members, and extensive off-the-job social relations. Employers homogenise new members of the loyalty system and recruit them within the existing social network (Granovetter 2005) . These transactions are shaped by assumptions of recurring exchange, expectations of interdependence and

reciprocity, generation of social capital, sharing of privileged and situated information, and the use of informal social ties (Schultze and Orlikowski 2004, p. 91).

3.3.3 The Role of Social Ties

Social ties can be defined as the geographical reach of people who interact with each other (Molony 2006, p. 69), or alternatively as the regular contacts and social connections among individuals or groups (Granovetter and Swedberg 2011). A consideration of social relationships will help us to understand the role of trust in economic institutions.

Granovetter's *The Strength of Weak Ties* (1973) classifies interpersonal links according to how they convey information. Because an individual's closest friends rarely possess much more information than the individual already has, it is in fact more distant acquaintances (the eponymous weaker ties) who tend to carry stronger information about new ideas and who are therefore more important in the diffusion of those ideas. Many processes depend on how connections influence the flow of information; people with more "weak tie" casual contacts tend to find jobs more easily than those with "strong tie" regular contacts, simply because of access to more information (Swedberg 1997).

In his 1992 book *Structural Holes*, Ronald Burt classified contacts as non-redundant or redundant according to whether they provide an information benefit. He describes entrepreneurship as connecting isolated, non-redundant contacts for mutual benefit, bridging a structural hole. Contacts that lead to the same people are redundant, insofar as they provide the same information. Burt (1992, pp. 8-49) refers to Simmel's (1923) idea of a *tertius gaudens*, where the third party's "pleasure" derives from brokering tension between two other players. *Structural Holes* shares obvious similarities with Granovetter's *Strength of Weak Ties* but reverses the direction of bridge formation. The actor who sits astride a structural hole is best placed to innovate – that is, to break away from tradition and

established routine. Schumpeter defined entrepreneurship as the creation of new opportunities by pulling together previously unconnected resources for a new economic purpose. One reason resources may be unconnected is that they reside in separated networks of individuals or transactions (Granovetter, 2005).

For interfirm relations, Gutek's 1995 *Dynamics of Service* describes a framework that distinguishes between two types of socially distinct interactions between customers and service providers: relationships and encounters. Relationship interactions arise between exchange parties who become known to each other and develop loyalty and expectations, evolving into bonds of trust that become more efficient over time and enhance future interactions. In contrast, encounters are service transactions between interchangeable economic agents made without the expectation of future interaction. While encounters can be efficient and sometimes desirable, relationships may add greater value. Intriguingly, Gutek describes encounters that are designed to feel more like relationships, which she labels "pseudorelationships."

3.3.4 Limitations of Social Embeddedness

The explanatory capacity and limitations of embeddedness theories have been considered by Platteau (1994). He describes Social Embeddedness theory as incomplete because it neglects some features observed in economic agents, including opportunism, independence, and atomisation. In their studies of regional production networks, Adler (2001) and Dore (1983) found that embedded actors satisfice rather than maximise on price, and shift focus from the narrow and economically rational goal of winning immediate gain and exploiting dependency towards the cultivation of longer-term, co-operative ties.

It has been argued that social relations create inefficiencies by isolating transactions from the market (Petersen and Rajan 1994). While embeddedness explains some forms of

economic action better than economic theory, its implications are indeterminate because of the imbalance between the relatively specific proposition of economic theories and much broader statements about how social ties shape economic and collective action (Uzzi 1997). A significant weakness of embeddedness theories noted by Teece (2014) is their failure to consider the economic actor's entrepreneurial and negotiating capacity to identify business opportunities and agree better deals.

3.4 ICTs and Economic Transactions

Mechanisms that transform exchanges have historically operated mostly through effects on intermediation (Wigand 1997), traditionally considered a transaction cost that must be incurred to reduce the search costs necessary to complete an exchange (Cordella 2009). Intermediaries encompass many economic agents, including wholesalers, retailers and brokers, and they play an important role in serving the markets on whose behalf they buy. By providing matching services for buyers and suppliers, they save time in searching for, comparing, co-ordinating and sourcing goods and services from a myriad of potential suppliers (Reynolds 2010).

3.4.1 Disintermediation and Re-Intermediation

Disintermediation is the displacement or elimination of traditional market intermediaries through direct trade between producers and consumers (Benjamin and Wigand 1995b; Chircu and Kauffman 1999; Malone et al. 1987). A more transparent electronic market where multiple sellers participate brings benefits to both exchange parties and can suppress intermediaries by allowing buyers to search directly for appropriate suppliers, reducing transaction costs (Benjamin and Wigand 1995a). The selling function is absorbed by customers through online ordering, and an opportunity is created to gather market intelligence and monitor consumer decision-making through behaviour and big data analysis

(Hoffman et al. 1995). However, while electronic marketplaces might reduce information costs, the hardware, software and operations cost of migrating from traditional marketplaces imposes sufficiently large incremental costs that uncertainty over the net benefit of this ICT intervention may persist long after switching (Bakos 1991, Riggins and Weber 2013). Indeed, ICTs will only reduce transaction cost if the resource penalty it imposes is less than the cost benefit it provides. Cost versus benefit can in principle be assessed by studying the constitutive elements of a transaction, as shown in Table 1.

Co-ordination and collaboration have become critical success factors for supply-chain management and companies are increasingly located at the intersection of one or more corporate networks through realignment and re-intermediation (Wigand et al. 1997). Information systems and distribution channels are aligned through intelligent platforms that allow companies to best meet customer demands and management of this chain is mainly driven by information sharing and redeployment activities. Web-based services involve various components and identities such as suppliers, manufacturers, factories, warehouses, and distribution agents. Platforms that facilitate communication between enterprises have become intermediaries.

Table 1 Analysis of the Costs and Benefits of ICTs on Transaction Costs

Transaction Cost	Reduce costs	Increase costs	References
Search Costs	Disintermediation reduces inventory and distribution costs but encourages re-intermediation. Reduces the unobserved cost of information searches with speed in collection and processing, if adequately managed.	E-marketplaces impose hardware, software, and operations costs. Paradoxically, may encourage greater intermediation: firms will offer market intelligence and monitor consumer behaviour in the e-marketplace. The volume of information increases complexity.	(Bailey and Bakos 1997; Benjamin and Wigand 1995b; Bakos 1991; Bakos and Brynjolfsson 1998; Ciborra 1993; Cordella 2009; Hoffman et al. 1995; Malone et al. 1987, 1989; Sarkar et al. 1995, 1998).
Negotiation Costs	Inventory control and systems for soliciting feedback from buyers that allow quality evaluation.	New co-ordination requirements emerge.	(Ciborra 1993; Cordella 2009; Malone et al. 1987).
Enforcement Costs	Service traceability and information exchange between parties to increase their links.	Enhanced communication but increases the requirements for co-ordination.	(Angelov and Grefen 2003; Cordella 2009; Daskalopulu and Maibaum 2001; Krishna et al. 2005; Merz et al. 1998; Singh 2008).

TCT predicts that ICTs should improve access to information, thereby reducing search, negotiation and enforcement costs. By facilitating the exchange of information, goods, services and payments associated with transactions, they should better match buyers and sellers and provide superior legal and regulatory frameworks that enable efficient institutional function. However, the effect of ICTs on transaction costs is complex and not unidirectional. Analyses must consider cross-effects and externalities and avoid the assumption that a change in exchange channel structure will not redistribute welfare among the agents that use this structure (Sen and King 2003). The costs and benefits associated with the adoption of ICTs are difficult to evaluate, but by reducing the amount of information, filtering it appropriately, and reducing co-ordination needs, it is possible to decrease costs while maintaining an efficient economic system (Cordella 2009).

3.4.2 Search Costs

ICTs will lower search costs only if the increased amount of information and/or speed of delivery is balanced by the ability to manage, process and evaluate that information (Cordella 2009; Malone et al. 1987). Additional information may eliminate uncertainty but at the cost of increased complexity that must be adequately managed. This illustrates an important point, that transactions occur in a complicated human context. While ICTs might nominally reduce uncertainty and increase the amount of information available, their implementation may impose a net cost penalty and, paradoxically, preserve

intermediation (Bakos 1998; Sarkar et al. 1998). Ungating an overabundance of information (Cordella 2009) can significantly augment complexity, requiring aggregation and filtering by specialised intermediaries in a more complex ecosystem that imposes additional transaction costs.

3.4.3 Negotiation Costs

Execution of a transaction imposes a negotiation cost that includes commission, agreeing terms and conditions, and drawing up a formal contract. ICT applications enable better control of the transaction for service provisioning and quality evaluation (Malone et al. 1987) for delivery to specific contractual requirements, and provide systems for soliciting feedback from buyers. New co-ordination requirements can emerge from ICT applications (Cordella 2009; Malone et al. 1987). In changing the distribution of information among economic actors, ICTs can affect information symmetry between them, offering new opportunities for opportunistic behaviour, something Williamson has defined as information expectedness (Williamson 1975).

3.4.4 Enforcement Costs

Enforcement costs include any negotiation undertaken to ensure dissatisfied buyers and sellers have their issues solved according to the initial contract (Cordella 2009). ICTs can facilitate contractual agreements and improve quality control and certification, offering service traceability from production to distribution. For example, radio tags facilitate monitoring of production and

distribution, and improve quality control (Cordella 2009). A more efficient information exchange between parties also strengthens the links between them (Malone et al. 1987).

The complexity of relationships and rights and obligations during the value exchange are key variables that make contract agreements in an uncertain environment complex and expensive, leading to higher transaction costs (Angelov and Grefen 2003; Daskalopulu and Maibaum 2001). The increased complexity of contractual agreements has encouraged investment in technological solutions that facilitate the creation and execution of contracts electronically (Krishna et al. 2005; Merz et al. 1998). The enhanced communication flow with additional information increases the requirements for co-ordination, and a positive cost outcome will only occur if solutions exist to manage the vastly enriched information that ICTs can provide (Cordella 2009), e.g. secured payment gateway, customer feedbacks, reviews. While ICTs have subverted much traditional intermediation, they have not fully delivered an early promised benefit, that of eradicating information asymmetry.

3.5 ICTs and Social Embeddedness

Networks and relationships are mutually reinforcing (Grover et al. 2002; Holland and Lockett 1997), and a substantial volume of work has examined the degree to which the introduction of information technology in organisations complements existing relations (Bensaou 1997; Boyd and Spekman 2004;

Grover et al. 2002; Holland and Lockett 1997; Schultze and Orlikowski 2004; Zuboff 1988).

The literature suggests that enactment of ICTs in buyer-supplier relationships leads to increased co-operative behaviour between firms. ICTs reduce task uncertainty through automation, integration and monitoring of interorganisational transactions, and they suppress opportunism and improve the information processing capacity of the relationship. Thus, ICTs can reduce the physical, spatial, and temporal limitations to interaction that have traditionally hindered effective co-operation (Bensaou 1997). Exchange parties are relieved of regulating operational transactions in favour of more co-operative activities, often requiring interpersonal and face-to-face interactions (Grover et al. 2002; Uzzi 1997). The frequency of social interaction among organisational members is one of the key drivers in building and maintaining interfirm relations. Research on the effect of ICTs in these relationships (Grover et al. 2002; Hart and Saunders 1997) has focused on what Malone et al. (1987) label the electronic integration effect, where exchange partners use information technology to create joint, interpenetrating processes (Schultze and Orlikowski 2004).

Avgerou and Li (2013) show with research on internet-based networks that the nature of Social Embeddedness is complex. An analysis of internet network relations among professionals and economic actors by Schultze and Orlikowski (2004) found evidence for the continuing significance of Uzzi's mechanisms of interpersonal relations, but Fowler et al. (2004) showed that "virtually embedded

ties” (the relations afforded by networks initiated and maintained through the internet) differ from both arm’s-length and socially-embedded relations of economic activity. These networks address issues associated with opportunistic behaviour, uncertainty and complexity by providing a digital means for price transparency, with widespread sharing of private and public information and community-based voluntary problem solving.

Networks represent a better form of organising and are well-suited for today’s firms that are increasingly technology-intensive. A more modern concept of the network has arisen with e-marketplace re-intermediation, a new ecosystem of buyers and sellers. E-commerce company Alibaba.com, for example, has become a prominent business information platform (Avgerou and Li 2013).

It is important to acknowledge the similarities and differences of the network and social embeddedness approaches. The network mode of operation is chiefly concerned with knowledge sharing and learning. Networks are particularly when there is a need for efficient and reliable information: they are more capable of generating, accumulating and distributing information and facilitating cooperation than either market or hierarchy. In Powell’s own words, “*the most useful information is rarely that which... can be inferred from shifting price signals. Rather is that which is obtained from someone whom you have dealt with in the past and found to be reliable*” (Powell 1990 , p. 304). Social Embeddedness argues that social relationships rather than institutional arrangements generate trust in economic life. It assists in understanding the

interactions, communications, connectivity, reciprocity and social capital that underlie the exchange of goods and services; that is, the importance of relationships – local, territorial, virtual, distant – in economic exchanges.

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Chapter 4 Research Methodology

4.1 Research Design

To understand how ICTs have been adopted by and affected the work practices on medium-sized farms in a developing country, I have applied an interpretive embedded case study design comprising two subunits of analysis and with careful consideration of contextual conditions. The case study is an appropriate research strategy because it is an empirical inquiry that investigates a contemporary phenomenon within a social context where boundaries may not be clearly evident, and it copes with technically distinctive situations in which there are multiple variables of interest and results that rely on multiple sources of evidence. Data are converged in a triangulating fashion, with prior development of a theoretical proposition to guide collection and analysis (Yin 2009).

A theoretical framework developed through multiple iterations of data collection and analysis helps generate rich and empirically grounded insights and captures everyday circumstances and conditions to better inform about typical experiences of people and institutions. It offers the opportunity to observe and analyse a phenomenon in different contexts: studying multiple geographical areas furthers the generalizability of findings and better represents the national picture of ICT use in rural areas. The outcome of this embedded case study research is a mid-range theory (Walsham 1995, p. 80; 2006, p. 322) about a

specific phenomenon, and is testable, novel, and empirically valid (Eisenhardt 1989).

4.1.1 Case Study Design

The single case study comprises two embedded units of analysis from crop sectors representative of Mexico's agricultural context: a cluster of banana producers from Tabasco and an organic rice grower from Campeche.

Tabasco's banana industry was established at the end of the nineteenth century, and survives as an agricultural business where continuity and family tradition are especially important. Although growers conduct transactions individually, they operate through the local banana association *UARSETPP*, which better enables them to use technology, formally and informally, to deal with export clients, track competitors, reduce hazards, and mitigate opportunistic behaviour.

The history of rice growing in Campeche is briefer, powerfully advocated in the 1960s but declining considerably since. The subject of the second unit of study is an organic rice grower who operates a single estate and has pursued more radical and innovative production and distribution strategies. Their use of (and dependence on) ICTs is more prominent and social networking more important as the grower has needed to establish a network outside the local area. Facebook and YouTube have been especially useful in the pursuit of new, middle-class customers.

The lessons learned from these units of study are informative about the experiences of the average farmers working medium-sized farms.

4.1.2 Case Selection

Attention is given to subunit typology. The decision to use an embedded, case study design with more than one unit of study in different geographical areas was taken with a view to mitigate the risk of units differing from that anticipated at the outset, to further the generalizability of any findings (Yin 2009, pp. 42-46), to better represent the national picture of ICTs in agriculture, to capture the network forms of organisation and any complementary with the logic of embeddedness as described in the theoretical framework, and to better test and compare the explanatory capacities of TCT and Social Embeddedness Theories for understanding economic activity.

This design has potential pitfalls (Yin 2009, p.45). It risks, for example, preoccupation with the subunit and a failure to return to the larger unit of analysis. Alongside my study of different farm typologies across Mexico, I visited other institutions, including wholesale markets, NGOs, and governmental institutions. Were it to focus on farms only, this research would have been an incomplete Information Systems study. Different data collection techniques were used at each level of analysis, from archival data to ethnographic interview.

4.1.3 Preparing for Data Collection

Entry to the case study was obtained through a gatekeeper in each region, an actor with influence over key sources and avenues of opportunity (Hammersley and Atkinson 2007). Gatekeepers provided an introduction to growers from their network; for example, a gatekeeper at Mexico City's wholesale market provided an introduction to a firm that cultivates and distributes bananas, which in turn lead to contact with a plantation owner in Teapa, Tabasco, and ultimately to an introduction to other farms in this case study unit. The head of the NGO *Ayuda para Ayudar* (Help for Help) provided access to Maya farmers in Yucatan and was gatekeeper to the second case study unit, the organic rice grower from Palizada, Campeche. Formal permission to engage in fieldwork was obtained from every site visited, as described in Appendix 2.

4.1.4 Exploratory Case Study

I conducted an extensive explorative study at various sites across Mexico to improve the final research design and identify and select case study sub-units. At the beginning of my research I was predominantly focused on smallholders and the role of ICTs in their distribution channels, but this evolved to include production and therefore the overall agricultural business process cycle. I followed a purposive sampling to identify participants, targeting smallholding communities:

I visited Tizimin, Yucatan (Maya communities that grow maize and chilli), Xicotepec de Juarez (coffee) and Atlixco, Puebla (huitlacoche). Unfortunately, the high capital cost of ICT artefacts and a feeble local infrastructure has significantly limited ICT adoption by smallholders, so their influence on decision-making processes is correspondingly minor. It was decided, therefore, that smallholders should lie outside the immediate scope of this study. ICTs have been adopted more fully by larger farms that can more easily afford (and more readily implement) infrastructure improvements like wireless base stations for internet access on their plantations.

I also visited the wholesale market CEDA in Mexico City. CEDA is effectively part of the intermediation process in rural areas, a layer between producers and consumers. This would enable me to map different relationships and connections across Mexico. Friendlier and less busy merchants agreed to be interviewed, the provision of a study overview and acquisition of consent to document our conversations aided considerably by the presence of a trusted gatekeeper. I learned about specialisation in agriculture, intermediation, the farming ecosystem, the main zones of agricultural production, and the role of ICTs in agricultural distributions channels, which I would later triangulate with information reported by farmers. I was introduced to contacts who would later become important sources of information in the embedded case study.

This formative exploratory study helped me to refine data collection plans with respect to content, sources, and collection procedures, and permitted formulation of an appropriate research question.

4.1.5 Quality of Research Design

Yin (2009) states that a research design should comply with four quality criteria: constructing validity, internal validity, external validity, and reliability. I constructed validity using multiple sources of evidence. For internal validity I performed explanation building in my data analysis, and for external validity I applied middle-range theory (Weick 1989) to develop a generalisable model, bridging gaps and refining existing theories between obtaining empirical evidence and generating theoretical findings. Applying multiple theories (new institutional economics, economic sociology, technology, development, social connectivity) alongside a business process approach helps to explain the role that technology plays for farmers working medium-sized farms and how they accommodate information technologies to improve their work practices and successfully reach the market.

I rely on a contextualist (Pettigrew 1987) and interpretive embedded case study method (Walsham 1995; Yin 2013), grounded in the accounts of relevant stakeholders (Madill et al. 2000). This grants a rich and deep insight into ICTs and farming business and working processes. I sought neither to impose an a priori theory on data nor to test a theoretical framework (Walsham 1995, 2006),

but instead examined and made sense of empirical data using constant comparative analysis (Strauss and Corbin 1998) to identify and refine initial concepts and link the evolving concepts to higher level of categories (Becker 2008).

Although procedures were documented to ensure the reliability of this research, it is evident that regional socio-economic differences, respondent age, literacy and internal or external forces (for example the obviously rapid pace of technological change) will influence attitudes towards ICTs, which might impact future replication of the findings.

4.2 Research Execution

The sources of empirical evidence used in this research were participant observation, interviews, ethnographic fieldnotes, archival analysis and visual data.

4.2.1 Data Collection

Fieldwork was undertaken over four phases between 2013 and 2016. Palizada smallholders were visited in December 2013 and January 2014. Wholesale markets in Iztapalapa, Puebla and Villahermosa, Tabasco, and banana growers in Tabasco were interviewed over March/April 2015, and five rural communities, government institutions, and a telecoms service provider were visited in July/August 2015. Communities, government institutions and NGOs

were revisited in August/September 2016 for follow-up interview. Communication was maintained with the main actors through email, instant messaging and phone calls.

4.2.2 Participant Observation

Observations were both as observer-as-participant (outsider) and as complete observer (insider). Gold (1958) recommends the more formal observer-as-participant role for one-visit interviews which entails less risk of “going native”, but because contact with informants is brief, there is a greater likelihood of misunderstanding the informant or being misunderstood oneself. In contrast, the complete observer role is detached, removing the fieldworker from social interaction with informants. The fieldworker attempts to observe people in ways which make it unnecessary for them to take him into account, such that they do not know he is observing them or, in some sense, that they are serving as his informants.

4.2.3 Semi-Structured Interviews

Robson (2011) recommends semi-structured interview in flexible and multi-strategy designs. Interviewers want responses to a list of topics but have considerable freedom in sequencing questions, in their wording, and in the amount of time and attention given to different topics. Interviews were conducted using a funnel technique, beginning with context and wider issues and reaching details on the usage of ICTs for agricultural decision-making.

Purposive sampling offered regular contact in informal settings, building trust and facilitating access to new contacts. Informal conversations led to other contacts within each sector. A total of 128 interviews were conducted (14 with gatekeepers, 42 with smallholders, 17 with medium-scale producers, 17 with wholesale merchants and 38 with federal government secretariats and community members that included local government officials, rural internet operators, and NGO staff), as summarised in Table 2. Interviews were conducted largely in Spanish. While only salient parts of conversations were initially translated, transcripts relating to the two case studies were prepared in their entirety to avoid destroying context for data analysis and coding. A summary of the interviewees is given in Appendix 1.

4.2.4 Ethnographic Fieldnotes

Fieldnotes do more than simply record observations, and at best they provide a written account of what the researcher has seen, heard and experienced in the field. Writing is an interpretive process, the very first act of contextualising, and fieldnotes provide the primary means for field researchers to grasp, interpret and appreciate the actions and concerns of others. They “*offer a subtle and complex understanding of others’ lives, routines and meanings*” (Emerson et al. (2011, p. 13). The following is an extract from ethnographic fieldnotes recorded in March/April 2015:

“CEDA at Mexico City is a wholesale market on an even more massive scale than the New London Convent Garden or Western International markets in London that I visited in preparation for this research. I began negotiating access in the third week of January and it was granted in early March. The administrator of CEDA CDMX agreed that I could visit the site, but that for security reasons I should be accompanied at all times by a member of staff. I met the admin at CEDA’s offices on Monday 30th March 2015 at 8am and we walked to the market. I observed that they have their own FM radio station and police station. We passed through a tunnel and were met by a wall of noise as we reached the entrance of the market. He gave me a guided tour of the retail section [Figure 2]. CEDA at CDMX is a building on an astonishing scale. Each aisle is 15 metres wide and more than a kilometre long. “Carretilleros” run around pulling trolleys, offering to load and transport fruit and vegetables around the market¹. As chaotic as the city in which it’s found and with the same friendly atmosphere, too. Voices and shouting drown out background music. There are mountains of fruit and vegetables, and everywhere people are waving greetings and offering samples. Colourful hand-written signs advertise wares: mamey fruit from Tabasco, guava from Chiapas, and – it being March – many sizes and variety of mango.

¹ There are approximately 10,000 carretilleros at CEDA CDMX, portering fruit and vegetables in the market.

The displays are very colourful: green, yellow, orange, purple and red and the stalls painted with Mexico's colours. I noticed that fruits had lamps next to them, possibly to keep them warm and ensure that they ripen properly. People were laughing happily everywhere and some of them asked me to take their photo. It had a party atmosphere.

I observed some people buying huge quantities of produce and learned that they were from restaurants. On completing their purchases, they would shake hands, "see you next time." Physical contact is important in Mexican culture.

We moved on to the wholesale section [Figure 3]. I observed that there were towers with a guard at the top and CCTV cameras. These measures were intended to reinforce security as merchants have been kidnapped in the past. The wholesale area was quieter and the presentation quite different: shop windows with display fruits cooled. It is a more refined environment with fewer people walking in the aisles. Some wholesale merchants import produce while others are primarily focused on the domestic market, e.g. apples from Chihuahua."

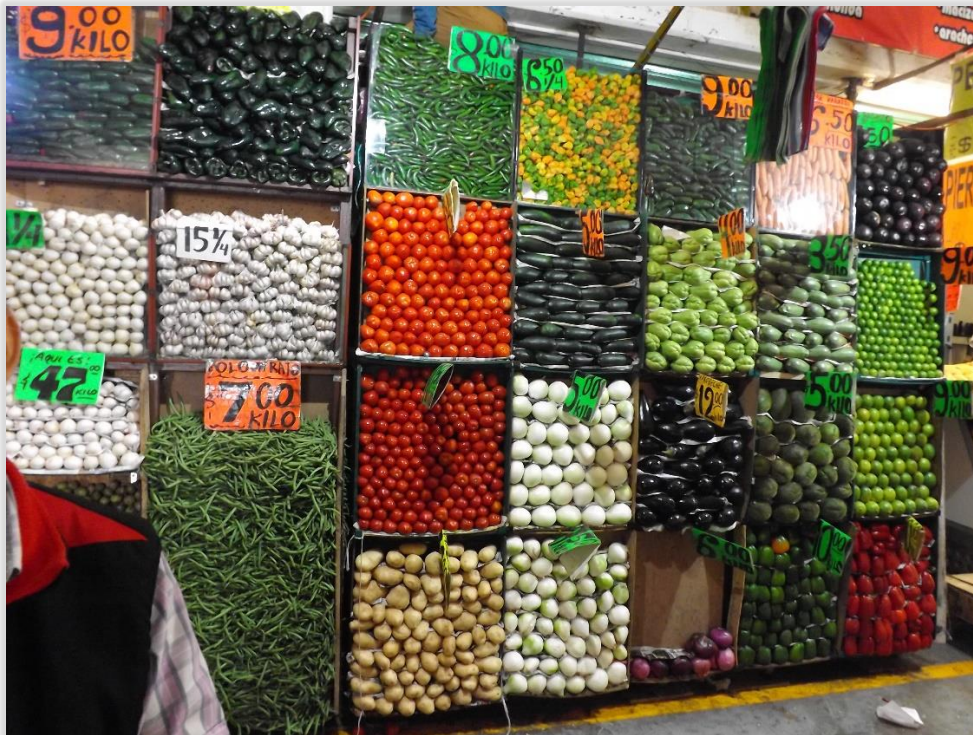




Figure 2 CEDA CDMX – Retail Section



Figure 3 CEDA CDMX – Wholesale Section

4.2.5 Archival Analysis

Archival analysis was carried out to obtain statistics. A range of sources was consulted for socio-economic indicators, including agricultural and population censuses, the Secretariat of Agriculture (SAGARPA and SIAP) and National Institute of Statistics and Geography (INEGI) databases, entrepreneurship policies from the Secretariat of Economy, the Mexican General National Archive, and the World Bank. Information from ethnographic fieldnotes at the wholesale market in Mexico City was triangulated with data extracted for their own archive (CEDA CDMX 2015):

The *Central de Abastos* (CEDA) at Iztapalapa is, with fish and seafood specialist *Nueva Viga*, Mexico City's largest wholesale market and the largest food warehouse and distribution centre of its kind in the world. The commercial section of the market covers 325 hectares, with 3,755 warehouses and 2,500 businesses that sell primarily fruit, vegetables, meat, and processed foods. More than 30,000 tons of food is sold each day, equivalent to 80% of metropolitan consumption. The market employs 70,000 people directly and has more than 300,000 visitors every day. 15,000 different products are sold, and supply and demand at this CEDA effectively dictates the national price of perishable produce. The market is divided into eight sections: retail, boxes and containers, fruit and vegetables, meat and poultry, auctions, flowers, warehouse transfers, and overnight staging for up to 1,000 trucks. Although most business is between wholesalers and retailers, retail sales still play a significant role.

Table 2 Summary of the methods used in this research

		4 phases - 2013-2016				
Interpretive Case Study	Embedded	Two units of analysis in different crop sectors and geographical areas				
Purposive sampling	Observation	Building trust and facilitating access to new contacts				
		Participant observation – insider/outsider				
Semi-structured interviews	Dec 2013 - Jan 2014	Mar-Apr 2015	Jul-Aug 2015	Aug-Sep 2016	Total	
Gatekeepers	5	7	3	2	17	
Smallholders	5		38		43	
Medium producers		2	11	12	25	
Merchants		14	3		17	
Federal Government Secretariats & Community members: Local Government, NGOs and Rural Internet operators			2	23	15	40
Total semi-structured Interviews	10	25	78	29	142	
Visual data	✓	✓	✓	✓		
Archival analysis	✓	✓	✓	✓		
Thematic Analysis	✓	✓	✓	✓		
People re-interviewed						
Gatekeepers			2	1	3	
Smallholders				1	1	
Medium scale producers			2	6	8	
Community members			1	1	2	
Total Re-interviewed	0	0	5	9	14	
Net Cummulative	10	35	108	128		

4.2.6 Visual Data - Photography

Visual records were made to document and triangulate comments from interviewees. Screenshots were taken of emails, instant messaging exchanges, and inventory control processes to exemplify how growers negotiate prices with retailers and receive payment confirmation from customers. Photos also helped to document packing processes: they tell a story, and have a long tradition in anthropology and ethnography. Radley (2010, p. 268) has argued that pictures

are more than mere representations because they are also resources, mediators that along with words give shape to ideas. Photos can reveal social structure in the social field, but also raise a number of issues. Potential problems identified by Denzin (1989, pp. 214-220) include the loss of a moment's expressiveness if subjects are arranged in a photo, the need for researchers to integrate themselves with the camera in a way that attracts minimal attention to provide honest insight into everyday life, and the potential to influence and manipulate a scene through montage or attempts at artistry that omit or exaggerate details key to the research question. The style of the photographer may influence the content of the photos and introduce bias into the research. Exactly as with the written word, what a photographer produces may be his own understanding about what he is investigating.

4.3 Analysis

The qualitative approach of this research permits thematic analysis of structure and process information from text sources (Hayes 2013). This technique is useful when research needs to draw interpretation and be consistent with the data that is collected, for example on participant behaviour, action, attitude, emotion, and thought (Hatch 2002), and it provides the opportunity to code and categorize data into themes (Miles and Huberman 1994). A code is an abstract representation of an object or phenomenon (Strauss and Corbin 1998); a word, phrase, sentence, paragraph, long passage, or a whole document (Bazeley and

Jackson 2013, pp. 122-123). A sufficient volume of information is essential for a coded segment to be analysed appropriately. Codes are of crucial importance for qualitative analysis and permit comparison of the subunits of analysis using a systematic set of criteria. Data was coded by first parsing interview transcripts, summaries and fieldnotes to identify as many key themes as possible. This was then parsed for sub-themes for analysis framed by TCT and Social Embeddedness Theories, as described in the data matrix of Table 3.

Attride-Stirling (2001) recommends thematic analysis using thematic networks, breaking up text to find explicit rationalisation and implicit signification within. Three classes of theme exist: basic, organizing, and global. Derived from textual data, the basic theme is the lowest order. Organizing themes group basic themes into clusters of similar issues, and the global theme describes the principal metaphors as a whole.

Lincoln and Guba (1985) have proposed four criteria to evaluate interpretive research: credibility, transferability, dependability and confirmability. Credibility is related to the adequate representation of the construction of the social world under study – triangulation and validating interpretation with raw data can help to reinforce credibility, for example. Transferability is aligned to the extent to which the researcher’s working hypothesis can be applied to another context. Dependability demonstrates coherence of the internal coding process and confirmability concerns the extent to which data can be confirmed by others.

Robson (2011) describes a number of computer packages designed for researchers to use when analysing qualitative data, with NVivo the preferred platform. The outcome of my coding is described in Table 3 below:

Table 3 Thematic Analysis. This table describes the processes followed to analyse and code data, for the identification of main themes in alignment with the theoretical framework.

Thematic Analysis - 1 of 5						
Themes	Category	Sub-category	Description	Example Statements	Occurrences	
					Case A	Case B
TCT	Transaction attributes	Asset specificity	Customisation & Process specificity	<i>“Growing bananas is a very specific production process and the fruit requires a lot of attention to ensure high quality. The fruit is very delicate and requires a lot of attention. Harvesting is manual, which increases the cost of production. Besides this, chemicals and pesticides are expensive. The banana is a perennial that lives about 20 years. This is the reason for why it demands a greater investment, but it is also one of the more profitable crops in agriculture.” A6</i>	26	30
		Uncertainty	Beyond expectations	<i>“As with other agricultural products, the main challenges for the banana business are financial and associated with seasonality in the production cycle. In late summer, the market price declines sharply. In winter, we need to sell only two containers to break even whereas in summer we need to sell at least 10-12 to safeguard the business and our workers.” A1</i>	22	8
		Frequency	Periodicity of transaction	<i>“Transactions are weekly, so there are 52 transactions in advance [each year].” A2</i>	32	1

Thematic Analysis - 2 of 5

Themes	Category	Sub-category	Description	Example Statements	Occurrences	
					Case A	Case B
	TCT	Enforcement costs	Enforcing the contract	<i>"logistics demands economies of scale."</i> B2	1	3
		Negotiation costs	Carrying out exchanges	<i>"They use the telephone to alter purchase orders or for anything beyond standard negotiation."</i> A1	12	2
		Search costs	Searching agricultural information	<i>"In the past customers would place orders by phone, now everything is through the internet."</i> B2	7	6
	Market	Distribution channels	Intermediation	<i>"We call it 'the pressure of the fruit.' If you don't act quickly, you will fall to the uncertainties caused by the basic axiom of supply and demand. There is opportunistic behaviour by buyers, and producers become easy prey for the 'coyote'",</i> A1	68	17
			Disintermediation	<i>"Facebook is a marketplace and a useful platform for communication, a good source of information that offers guidance on what customers like and dislike."</i> B1	14	7
		Opportunistic behaviour	Spot price	<i>"Fruit production doubles or even triples [in late summer] and domestic revenue declines because spot market price is very low."</i> A1	48	6

Thematic Analysis - 3 of 5

Themes	Category	Sub-category	Description	Example Statements	Occurrences	
					Case A	Case B
	Hierarchy	Centralisation	Production costs	<i>"We control costs and maintain contacts with input suppliers, and customers. We calculate the weekly payroll. The payroll software allows us not only to calculate weekly salaries, but also to monitor worker productivity. The management control systems allow us to record yield, boxes packed and shipped, variable and fixed costs, etc."</i> A6	2	1
		Production	Vertical integration	<i>"We constantly regenerate and replace old or ill plants. We have our own mesh-covered greenhouse covered to create shady conditions similar to the banana's natural environment, where light does not directly reach the daughter plant."</i> B6	24	32
	Network	Co-operation	Long-term contracts	<i>"Exports are based on an annual contract and are very useful when there is overproduction for the domestic market. Exports help to mitigate exposure to declines in domestic price due to fluctuations in supply, principally from seasonality. Needs vary among producers, but a combination of 70 percent export on fixed-price long-term contract and 30 percent domestic sales is good."</i> A6	21	5
		Contract farming	Financial security	<i>"We need a contract because the funding [requirement] is higher. With this we could expand production three-fold."</i> B1	48	15

Thematic Analysis - 4 of 5

Themes	Category	Sub-category	Description	Example Statements	Occurrences	
					Case A	Case B
	Network	Collaborative arrangements	Long-term ties	<i>"I need a good relationship for security: I would like them to invest. They [HiPP GmbH] have been involved in discussions and they have said yes."</i> B2	52	16
		Social media	People who interact with each other	<i>"People who consume organic food are middle or upper-middle class who are usually keen to provide feedback. Consumers give me new ideas and show how the market is moving."</i> B1	13	1
		Reciprocity/ Embedded logic	Obligations toward co-operation and trustfulness can also come through moral and social pressure	<i>"If a customer orders a container and pays in cash up front, they are reliable and I need to find the fruit and send it according to their specifications. Telling the truth and delivering on time. Many people find good customers who pay in advance, but then fail to deliver on time or send unacceptable produce. This usually destroys trust."</i> A4	5	0
		Trust	Confidence in others	<i>"To find people with the right qualifications to sell in traditional channels is difficult. My profits are very small, I cannot pay somebody else to do this type of work."</i> B2	33	2

Thematic Analysis - 5 of 5

Themes	Category	Sub-category	Description	Example Statements	Occurrences	
					Case A	Case B
Social Embeddedness	Business relationships		Community	<i>"Suppliers finance our operations by increasing the invoice period to 90 days. We pay off our loans when price recovers."</i> A1	37	0
	Norms		Actions that are acceptable and unacceptable	<i>"If buyers don't pay in cash there is no business. That is the rule of the game, the traditional way of doing business. It is the result of lessons learned."</i> A2	6	0
	Sporadic co-operation		Who you know, connections	<i>"If my Russian customer puts in a large purchase order and I do not have enough capacity, I join efforts with other producers to complete the shipment."</i> A3	11	1
Adoption and Enactment of ICTs		Changing the way of doing activities	Ex-ante/ex-post	<i>"Computer systems generate weekly and monthly reports with KPIs of production, shipments, packing, and personal productivity."</i> A3	73	63
		Innovation	New approaches	<i>"I use it [drone] on the plantation for aerial photos, because it helps me to identify areas that are in bad shape. With aerial images, it is easier to distinguish between the broad green leaves of a healthy banana plant and the paler green leaves of weaker plants that need replacing. This will save me money in the future."</i> A6	34	32
		Processes	Input/outputs	<i>"We maintain daily, weekly and monthly records of rainfall and our plantation has a sprinkler system that is activated at sunset if our records show that the plants need water."</i> A6	48	15

4.4 Ethics

Five major ethical issues apply to social research (Hammersley and Atkinson 2007, pp. 264-275): informed consent, privacy, harm, exploitation, and the impact for future research. While it is often argued that subjects should give unconstrained consent after being comprehensively and accurately informed about the research, the question remains as to what exactly constitutes free consent. Researchers operating in an overt manner rarely tell everything about the research to the people they are studying. There are various reasons for this. When initially negotiating access, the researcher cannot anticipate exactly how the study will evolve and once a research strategy has been clarified there are reasons why only limited information may be provided to participants. Subjects may not be very interested in the research, they may perceive any insistence on providing information as intrusive, or their behaviour might be affected and the research invalidated by revealing certain information. Researchers often try to give people the opportunity to decline to be observed or interviewed, but this is not always possible without making the research highly disruptive, and in some cases the researcher does not have control to ensure that all participants are fully informed and have freely consented to their involvement.

Privacy is a frequent concern for social research as it involves making public things said and done in private. While public versus private is rarely well defined, a common practice is to draw the distinction between the two depending on who is involved or in relation to specific audiences having (or lacking) legitimate access to information of particular kinds, for example adults versus children. In some cases, a perceived invasion of privacy seems to be justified if information will be published for a specialised audience that does not include the people studied or their acquaintances. Lincoln and Guba (1989) have argued

that participants have the right to control information relating to them and must give their permission for its use by researchers. Others have argued that this might open the door to distortion of evidence by participants (e.g. Jenkins 1980). Gatekeepers were informed of the research objective, a study of ICT use in agriculture. While conducting interviews, I explained the scope of the research and obtained consent to use the information for academic purposes and possible publication. Interviewees were anonymised for data protection. Fieldwork accounts can affect both the reputation of individuals and their material circumstances. The potential for damage caused by the publication of research findings is not restricted to effects on what is publicly known or on the reputation of people or organizations. Furthermore, there are current security concerns in Mexico that make privacy especially important; kidnapping for ransom is unfortunately common in rural areas.

Also important is how information is used. It is not always clear in whose interest it lies, and some might argue that the value of scientific knowledge, or the public right to know, negates such considerations, but a researcher must ensure that any knowledge produced is used for good causes. This message I passed on to the interviewees. Even now, three years after the first interview, I inform key participants of progress and supply clarification as the research evolves. They have also reviewed and commented on an academic paper resulting from this research (Lastra-Gil 2017). Participants will be offered a copy of my research, and their comments noted.

It has been claimed that research exploits human subjects since participants provide information without receiving anything in return. The question of exploitation is always a matter of judgment because it is difficult to quantify what is contributed to the research by each side. The argument about the exploitative potential of social research leads to a variety of recommendations; for example, that researchers should give something back,

in the way of services or payment, that participants should be empowered by becoming part of the research process, or that research should be directed towards studying the powerful rather than the powerless.

Social science researchers rely on being offered access to settings. If the research is subsequently considered objectionable by subjects, they may refuse future access, leading to inconclusive findings. We cannot assume that researchers and participants perceive or interpret research in the same way. There may be conflicting perceptions and clashes of interest that lack simple solutions.

Chapter 5 Case Study

5.1 Overview of the Mexican Economy

Mexico is the fifteenth largest country in the world by area, at 1.9m km² (World Bank 2017a). One fifth of its population of 127 million (estimated; 1.46% cumulative annual growth rate 1995-2016) lives in rural areas. Mexico's free market economy, a mixture of the modern and the traditional, is increasingly dominated by the private sector.

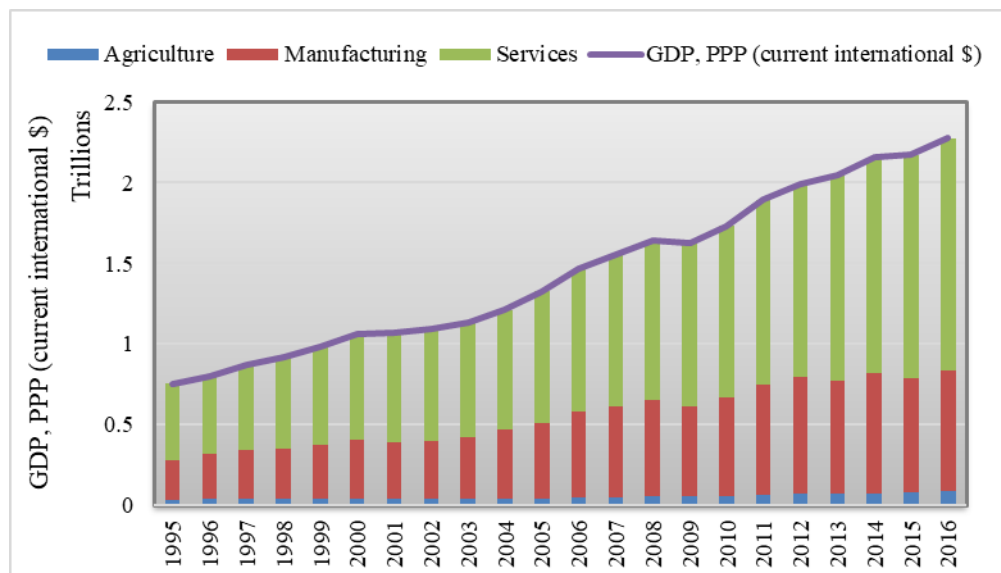


Figure 4 Mexico GDP (1995-2016) per sector

A per capita GDP of \$17,862 is approximately one third of that in the US, and income distribution remains highly unequal with a Gini Index of 48.2 (World Bank 2017b). Mexico is highly dependent on overseas trade and has become the United States' second-largest export market and third-largest source of imports, with two-way trade in goods and services in 2016 exceeding \$579bn (CIA 2017). Since implementation of the North America Free Trade Agreement (NAFTA) in 1994, Mexico's \$2.2tn Purchase Power Parity (PPP) economy has oriented increasingly towards services and manufacturing.

Services lead the economy at 63% of GDP, followed by manufacturing (33%); agriculture contributes just 4% of GDP (Figure 4). The total labour force is 57.8m (45% of the population).

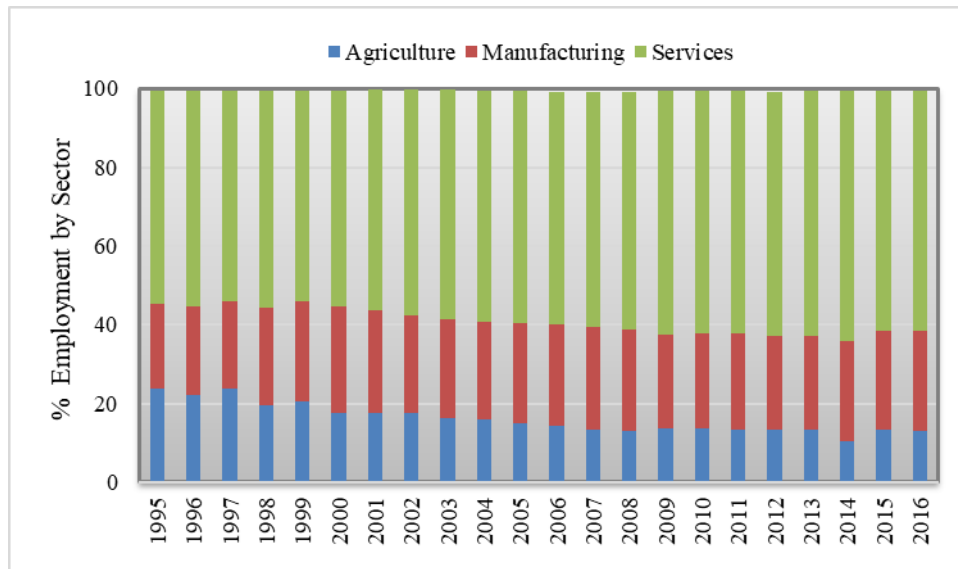


Figure 5 Employment per economic sector in Mexico (1995-2016)

Between 1995 and 2016, employment declined by 2.8% annually in the agricultural sector, grew by 0.8% annually in the manufacturing sector, and grew by 0.6% annually in the services sector (Figure 5 and Table 4); (World Bank 2017b).

Sector	% of total employment in 2016	% CAGR 1995-2016
Agriculture	13	-2.8
Manufacturing	26	0.8
Services	61	0.6

Source: World Development Indicators (World Bank 2017b).

Table 4 The distribution of employment in Mexico by sector in 2016, and compound annual growth rates between 1995 and 2016.

5.2 State Policies

Empirical evidence shows that a farmer's idiosyncratic individualist approach of conducting transactions is assisted by sporadic community support. While an organisational logic of the network describes some of the features observed in the units of study, co-operation may not be sustained effectively over the long run. ICTs can help mitigate hazard in farming exchanges: with intermittent community co-operation, uncertainty is reduced, risk is shared and tacit knowledge made available through short-term alliances and mutual assistance. Social relationships, rather than weak state policies, have most shaped the distinctive patterns of economic activity seen in farming.

Formal regulations in Mexico are weak, with no regulatory system to facilitate or sustain collaborative arrangements. National Digital Strategies and National Development Plans are published every six-year presidential term, but lack top-down co-operative support for their implementation. Policies that promote collaboration among national and local governmental institutions, universities, communities and the private sector for sustained development are limited, and the few that exist have been only isolated efforts. Each Secretariat has its own budget and tends to operate like a silo, severely limiting cross-team collaboration. A civil servant working for *Mexico Conectado* (a governmental organism led by the Secretariat of Communications and Transports to promote connectivity and digital inclusion) commented on this:

“Each Secretariat has its own budget and works independently. Although performance is measured according to the impact that we have on the population and the number of people we benefit, there is jealousy and pride in our directives: showing-off achievements in our areas and limiting open collaboration with other governmental agencies. The annual budget is limited, and Secretariats try to

demonstrate that they can produce better results on their own, so they can get greater investment in subsequent years. We are constrained by a six-year tenure, therefore good results would potentially ensure the sustainability of our projects, our own survival and perhaps greater political influence, but in many cases to the detriment of the communities that could have benefited more if we were working together. There is a degree of protectionism in our activities and we don't want to openly recognise that there is a duplication of efforts between Secretariats. We know that teamwork works and that combined efforts can produce better results, but we are primarily focused on our own short-term achievements, and sadly there is no state policy to promote co-operation among institutions. Those agencies and staff that could help promote a stronger regulatory system [e.g. National Digital Strategy (2013-2018)] do not control their own budget and, most importantly, lack leadership.”

Institutional support and appropriate development policies will ultimately be required for Mexico to both extend its physical telecommunications infrastructure (see Appendix 3) and provide the necessary human capital for rural farmers to acquire, develop and implement the capability to fully exploit technologies. These changes are unlikely to be achieved by market forces alone.

5.2.1 Secretariat of Agriculture, Livestock, Rural Development, Fisheries and Food (SAGARPA)

The Secretariat of Agriculture manages the national funding of rural development, promotes research, and regulates fishing, food and veterinary medicine. It provides information about agricultural development programmes, funding sources and their requirements, and publishes lists of successful applicants. Directives from this Secretariat

have identified individualism as an important characteristic of Mexican culture. Farmer collectivism occurs only in circumstances where there is need of support:

“An idiosyncrasy of Mexican farmers is their not being associative. This is a cultural problem: everyone wants to work independently because there is friction in daily operations. Farmers prefer not to associate with others to avoid problems related to the scope of work, roles and responsibilities. It is common to think that others want to take advantage or act opportunistically.” Director of Methods and Procedures - SIAP

Farmers can access information through SAGARPA’s website and dedicated smartphone applications. Websites operated by SAGARPA offer information on agricultural subsidies, but these are complicated to obtain and secured mostly by larger co-operatives, corporations and rich landowners who can afford the expertise required to navigate bureaucratic waters and comply with technical and business modelling requirements. Funding otherwise only tends to cover basic needs.

5.3 Case Study Outline

Mexico has 107m hectares of viable agricultural land (55% of its total area), of which 22.2m hectares were worked in 2014 (World Bank 2017b). More than half of agricultural production is concentrated into just eight of Mexico’s thirty-two counties: Michoacán (11%), Jalisco (9%), Sinaloa (9%), Veracruz (7%), Chihuahua (7%), Sonora (7%), Guanajuato (4%), and Estado de Mexico (4%) (SIAP 2017a). Major agricultural products include corn, sugarcane, chilli, avocado, wheat, soybeans, rice, beans, coffee, fruit, tomatoes, beef, poultry and dairy produce (SIAP 2017b).

The units of study of the embedded case study described in this thesis were undertaken at two locations (Figure 6): **Case A**: Banana growers from Teapa, Tabasco (The Unión Agrícola Regional de la Sierra del Estado de Tabasco Productores de Plátano, UARSETPP²) and **Case B**: an organic rice grower from Palizada, Campeche (Organicos del Tropico³):



Figure 6 Map of Mexico showing the location of the two case study units presented in this thesis.

5.4 Case A: Banana Growers – The Teapa Model

Commercial bananas (*Musa acuminata*) are cultivated across sixteen states in Mexico, principally Chiapas, Tabasco, Veracruz, Colima, and Jalisco. Production in 2015 was 2,262,029 tonnes (2 percent of global banana production) with 440,808 tonnes (US\$ 181.2m) exported, 76% to the US and 24% to European markets (SIAP 2016, 2017a).

In Tabasco, banana production began towards the end of the nineteenth century, with export to the US documented by 1906 (Contreras-Martinez de Escobar 2014). The

² UARSETPP: <http://www.productoresbananateapatabasco.com.mx/index.html>

³ Organicos del Tropico: <http://organicosdeltropico.com/>

modern economic history of Mexico's banana industry reflects ongoing globalization of the agricultural sector, largely through NAFTA, that began in the late twentieth century. The vanguard in Mexico was led by Carlos Cabal Peniche, a well-known entrepreneur and former fugitive banker from Tabasco who had bought producer and distributor Fresh del Monte Produce following the 1991 collapse of Polly Peck. During his tenure, Cabal transformed production by modernising production technologies (e.g. mechanical pulleys to transport bananas from fields to the packing area, better irrigation, improved sanitation, and the use of plastic covers to protect growing fruit clusters). He opened new markets for Tabasco's growers and encouraged them to establish a packing mill. Still considered a visionary by many, he is currently the owner of San Carlos Company, which has recently expanded banana production into Nigeria.



Figure 7 Map of Tabasco

5.4.1 Site and Participant Selection

Teapa lies 60 kilometers south of Tabasco’s state capital Villahermosa and has a tropical climate and excellent soil fertility. It is home to numerous small- and medium-sized banana plantations (Figure 7), and roadside advertisements for agricultural inputs (agrochemicals, packaging, bags) are everywhere to be seen. Access to domestic and export markets is excellent, via road networks and Mexico’s main ports.

Seventy producers working a total of 10,000 hectares operate as UARSETPP (Table 5), producing 18 percent of Mexico’s bananas (Figure 8); (SIAP 2017b) and forming the town’s biggest employer (SAGARPA 2012). UARSETPP’s entrepreneurial and communitarian approach has, according to its president, contributed significantly to Teapa’s prosperity. Members are supported by a network of small and medium enterprises that have established strong commercial relationships with the growers and which supply inputs like fertilisers, packaging and crop spraying services. They interact daily, either face-to-face or through ICT artefacts (mobile phones, internet, etc.). They do not use e-business marketplaces to exchange goods or services.

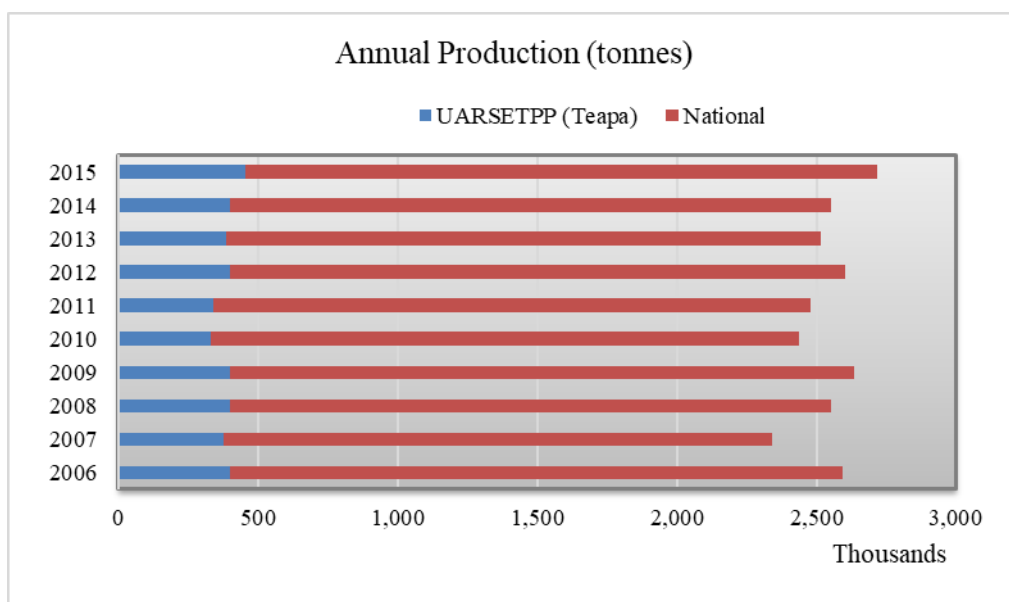


Figure 8 UARSETPP production as a fraction of national yields

I interviewed seven members of UARSETPP (A1 through A7), who between them operate four plantations (one large and three medium-sized). I visited the plantations *Rancho Alegre* and *La Gloria*.

Typology of agricultural producers in Teapa	Number of producers (all crops)	Hectares	Members of UARSETPP*	Interviewees
Smallholders < 50 ha	1,360	13,478	35	0
Medium > 50 < 200 ha	182	18,642	28	6
Large > 200 ha	39	11,612	7	1
Total	1,581	43,732	70	7
Source: INEGI, 2007 Agricultural Census. *Calculated from percentage data provided by UARSETPP				

Table 5 Agricultural producer typologies in Teapa. Typology of producers by size and number of interviewees

A1 [representing brand *Santa Rita*] is a former academic from the School of Agriculture at the Universidad Autónoma de Chapingo. Hired by Carlos Cabal to work for *Produce del Monte* in Costa Rica and Guatemala, he returned to his family's 120-hectare plantation following a reversal in Cabal's fortunes. His plantation employs more than 120 permanent manual labourers and 3 office employees, and his brand *Santa Rita* targets the domestic market through wholesale and retail channels and the export market through brokers. New customers are usually engaged at international fairs. His brother A7 is a lawyer and public notary and also owns a banana plantation; his son A6 manages the family business, having studied Management to degree level and currently pursuing a Master's in agribusiness.

A2 [representing brand *Grupo Alta*] read Accountancy and Finance at the Monterrey Institute of Technology and lived and worked for several years in New York. In 2009 he joined the family business *Agropecuaria Alta* as a fourth-generation banana grower. He

modernised the company, which had for many years been run by his father as a traditional centralised operation. The family owns 630 hectares (130 of banana plantation, 500 of pasture) and employs 130 permanent manual labourers and two office employees. *Grupo Alta* targets the domestic market through wholesalers and the export market through distributors and brokers. Agropecuaria Alta also engages new customers at international fairs. Despite an enthusiasm for ICTs, their business has not seen spectacular growth.

A3 [representing brand *El Refugio*] has worked in the banana business for thirty years and for the past seven has been president of UARSETPP. He sells 70 percent of his production to Europe, which has helped him to manage working capital without speculating on domestic price. He owns 550 hectares (180 of banana plantation, 370 of pasture) and employs 150 permanent manual labourers and 4 office employees. *El Refugio* is predominantly focused on the export market via brokers. Only a small fraction of production is for the domestic market through wholesale channels. He is a strong advocate of international fairs.

Born under humble circumstances in Chiapas, A4 [representing brand *Tony Bananas*] is a self-made entrepreneur who is, unusually, both producer and broker. He first worked on a plantation owned by Carlos Cabal and developed his business through relationships and networks rather than kinship or ICTs. He believes that quality and service are why his brand *Tony Bananas* has so quickly earned reputation since its foundation in 2007. At the time, warehouses in CEDA CDMX bought direct from producers and few traders operated locally. He established a working relationship with the warehouses through his friendship with their truck drivers, and was commissioned by them as a broker to address quality control problems. He realised they were trustable people who wanted good fruit and could pay in cash. With his connections and a business model similar to Cabal's – tenanting instead of owning land – A4 expanded rapidly into banana production and now

employs 420 permanent manual labourers and 15 office employees on 600 hectares of plantation. Production is exclusively for the domestic market through wholesale channels. He received financial support from SAGARPA and from his wholesaler contacts to buy machinery and agricultural inputs. His son A5 is an undergraduate student of Economics, and is also involved in his father business.

	Interviewee A1	Interviewee A2	Interviewee A3	Interviewee A4
Brand	<i>Santa Rita</i>	<i>Grupo Alta</i>	<i>El Refugio</i>	<i>Tony Bananas</i>
Hectares	120	630 (130 banana plantation)	550 (180 banana plantation)	600 (rented land)
Stakeholders	3 (relatives)	2 (relatives)	1	2 (relatives)
Customer channels	UARSETPP, International Fairs, agricultural contracts	UARSETPP, International fairs, agricultural contracts	UARSETPP, International fairs, agricultural contracts	UARSETPP Is both broker & producer
Market	Domestic/Export	Domestic/Export	Domestic/Export	Domestic
Distribution Channels	Wholesale, brokers, retailer and international fairs	Wholesale, distributors, brokers and international fairs	Wholesale, distributors, brokers and international fairs	Wholesale
Employees	3 office employees 120 manual labourers	2 office employees 130 manual labourers	4 office employees 150 manual labourers	15 office employees 420 manual labourers

Table 6 Participant Selection

Family tradition and continuity are important in Teapa's banana industry, with some farmers fourth-generation banana growers. Although they conduct transactions individually, the growers have associated through UARSETPP, which through formal and informal use of technology has helped growers export, track competitors, reduce hazards, and mitigate opportunistic behaviour with ad-hoc collaborative support from other farmers. The association supports its members in other ways, encouraging them to attend international fairs and advocating for co-ordination in production to supply larger purchase orders and annual contracts.

“If my Russian customer puts in a large purchase order and I do not have enough capacity, I join efforts with other producers to complete the shipment.” A3

Seasonal factors aside, banana production is ultimately dictated by plantation size. The plants are perennial, demanding increasing agricultural inputs as they age. Neither crop rotation nor animal grazing are possible. Transactions are frequent and with high uncertainty. They require substantial exchange-specific investments that cannot easily be transferred and therefore favour a formal hierarchical structure of authority and centralised firms. Production is immersed in familial ties and business relationships, with long-term connections shaped by previous interactions.

To be commercially viable, banana production demands a minimum plantation size of 20 hectares, which yields one container (1,560 14kg or 1080 20.5kg boxes) per week. Fixed costs dominate at this scale.

“The typology of banana production is aligned to the size of production unit. A small [plantation] is 20-60 hectares, medium less than 200 ha, and large greater than 500 ha. The mode is about 50 ha. Some growers have more than one plantation. The organisational structure of the plantation is modest and determined by its size.” A1

While most plantations are ~50 hectares, the optimum size for production is 250 hectares; at this scale, a firm better absorbs fixed and variable costs and generates a reliable profit. Agricultural inputs and labour are 55 and 45 percent, respectively, of the total cost of banana production. Technology can be quite advanced, for example tractors, excavation machinery, aerial spraying, and computerised offices and management control systems (costs, payroll, electronic banking).

Banana production is a dynamic local industry, with plantations typically operated directly by their owner. Each plantation has an agricultural engineer (*jefe de campo*) and manager, one foreman for every 20-40 hectares, and approximately one worker per hectare. They have their own packing lines and floor managers.

“We employ approximately 10,000 people on plantations with a total weekly payroll of \$US6m.” A1

Approximately equal numbers of men and women work on the plantation. Women tend to dominate on the packing line where bananas are washed and treated with bactericide.

“Women are more skilful than men at packing. They are locals and they know the difference between a good and the best banana.” A1

Bananas are perishable but can be refrigerated for up to 30 days. The high frequency of economic transactions helps business relationships based on quality, trust, and reciprocity. There is uncertainty in both banana supply and demand but a predictable production glut in summer and autumn that can easily exceed domestic demand.

As commodities with a generalised description, the information needed to specify the banana's attributes is typically simple.

“You compare a green bunch of banana with another and they look the same. You can also compare 1,000 boxes and everything is the same. There is no differentiation except for the degree of maturity [Figure 9] and quality [and variety]. In contrast, cattle can be classified according to breed, colour, size, weight, cattle features, male, female, etc.” A3

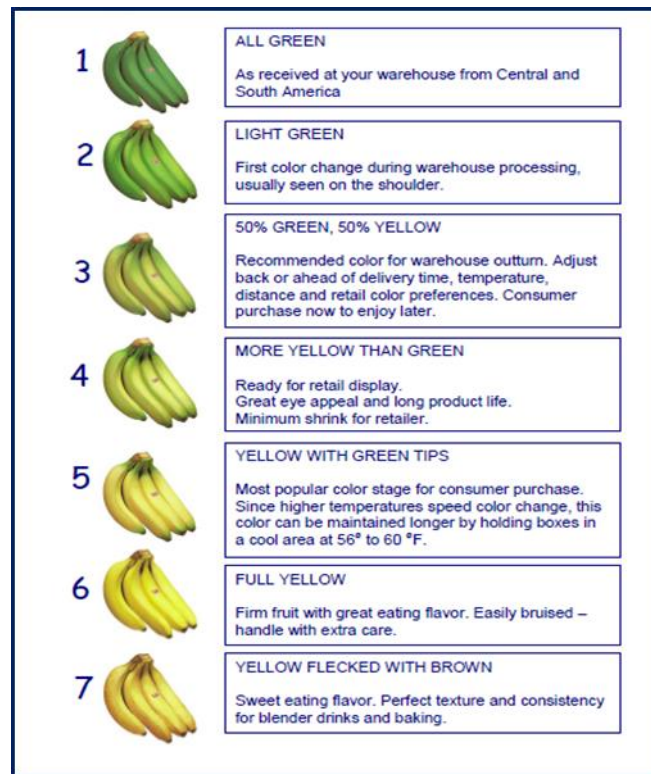


Figure 9 Banana Maduracion (ripening) Guide (Standard Fruit Company, now Dole Food Company)

5.4.2 The Business Process Cycle for Case Study A

5.4.2.1 Production Phase

The agricultural production phase includes three major steps: crop planning; buying, planting and growing seedlings; and harvest, packing and storing.

Crop Planning is essential for the plantation. Farming practices include co-ordinating and controlling end-to-end operations, deciding whether to expand through renting, buying or sacrificing pasture, deciding on the spacing between plants, obtaining finance and agreeing term and conditions with suppliers, preparing or buying tissue-cultured seedlings, buying input supplies, and buying or renting agricultural machinery and services, e.g. crop spraying.

Short-term decisions are driven mainly by operational requirements while longer-term decisions tend to concern the competition, customer base and globalisation. The interviewees were aware of the importance of agricultural contracts and export markets. They use historical and land productivity data to monitor soil fertility, tracking yields following flooding or heavy rain or process modifications. Three of the four interviewees periodically attend international fairs and interact with the export market, recognising the domestic market volatility that A4, with his experience in brokerage, can more effectively contend with.

Input suppliers are an important source of credit for this business. Banana growers maintain close trust-based commercial relationships with offices and warehouses in Teapa:

“There is no signed contract, rather a relationship based on trust and reputation.”

A1

Banana prices are inversely proportional to production. A seasonal decline in the third quarter due to overproduction often causes temporary debts with suppliers, liabilities that should be cleared when yields fall and price recovers (Figure 10); (SNIIM 2017). Nevertheless, as for much of the agricultural sector, financial uncertainty and seasonality remain significant challenges for banana growers.

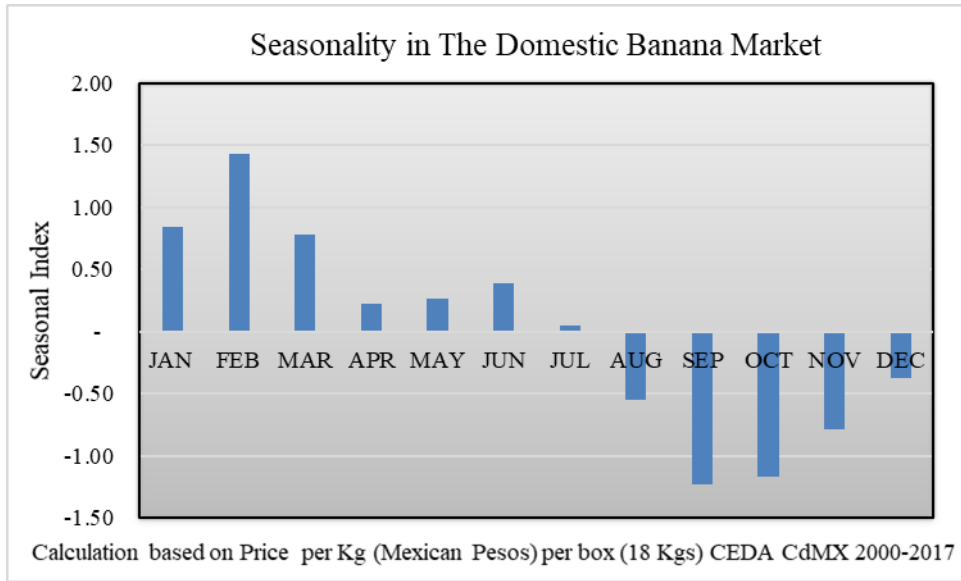


Figure 10 Price seasonality in the domestic banana market

UARSETPP banana yields in 2009-2015 were 62 ± 4 tonnes/ha/yr, consistently more than double the national productivity of 29 ± 1 tonnes/ha/yr (Figure 11).

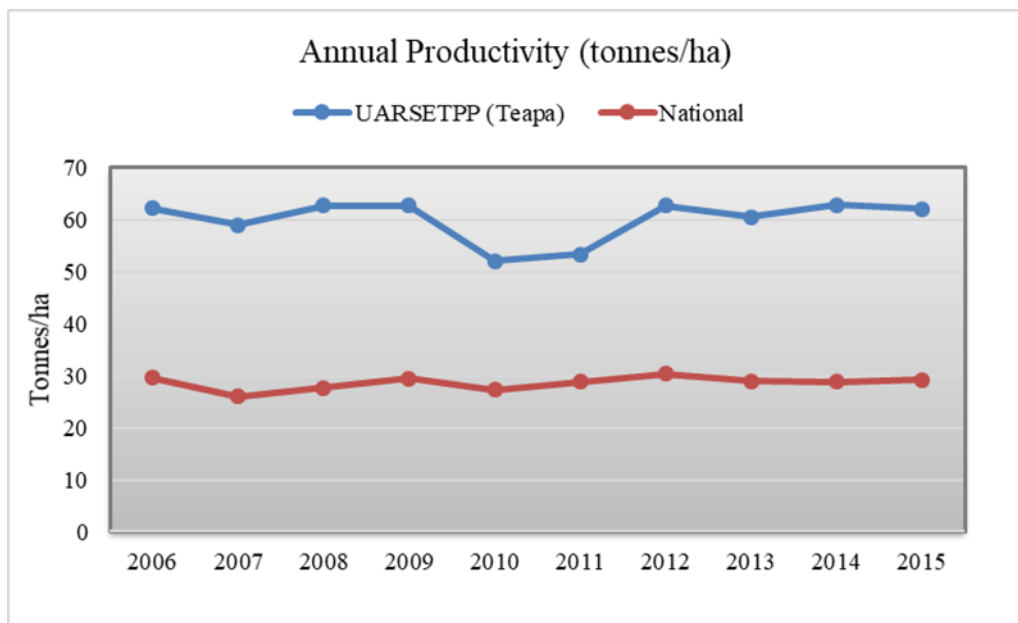


Figure 11 Comparative analysis of banana yields

Buying, planting and growing seedlings. Farmers execute production plans by first preparing the land. Soil is analysed for its nutrient profile and assayed for nematodes, and

crops planted or re-planted as necessary. Fertilisers are applied, banana plants desuckered, the land irrigated where available, and quality control activities implemented (bagging and removing leaves, monitoring growth, and controlling pests and disease).

Local producers specialise in the Valéry and Grand Nain varieties of the Cavendish cultivar. While it is a palm-like plant, fruit production by the banana is unlike that of a typical tree; fruit clusters cut from the plant are replaced by daughter crops. Bananas crop every 15 or 16 weeks in winter's cooler temperatures and as frequently as every 8 or 9 weeks in summer. Manual labour is intensive and automation difficult. 0.8 to 1 man-days are required per hectare, accounting for 45 percent of total production costs. Banana plantations are essentially permanent and crop rotation is not feasible because of its high capital cost.

As for much of the agricultural sector, the grower's immediate priority is yield and quality in the production phase. Preserving soil fertility demands careful control of crop density by both traditional and modern methods and maintaining effective artificial drainage to remove excess groundwater. Plants are spaced to capture adequate sunlight, and are typically replaced every 10 years, reducing the pest and disease burden and hence the cost of agricultural inputs. Tracking precipitation is extremely important; electronic daily records are maintained and modern ICTs provide far more accurate local weather forecasts than traditional radio reports.

“Rain is frequent, but there are periods when we know that the plants will need irrigating. On Rancho Alegre we have an irrigation system and the plants always look vigorous; Rancho La Gloria does not have one so we wait until it rains. This could affect quality...” A6

Nutrient management is intensive, with weekly application of chemical fertilisers by air. UARSETPP producers have grouped to create their own spraying company, an economy of scale that reduces the cost of the plane and chemicals.

“Growing bananas is a very specific production process and the fruit requires a lot of attention to ensure high quality. The fruit is very delicate and requires a lot of attention. Harvesting is manual, which increases the cost of production. Besides this, chemicals and pesticides are expensive. The banana is a perennial that lives about 20 years. This is one reason why it demands greater investment, but it is also one of the most profitable crops.” A6

Fruit harvesting restores some organic matter to the soil, but the plants demand significant fertiliser and pesticide inputs and substantial labour. Crop quality is ensured by following good agricultural practice: selecting and planting good cultivars grown *in vitro*, monitoring soil, replacing sick or aged plants (Figure 12), monitoring recommended practices, and following global news. Most importantly, growers must comply with the standards defined by contract or certification bodies.



Figure 12 *In vitro* tissue culture and plantation regeneration

Many banana growers have integrated production from crop planning through to harvest and packing/storing, absorbing activities as they strive for greater efficiency and cost savings. Some have nurseries to harden *in vitro*-grown seedlings, for their own use and to supply other growers in the association.

“We constantly regenerate and replace old or ill plants. We have our own greenhouse covered with mesh to create shady conditions that mimic the natural environment, where light does not directly reach the daughter plant. We ensure better growth during the early life of the young plant, which will enhance future yields on our plantations because the adult plants will be stronger.” A6

Production and distribution have also been vertically integrated to reduce uncertainties and better guarantee transactions and contractual promises. Former wholesale broker A4 quickly expanded into production by renting 600 hectares, growing fruit to sell to wholesalers. A combination of intimate market knowledge and control of production has enabled him to efficiently deliver up to 35 to 40 containers a week to 15 different customers. Such is the value of network, social capital and reputation in agriculture:

“I learned through acquaintances that a banana wholesaler was looking to buy good quality fruit. I explained that poor quality is an indication of fundamental problems in production, and that there was the need to improve conditions on the plantations. I volunteered to do it and asked them to finance the operation. The wholesale customer trusted me. This is how I started, with financial support from a wholesaler. I rented land and purchased fertilisers and packaging. I improved conditions on the plantation. I possessed know-how because I had worked in banana production since my early teens, doing basic activities such as harvesting and transporting bunches and loading containers.” A4

Further integration of production and distribution has been achieved by disintermediating two traditionally wholesaler roles, warehousing and ripening. One producer had constructed a temperature- and humidity-controlled ripening chamber, adding value to the fruit and increasing revenue because the supermarket pays a better price. Supermarkets are powerful customers, demanding high quality fruit of excellent external appearance and a strictly defined ripeness. Growers need to include ripening if they are to supply supermarkets directly.

“Only very few growers in Teapa add value to the fruit. We need to compensate for revenue loss during the low season by including ripening in our production process.” A1

Vertical integration of banana growers towards end-customers is common. Large firms from the region (e.g. La Carmelita and Grupo Bronco) own warehouses at CEDA CDMX and manage transportation and assist with loading and packing. Significant value is added by properly ripening the fruit. This *maduración* was traditionally a function of warehouses at CEDA CDMX but is increasingly carried out by supermarkets, freight companies or the growers themselves. Producers recognise the importance of adding value for their business strategy and actively seek to invest in onsite ripening chambers or warehouses with these facilities, for both the domestic and international market.

Harvest, Packing, Storing. When bananas are ready for harvest they are selected, picked, washed and cleaned, packed, stored and ripened, then transported to their destination.

Quality (size and appearance) is achieved through a combination of tacit knowledge and good agronomic practice: appropriate plant density, adequate irrigation and drainage, good fertiliser use, protection of growing fruit clusters with plastic bags, and skilled

pruning. Freshly harvested bananas must be transported quickly but carefully from the field to the packing line and packed skilfully to avoid mechanical damage. Road transport must be on the best roads available. A supervised and carefully controlled co-ordination of production, packing, and transportation processes is essential:

“The foremen and I supervise selection of bananas. Sometimes workers assign the wrong bananas to a client.” A6

Harvesting demands tacit knowledge: it is manual and follows long-established criteria for crop readiness. Fruit clusters are covered with a polyethylene bag before removal and the topmost hand discarded. The cut bunches are protected from mechanical injury by polyethylene padding and carried to the processing plant by steel cables suspended across the plantation. This ensures workers do not need to walk long distances with freshly cut fruit.

“No machine in the world can go inside the plants and do the manual work required. There is very limited mechanisation. We know this because we are in contact with large multinational companies like Chiquita Brands International and Produce del Monte which outsource from this region: they share their production practices with us. They advise us on how to improve quality and select the right bananas. We are entirely reliant on manual labour.” A2

Proper packing is important because the banana bruises easily. An attractive external appearance is a basic requirement in the business: bananas must reach their destination green and firm. Fruit that is overripened in *maduración* will usually be discounted and erode the grower’s credibility.

5.4.2.2 Distribution phase

Selling follows harvest and involves the exchange of the agricultural produce for money. A1, A2, A3 and A4 all possess their own trade brand (Table 6): *Santa Rita*, *Grupo Alta*, *El Refugio*, and *Tony Bananas*. Their customers are a mix of domestic and international.

Distribution Channels

Scenario	Trade Fair	Broker	Wholesale	Internet	Distributor	Retailer
1. Wholesale			X			X
2. Broker		X	X			X
3. Supermarket						X
4. Export Broker	X	X			X	X
5. Export Distributor					X	X

Table 7 UARSETPP Distribution Channels.

Distribution is predominantly through traditional intermediaries more exposed to the uncertainties of supply and demand.

The first three scenarios in Table 7 are for the domestic market. Scenario 1 is direct sale to the wholesale market and the most important distribution channel for UARSETPP members (Figure 13). Negotiation is with a wholesaler who controls end-to-end distribution. Terms and conditions are typically 1-2 weeks' credit.

“The wholesaler adds value to the fruit. They have a ripening chamber to make the fruit yellow. They can keep it green for up to 40 days, depending on wholesale commitments.” A2



Figure 13 The banana section at the wholesale market - CEDA Mexico City

Aside from A4, who integrated backwards from brokerage into production, UARSETPP growers avoid broker-mediated sales (Scenario 2) unless there is an urgent need to sell produce quickly. Brokers pay in cash, but their commission reduces margins. This shows an individualist and opportunistic approach. Farmers use middlemen on an ad-hoc basis outside of long-standing arrangements.

“They [brokers] have connections and tacit knowledge of the market while growers have production know-how.” A2

In Scenario 3, the producer adds value by ripening the fruit himself and selling direct to a retailer, a disintermediation of the wholesaler. Supermarkets offer better prices and longer terms, determining spot prices weekly rather than offering annual contracts. But to supply supermarkets, growers must plan at least 10 days in advance to ensure that fruit

reaches the optimum *maduracion* state for display. Fruit is removed from refrigeration at stage 3 and shipped at stage 4, for supermarket display at stage 5.

Banana consumption in 2013 was 11.9kg per capita globally and 14.1kg per capita in Mexico⁴. Repeat domestic buyers are the main source of revenue for UARSETPP's growers: domestic consumption in Mexico has remained steady since 2007, but despite a 10% increase in global consumption between 2007 and 2013 the number of growers in Teapa has remained steady. The only new entrant into production was A4, working existing plantations. Some producers have converted pasture into additional banana plantation. Suppliers, producers and customers know who is who in the domestic market.

“All the producers have known each other for years. The only new producer is A4, but we already knew him because he was a broker. He integrated his operations. He rented land and supplies customers with his own bananas, and sometimes buys fruit from other producers.” A2

Scenarios 4 and 5 describe distribution channels for the export market. Growers are increasingly inclined to sell to export intermediaries who offer longer-term contracts. Growers sell to export distributors and large agribusinesses directly or via brokers. Often meeting at international fairs, potential export buyers will first visit UARSETPP and its plantations. In 2016, twelve UARSETPP producers contracted to supply Chiquita Brands International Sàrl, an international agribusiness corporation. Corporate agribusinesses are large companies owned by shareholders, officially recognized and registered as such. They are grouped into two categories, unlisted private companies owned by family members or partners, and public companies whose shares are traded on stock markets. Private agribusiness companies can be very large, including Chiquita Brands

⁴ <http://www.helgilibrary.com/indicators/banana-consumption-per-capita/world/>

International Sàrl (Evans 2014). Corporate agribusiness acts as a distributor, buying from producers around the world.

“The contract with Chiquita is FCA, we are responsible for production and harvesting and the labour for packing. They are responsible for land and sea transport, from the ranch to the port and from the port to the final destination.”

A2

Mexico’s banana exports have been transformed by a free market that has brought greater flexibility in export and low-cost international transportation.

“In the past, we needed to send over one hundred containers [each of 22,000kg] per shipment to Europe. Now we can export five containers per week.” A3

Export is attractive as contract farming because it reduces market uncertainties. UARSETPP recommends its growers export at least one third of their production through contract farming.

“It is our objective to make Teapa an exporting municipality.” A6

Each farmer signed independently with Chiquita. The need to satisfy the challenging export market has encouraged collaboration between suppliers, producers, and customers. It has become an important avenue to improve internal processes and the quality of the agricultural produce.

“Chiquita Brands International’s technical advisors visited our plantation. They identified ways to improve production and offered recommendations. For example [a previous method of bagging growing clusters in a torch shape] damages the banana. They suggested that we instead bag them in a conical form to keep the bunch symmetrical and avoid pushing banana fingers to one side.” A6

The importance of these sales illustrates the significance of outsourcing and agricultural export contracts with commercial partners.

“Our goal is to match banana supply with international and especially European demand when the domestic market is saturated. We not only help the national economy, but also those producers who focus on the domestic market.” A3

5.4.3 Adopting and Enacting ICTs

While traditional farmers have historically preferred to invest directly in production to improve quality and yield, planning and control remain important elements for decision-making in banana production. ICTs have been adopted and enacted along the end-to-end business process not only to plan and control production, but also for intra-cluster cooperation, for negotiation with customer and suppliers, and for internal and external communication. They have blurred the boundaries of the agricultural business process. For example, in outsourcing negotiations with Chiquita Brands International Sàrl, many meetings were face-to-face but formal communication and the distribution of minutes was by email. Informal communication (voice, text messages, photos, video) has become increasingly common, via instant messaging platforms like WhatsApp, where producers have created groups for communication.

Farmers who export are more conscious of the advantages that the internet offers. ICTs have influenced their decision-making process through management control systems that allow them to monitor and evaluate performance, profitability, and investment performance. Production KPIs permit comparison and standardisation of processes, and cash flow plans identify gaps and allow farmers to implement contingency plans to reduce operational risks and uncertainties.

“The internet helps us more for production and less for marketing. It does not bring us more customers [note: this contradicts other growers]. It is useful for finding suppliers, for finding literature about agricultural inputs, for Wikipedia, for satellite data, and for weather forecasts.” A1

Members of UARSETPP are surprisingly heterogeneous, as evidenced by their different expectations of ICTs. Some have reduced uncertainty by exporting to international markets under long-term contracts; others have consciously avoided exactly these long-term fixed-price contracts, instead operating under a more domestic market-driven mode of operation. ICTs have delivered operational benefits through learning and co-operation and allowing farmers to better monitor production costs.

The family that owns *Santa Rita* operates two banana plantations, *La Gloria* and *Rancho Alegre*. They have no plans to expand production in the short-term. They have implemented management control and payroll systems, irrigation tracking and control, and electronic banking with customers and suppliers, and have recently begun to test drones to monitor plant health. According to them, ICTs provide control, stimulate business growth, and improve personal safety. They recall the changes that followed the provision of internet access:

“We have recently invested in ICT infrastructure. We used to communicate with personnel on the plantation through two-way VHF radio. Now we have the internet. It was more complex than contracting from an internet service provider because we had to install a microwave transmitter base station on one of the ranches. But it was a wise decision to have ICT services on the plantation because the management team is there.

We control costs and maintain contacts with input suppliers and customers. We calculate the weekly payroll. The payroll software allows us not only to calculate weekly salaries, but also to monitor worker productivity. The management control systems allow us to record yield, boxes packed and shipped, variable and fixed costs, etc.

We implemented payroll debit cards at the beginning of 2016 and this was a very useful change. The main reason for implementation was security rather than cash flow control. But now, I certainly recognise that it helps us control it. Thanks to it we have reduced cash use on the plantation. We eliminated the risk of robbery, which has happened to other growers. It is not uncommon. Very often we learn from someone who lost their payroll on the way to the plantation or on the plantation itself. I am very happy with the results, and the management team is, too. I was responsible for implementation and we achieved it.

It was very difficult to implement. Workers were resistant to change because they must now collect their salary in Teapa; but in reality they were reluctant to use the cash point because they didn't know how to. But they quickly learned, they are mostly young people. We were adamant that this was the only way to get paid, and little by little we implemented it. We still pay a small number of workers in cash, people from Chiapas who only pick fruit.

We purchase fertilisers, packaging and other agricultural inputs locally. I searched on the internet for the cheapest input suppliers near Teapa and in the US. A significant limitation is that they are large distributors and want large purchase orders. UARSETPP is also one of our suppliers, through which I purchase box staples, bags, and so on. Typically, suppliers organise events to

promote their products, they visit plantations, provide samples, or invite us to lunch or dinner. They also promote their products through email.

When we need to purchase an agricultural input, we confirm stock availability and negotiate by phone. We pay electronically through bank transfer and they deliver. If they cannot deliver the same day, they usually ask if we want to collect it, otherwise they deliver the next day. Electronic banking is the closest we have to electronic commerce, but negotiation and bargaining is verbal. We use the telephone because it's easier than using email. There is also a difference for this type of transaction because we don't need to pay cash in the shop and it is safer.”

A6

“There has been an evolution in ICTs. Email and technology convergence are fundamental to the exchange of goods and services in our business. It gives us mobility and the capacity to react wherever we are. We didn't have this before. It helps us to control the operation. Moreover, you don't lose the opportunity to negotiate and communicate because we have the means in our hands. It is an opportunity.” A1

Plantation *El Refugio* is owned by A3, the president of UARSETPP. Most of its bananas are exported and the farm has integrated horizontally into cattle breeding. Decentralisation, lower search and negotiation costs, and KPI and personnel monitoring have reduced asset specificity and superior cash flow forecasts have reduced uncertainty. Land is being increasingly diverted from grazing as banana exports grow.

“We have internet access on my ranch, and a mobile phone signal. The plantation and management team work in my absence. I believe that delegation is necessary and ICTs help. All transactions are paid electronically, including the payroll. For

security reasons, we no longer use cash. I have also installed cameras on the ranch and at home. The cameras are necessary for supervision.

Computer systems generate weekly and monthly reports with KPIs of production, shipments, packing, and personal productivity.

My mobile phone gives me mobility. It is an indispensable service. I use ICTs for sales, purchasing, emailing, and for transactions and negotiations.

ICTs have helped speed up operations. Financial intermediation has disappeared, we no longer need credit letters, for example. European payments are direct from the broker. They process payments on Mondays and I receive them on Wednesday. We communicate through the internet and email. Email is more important because I can carbon copy several people and receive confirmation when they have read it. I use WhatsApp for suppliers and local customers.” A3

Alta Group has also integrated horizontally into rearing cattle. Its management has evolved from old-fashioned centralised decisions guided by intuition and tradition into a much more ICT-dependent system with modern management control, KPIs, cost controls, electronic banking, tracking systems, and closed-circuit cameras for security.

As with other growers, ICT changes and their impacts at *Grupo Alta* have primarily been to the production phase. Distribution effects are less obvious and access to markets is via the same traditional distribution channels, although they now communicate through novel ICT artefacts. *Grupo Alta* has agreed a long-term contract to deliver bananas to an international agribusiness, which should reduce uncertainty and stabilise revenues, a gentle “move to the network” form of organisation. Despite implementing multiple ICTs and introducing more sophisticated process controls, it has not achieved major business

growth and does not expect to expand production. This should not be interpreted as a failure of ICTs, however: production is ultimately constrained by available land.

“I implemented management control systems in the company, including inventory control and HR systems. Software is from Compaq and enables us to manage multiple locations: office, warehouse, dairy, packaging plant. Nothing offers better customisation at our level. ERP [enterprise resource planning software] is more suitable for larger businesses.

I use Excel for reporting because it is easy. My everyday ICT kit comprises four devices: a tablet [iPad, Apple Inc.], smartphone [iPhone, Apple Inc.] and smartwatch [iWatch, Apple Inc.]. I do almost everything with my smartphone. I can transfer money using my iPhone, but I can also use my iPad. I use a laptop if I'm working for two or three hours, checking reports in Excel. The tablet has replaced my chequebook, notebooks and camera. Tracking software allows me to monitor my cattle – their sex, their age, and where they are housed.

I also have CCTV cameras. Sometimes people need to be monitored. If the owner is not there, employees do as they please.” A2

Tony Bananas is operated by broker A4 who in 2007 expanded into banana production, tenanting 600 hectares of banana plantation. Rapid growth was possible with investment from a wholesaler he had previously sold to and worked with as a broker. He has implemented ICTs and modern control processes:

“I have 15 employees and more than 400 workers. We have a centralised system in the office. We use Excel to monitor production costs and have begun to use a computerised system that combines accounting, payroll and supplier and

customer handling. The system was customised for the needs of our company by a systems engineer.” A4

Surprisingly, while he was the primary contact between UARSETPP and multinational Chiquita Bananas during their contract negotiations, A4 declined to participate in the resulting supply agreement. In interview, he was adamant that the market offers a superior mechanism for business growth. How can we account for this apparent paradox, the reluctance of one of UARSETPP’s largest growers and closely linked to a multinational, to commit to an annual contract with that multinational despite nominal benefits for the grower and encouragement by ICTs? The reasons are complex, a colouring of rational economic decision-making by social obligation. Given his history as a broker and financing by a wholesaler, it is perhaps not surprising that his preferred form of exchange should be the market. Persistence with this organisational mode has been encouraged by the trust, relationships and reputation he accumulated in the distribution channels where he was (and continues to be) a broker. Indeed, the market is his network, and likely the optimal economic organisation for his business.

5.5 Case B: Organic Rice Grower – The Palizada Model

The second unit of study describes a more radical and innovative business that has introduced new cultivation techniques and pursued novel distribution channels, both supported by the prominent use of ICTs. A network mode of organisation has been important, for this small firm has needed to build relationships outside the local region. Facebook and YouTube have proved useful to reach new customers, especially the middle classes.



Figure 14 Map of Campeche

Intensive rice cultivation began in Palizada during Mexico's so-called Green Revolution in the 1960s that saw the adoption of modern crop varieties and agricultural technologies like mechanisation. Palizada has several geographical advantages for rice production, including favourable terrain and a hydrographic network that provides access to Laguna de Terminos and Gulf of Mexico ports. It sits on a large basin that drains the nutrient-rich Salsipuedes, Blanco, Usumacinta and Palizada rivers (Figure 14). River sediment and artificial irrigation created ideal conditions for growing rice, historically on larger-scale plantations, and which peaked in the 1980s.

Organicos del Tropico is a family-run organic rice grower that has adopted ICTs to expand its presence in the domestic Mexican market. Its customer base has grown through the exploitation of traditional distribution channels and the effective use of the internet and especially social media. Despite recognising that ICTs can support market mechanisms, the owners believe that a network mode of operation through longer-term agricultural contracts and active use of social media will mean more efficient exchanges and better safeguarding of their plantation's future.

5.5.1 Site and Participant Selection

Palizada is a town where the gulf in wealth between rich and poor is substantial and where one's family name is important, especially for local politics. Land ownership is especially unequal, with 73% held by just 115 landowners (Table 8). Since changes to Mexico's constitution under Carlos Salinas de Gortari in 1992, every local democratic election has been won by this landowning elite. The local economy is stagnant and popular resentment is rife, particularly over perceived limited job creation, with landowners accused of discouraging competition that might jeopardise their interests.

The town's population of 8,352 (INEGI 2010) is dispersed, which has created problems for access and utilities penetration. Annual population growth in the municipality was just 0.3% between 1960 and 2010, lower than the national rural average (0.7% rural, 3.1% urban; (INEGI 2010; World Bank 2017b). There has been significant migration to richer and less socially constricted urban areas, and Palizada's traditional agrarian social structure has survived largely intact.

The land around Palizada was once highly fertile, and 60000 hectares of woodland were cleared for grazing and rice production in the early 1970s. However, poor oversight exhausted soil fertility and just 5000 hectares remain productive today. Infrastructure

built at the peak of rice production has been largely abandoned: even the once wealthy rice growers' association has gone. The region has failed to take advantage of globalisation and the opening of markets in the first decade of the twentieth-first century; agricultural produce has often been left to rot unharvested, and local rice yields were 24±6 percent below the national average (3.5 vs 4.6 tonnes per hectare over 2003-2012; (SIAP 2014). The smallholders interviewed during my preliminary fieldwork reported problems with distribution channels because of corruption, weak infrastructure, unreliable pricing information, and inadequate planning support and training.

Operated by a fourth-generation farmer, *Organicos del Tropico* grows organic rice for sale to domestic supermarkets and organic stores and demonstrates just how effectively ICTs and especially the internet can be for business development in the agricultural sector. Mirroring some UARSETPP banana growers, *Organicos del Tropico* has integrated buffalo livestock alongside its primary arable crop. While it is a smaller plantation at 400 hectares (a rotating system of 100 hectares for organic rice cultivation and 300 hectares for grazing), through the active and effective use of ICTs it has migrated from failing conventional rice production and succeeded in identifying novel markets, joining Mexico's nascent organic food industry. I interviewed the owners over the summers of 2015 and 2016.

Typology of agricultural producers in Palizada	Number of producers (all crops)	Hectares	Ha/producer	Rice growers interviewed
Smallholders < 50 ha	1,154	11,552	10	0
Medium > 50 < 200 ha	182	17,975	99	0
Large > 200 ha	115	78,557	683	3
Total	1,451	108,084	74	3
Source: (INEGI 2007)				

Table 8 Agricultural producer typologies in Palizada. Typology of producers by size and number of interviewees.

The owners of *Organicos del Tropico* come from a landowning merchant family that is still politically influential. B2 is a stakeholder in *Organicos del Tropico* and former conventional rice grower. His current project is palm oil, cassava and yam production using technical support from experts in Brazil and Colombia. He also hopes to establish a naturopathic health retreat, for which he has received virtual training from the Czech Republic. Although both projects are still inchoate, he was keen to discuss what he considered to be the essential role of ICTs. He argued that transformation of his farm has been entirely because of ICTs and especially the internet, complaining that Mexico's weak rural infrastructure is perpetuated by a reluctance of technically skilled individuals to live in the countryside. He described returning from his undergraduate degree at Monterrey to a family ranch that was supplied with neither electricity nor running water. It convinced him to leave for the city. Better provision of utilities would encourage the best educated and skilful to stay today, he believes, despite weak local schools.

“Younger generations can stay where they were born, if their houses are ICT connected.” B2

His son, B1, founded *Organicos del Tropico* and is another strong advocate for ICTs in agriculture. Having graduated from the Monterrey Institute of Technology and Higher Education where he participated in an incubator entrepreneurship programme, B1 joined his father's business in 2001. At the time, Rancho Pancho Villa had no internet access, necessitating regular 20-mile journeys to the nearest town. In 2003 they invested in a satellite-based internet connection.

B3 was a visiting engineer from their internet service provider.

B4 is B2's second son and has recently completed an undergraduate degree in Industrial Engineering. He supports B2 in his new agricultural ventures.

Capital, knowledge and land are the principal assets needed to grow organic rice. While *Organicos del Tropicico* works a relatively modest 400 hectares, the family owns 3,000 more hectares of pasture, forest, and wetland. Two thousand head of buffalo graze rented land and complement organic rice cultivation. In 2016 the rice plantation had 3 employees and 25 workers, and six cowboys managed the buffalo, supported by a veterinary surgeon and technical manager. *Organicos del Tropicico* was started with private funding from the family and prefers financial investment and support from customers rather than banks.

"If I want to expand production capacity I need more land and capital. I can rent [additional] land from my father, helpful if business expands." B1

Transactions are dominated by asset specificity (land, capital, production process, technical and human knowledge, organic registration), and distribution requires certified warehouses. Exchanges are much less time-sensitive than for bananas: packed rice can be stored for at least a year.

End-consumers tend to purchase organic rice from specialist shops and high-end supermarkets, with whose purchasing departments organic growers often deal directly. Only simple information is required to describe the rice's attributes. Grains are dehusked in mills and on some plantations are precooked to add value. Differentiation into organic production commands a premium but reduces yields and requires appropriate labelling, transport and storage.

5.5.2 The Business Process Cycle for Case Study B

5.5.2.1 Production Phase

Crop Planning. In contrast to commercial banana cultivation where cultivars are few and plants perennial, rice growers must select rice varieties annually. *Organicos del Tropico* works land previously used for the cultivation of conventional rice, a practice that had declined due to falling soil fertility and productivity.

“My father stopped producing conventional rice because it was no longer profitable. At the time, he owned 5,000 hectares and managed a co-operative of more than 20,000 hectares.” B1

The management team plans production, control and sales.

“I primarily look after larger accounts but try to delegate as much as I can. In rural areas is difficult to find personnel with the right qualifications.

It is also very important to generate cash flow to pay employees. My goal is to earn a good salary in the company.” B1

Although B1 considers the domestic market for organic rice to be almost saturated with his brand already sold at most major national supermarket chains, he plans to expand production. Contract negotiations are underway with HiPP GmbH & Co. Vertrieb KG, which approached *Organicos del Tropico* through its website and appears to be willing to invest as a business partner. B1’s goal is become a major supplier of japonica rice, a shorter-grained and stickier variety than the more commonly grown indica and more suitable for baby food. There is already some japonica cultivation in the USA, mostly in California, but rice production is cheaper in southern Mexico where labour costs are lower and climate conditions more favourable. HiPP has funded a pilot project with *Organicos*

del Tropico to trial varieties more suitable for Palizada's tropical climate. Planting began in January 2017.

"We are trialling twelve different varieties of japonica rice. We began with 100 grams, then 15 kilograms, and then 300 kilograms of each variety. I have allocated 20 hectares." B1

"More financial resources are needed to expand production capacity. We need a contract because the funding [requirement] is higher. With this we could expand production three-fold." B1

Buying, planting and growing seedlings. At *Organicos del Tropico*, this requires sourcing of organic seeds and fertilisers. The production cycle for rice is much longer than for bananas, with harvest and distribution every 4-6 months rather than weekly.

Organic rice production requires specialisation and tends to be carried out by younger farmers.

"We don't disregard the possibility of competition, but it perhaps won't happen in the short term." B1

Organic rice can be produced year-round with land rotation (alternating with buffalo grazing) using appropriate irrigation and organic fertilisers. Under previous conventional agriculture, they also kept sheep, rotated legumes, and used vegetable compost and rock minerals, but soil fertility declined and the business was loss making.

Organicos del Tropico's buffalo herd is growing in number, and they consult online resources on buffalo production. They have delegated part of herd management to a community of Mennonites on the neighbouring 4,000-hectare ranch *El Salvaje*.

Harvest, Packing, Storing. After harvest, rice is dried, cleaned, milled, and stored in silos. The infrastructure for this already existed, having been developed for conventional rice processing. In 2015, organic rice production was profitable, with production costs of \$MX21/kg and a supermarket strike price of \$MX\$35/kg for final sale at a minimum of \$MX45/kg. Partly because it is considered a gourmet or luxury item, the supermarket mark-up for organic rice is approximately double that of conventionally grown rice. Nevertheless, farm profitability is good.

The farm is integrated. They own water abstraction, irrigation and drainage systems, a mill to dry and thresh rice, and silos for storage, all of which had been installed three decades earlier for conventional rice cultivation. Rotation with buffalo grazing helps to preserve soil fertility. Importantly, they possess tacit knowledge, having grown rice conventionally since the 1980s.

“For commercial agriculture, land, irrigation, capital and knowledge are inevitably the most important elements. Had I had given my son unirrigated land it would have been difficult for him to succeed. He is now collecting the benefits because the land is ready. I told him that I was going to prepare the soil [with organic matter] because he lacked the tools, knowledge and capital. He could learn this and focus on the final phase, marketing and sales. And he succeeded.”

B2

Through appropriation of distribution activities that rice growers (conventionally forwardly integrated) have usually delegated to external actors (e.g. drying, milling, and packing), *Organicos del Tropicó* adds value and can more easily exploit novel distribution channels.

5.5.2.2 Distribution phase

Selling

B1 meets potential new customers at organic food fairs and, since 2012, through the internet.

Distribution Channels

Selling organic produce is complex, requiring certification of both production and warehouses. He has created his own brand of *Pijije* rice, named after a local duck (Figure 15).

Scenario	Trade Fair	Broker	Wholesale	Internet	Distributor	Retailer
1. Domestic supermarkets					X	X
2. Domestic organic retailers	X					X
3. Social Media				X		X
4. Company webpage				X	X	

Table 9 *Organicos del Tropico*: Distribution Channels

At present, *Organicos del Tropico* exploits four principal distribution channels. The first scenario in Table 9 describes a relationship with domestic supermarkets via the distributors Campo Vivo and Aires Del Campo (Herdez), selling supermarket own-brand and *Pijije* rice. Distributors usually buy from multiple suppliers to generate economies of scale. The second scenario describes distribution to specialised organic retailers encountered at trade fairs, mostly independent stores on the Yucatan peninsula. For these customers, buying directly from a farm is more convenient and cheaper than purchasing

through a distributor in Mexico City. The remaining scenarios are non-traditional and demonstrate how social media and a webpage respectively have enabled *Organicos del Tropico* to reach new customers both domestically and abroad. Approximately 10 percent of their total customer base has been acquired through Facebook, a partial disintermediation and escape from traditional distribution channels.

5.5.3 Adopting and Enacting ICTs

This case study demonstrates a positive contribution of ICTs towards overcoming isolation in rural areas. Developing network modes of collaboration has had a direct impact on customer base growth, assisted by extensive application of ICTs. *Organicos del Tropico* has created a website to attract new customers, they participate in online courses, and they use social media to communicate with producers in other parts of the world (Figure 16). ICTs have assisted an entrepreneurial escape from tradition and conventional agricultural production without abandoning local or family collaboration. This is key: longer-term agricultural contracts require capitalising on traditional principles of family obligation and support, as B1 will need to work more of his father's land to expand his business relationships with larger corporations.

B2 was a conventional rice grower who is divesting into palm oil, cassava and yams. He recounts his trajectory and experience with ICTs:

“I helped bring rice production from the north of [the county of] Campeche to Palizada. After graduating as an agricultural engineer, I was offered a job by the governor of Campeche. I was responsible for agriculture. It was a high-level position. My original plan was to learn, and I realised that there were many opportunities. I travelled across the USA to study rice production processes and

became a subject matter expert. At University, I had focused on cattle, but recognised that rice production was better for regional development.

Most important was helping growers with capital. I obtained significant credit from the World Bank that benefited many farmers in the region, and approximately US\$200m was invested in the area. Palizada has the most important of natural resources, a highly fertile plain with basin drainage.

[The land had already been deforested] by cattle farmers and timber merchants many years ago. Investment was mainly in rural roads. Farmers had to build their own irrigation systems... I installed one on my ranch, which has helped to enhance yields and has also increased the value of the land.

Communication has always been important for agricultural trading. I have witnessed the improvement of ICTs over the past 60 years. My father was a merchant in Palizada. The telegraph was his counterpart to the internet, and he sent an average of 100 telegrams every day to customers and suppliers, and would receive the same amount too. He also had a two-way VHF radio. Every morning at 5am he spoke to the captains of his two riverboats to supervise them and ensure his instructions were clear and transactions were carried out accordingly: his business survived for more than 30 years.

Communication tools have evolved and we have now a wireless communications station on the ranch. We use text messaging, WhatsApp, email, and so on. But the essence of communication remains the same, we need to communicate if we want to sell. We now use more advanced technology aligned to the requirements of trade. Logistics are better organised. For example, input supplies are delivered to us faster, this is a change.” B2

ICTs have helped (and hindered) businesses for many years. It is not surprising that ICT artefacts have largely or completely superseded obsolescent or obsolete technologies like surface post and the telegram.

Serendipitously, while interviewing B1, an ISP engineer (B3) was conducting maintenance on the farm's satellite-based internet connection. He explained that demand for internet access in rural southern Mexico is mostly from younger people and has increased alongside Facebook's growing popularity. There are many *ejidos* or small villages (e.g. Mactun, Balancan, El Aguila, El Triunfo) where young people have requested broadband purely to access social media platforms. Many people want wireless broadband to connect with each other rather than with schools or businesses or government services.

“In Mexico's marginal areas where the poor live, people don't care about school. They only care about people living in the US. They want to communicate with them and imitate them.” B3

A purely social goal perhaps, but a starting point that can later be adapted for business.

As discussed above, *Organicos del Tropico*'s customer base comprises both traditional and non-traditional distribution channels. The owner recalls how he approached his first customer:

“Unifoods⁵ supplies milk to supermarkets. I contacted the owner at the address on the carton, he replied and agreed to meet me. He was starting a company called Aires del Campo to sell organic produce. He introduced me to this new company.

⁵ <http://unifoods.com.mx/>

So in this case, a business relationship started in a traditional manner: product and market research, and relationship and network building.” B1

Creating a company website in 2012 stimulated turnover by offering another route of contact for customers (e.g. distributor Campo Vivo⁶, which now supplies *Organicos del Tropico*'s Pijije brand to supermarkets). This is a clear demonstration of the positive contribution implementation of ICTs can make, a direct impact on customer base growth.

In Table 10, I highlight the milestones achieved by B1.

⁶ <http://www.campovivo.com.mx/>

Year	Event	Implications
2001	Graduated from Monterrey Tech	Entrepreneur - incubator module
2001	Ran a pilot project of rice production and crayfish farming.	Became familiar with organic production and its challenges but could not generate economy of scale
2001	Began growing organic rice	Searching for distribution channels and breakeven point
2002	Produced organic cheese	Uneconomic: ceased after one year
2003	His mother suggested to expand organic rice production to differentiate from the competition	Accompanied his father to Rio Grande do Sul to train further in rice production. They temporarily hired a consultant
2003	Received certification as an organic plantation	100 ha rice and 300 ha of pasture (600-700 head of buffalo)
2003	Invested in ICT to bring internet access to the farm	A satellite internet link was installed
2003-2006	Sold organic rice to a company in Mexico City that distributed to their own shops.	Looking for alternative channels, B1 created his own <i>Pijije</i> brand and started selling to supermarkets
2006-2009	Began selling to a company that made rice syrup.	The syrup company would quit the market in 2009. By this time however, 50% of rice production was being sold to supermarkets and brokers
2009	Change in customer mix	30% of capacity sold as <i>Pijije</i> rice through distributors Campo Vivo and Aires del Campo
2010	His father B2 ceased conventional rice cultivation because it was no longer profitable	Up to 10,000 ha of land are available to rent from his father
2012	Implemented a company website	Now in constant contact with his customers
2012-2015	Expanded customer base	Largely on the Yucatan peninsula
2015	Contacted by a significant potential European customer	A representative from HiPP GmbH contacted B1 through his webpage. A base station and microwave transmission system were installed to provide a wireless signal over the whole plantation
2016	Developing a new product for HiPP GmbH	Began trial production of japonica rice on 20 ha.

Table 10 Timeline of B1's career and the history of *Organicos del Tropico*



Figure 15 Pijije brand rice



Figure 16 The company's website, at <http://www.organicosdeltropico.com>. Communication with customers is via email, Facebook, and YouTube

Chapter 6. Analysis

Analysis was conducted for each unit of study to address the research sub-questions: How do farmers come to know about ICTs and make decisions about their adoption and implementation? What type and form of ICTs are used by farmers? How do ICTs impact farming? Who are the beneficiaries? Are there losers? The main themes are grouped as follows: the discovery, adoption and implementation of ICTs; their classification by typology, form and enactment in production or distribution; and their impact – the beneficiaries and the losers.

6.1 Case A: Banana Growers – The Teapa Model

6.1.1 The Discovery, Adoption and Implementation of ICTs

6.1.1.1 Learning from other actors

Farmers adopt and learn how to use ICTs by interacting with other actors in the operation of their business. They maintain a reciprocity that is compatible with the pursuit of self-interest using connections with family, business partners and long-term ties, trusting information that comes from sources they know well. Banana growers possess significant knowledge of and specialisation in both production and distribution, a know-how that is accumulated over years from foundations typically learned through involvement at the operational level. Tacit knowledge is not limited to an individual task but is applicable to a wide range of activities:

“Knowledge improves by sharing experience with people. Relationships and contacts between producers are always important as an instrument of socialisation and for benchmarking. How do you perform a task? What results do

you have with that agricultural input? To whom did you sell it? How much did they pay you? There are people who you trust more than others. Especially when you talk about price there are people who like to be very boastful, and you realize they are exaggerating but socialisation definitely occurs.” A1

“Agronomists can have general experience and be good in their field. But this does not mean that they know anything about bananas! This business requires specialisation. They need to learn this in the production process, by working on the operation. The same applies to becoming a market expert, usually a self-made role. People build expertise and knowledge by interacting and conducting daily or weekly exchanges within their networks. Both agronomists and traders become knowledgeable over the years. People learn how to conduct business. A banana grower does not work with speculation: either you harvest the fruit at the right time or it will be lost. We call it ‘the pressure of the fruit’. If you don’t act quickly, you will fall to the uncertainties caused by the basic axiom of supply and demand. There is opportunistic behaviour by buyers, and producers become easy prey for ‘coyotes’.” A1

One plantation owner described an evolution from unreliable record-keeping and parochial business processes towards using far more sophisticated technical expertise from advisory services, external web-based resources and the local banana-growing community.

“When I returned to work on the family farm I brought management skills [acquired while working for a consultancy in New York] that helped me to implement information systems. Before I joined, my father was in charge.

Everything was centralised, and nothing was written down. The business has changed and we have managed to nearly double production.” A2

In the absence of effective control mechanisms, tacit knowledge may be incompletely or ineffectively applied.

“We had tacit knowledge because I am a fourth-generation banana grower.

Key indicators for the banana sector are production per hectare and production per year. This shows how well your plantation is doing. In the past, this was not recorded. I arrived in June 2009 and the following month began to collect statistics; since then, I have been able to compare yields per year, per hectare, per ranch and per zone. When I arrived, we produced just 2,000 boxes (28 tonnes) per hectare. This was poor: some ranches produced 4,000 boxes (56 tonnes) per hectare.

To improve, one must first make mistakes. From the data, we learned that something was wrong. We focused on operations and checked fertilisers and propagation techniques - the quality of the bunches depends on the proper selection of daughter plants.

We promptly made some decisions: we hired a subject matter expert (a technician) from Costa Rica, and shared knowledge and benchmarked productivity data with other banana growers. I searched for potential solutions on the internet. Knowledge from managing IT and the use of that information for making decisions has helped us reinvent our business.” A2

KPI records allow better sharing of knowledge and easier identification of inefficiencies in business operation. They can be used to compare fertilisers and cultivars, for example.

Specialised websites are available for consultation. The interactive global website FreshPlaza.com hosts not only product advertisements but also the latest global news and information on new processes.

6.1.1.2 Co-operation with Family

Farmers' decisions and ICT learning processes are influenced by social factors – here, illustrated by personal history and family obligation. We must not ignore social context when considering the adoption of ICTs. Social mores and traditions are powerful and change slowly, but while many farmers still insist on traditional face-to-face meetings, advanced ICTs are not redundant – an e-calendar can schedule and co-ordinate those face-to-face meetings, for example. UARSETPP encourages co-operation among its members, especially to pursue export contracts, and growers accept that ICTs are useful for maintaining customer relationships and managing internal operations:

“Exports are based on an annual contract and are very useful when there is overproduction for the domestic market. Exports help to mitigate exposure to declines in domestic price from oversupply, principally due to seasonality. Needs vary among producers, but a combination of 70 percent export on a fixed-price long-term contract and 30 percent domestic sales is good.” A6

“I sell 70 percent of production to a Spanish customer. Perhaps I am more averse to market risk and price fluctuations than my colleagues, but I avoid speculation on the domestic market. The security of a long-term contract allows me to plan working capital and business needs without the complexity of dealing with multiple distribution channels. It also helps me to plan capital investment on my ranch.” A3.

“Selling to Chiquita [Brands International] will provide stability to revenue and help us to avoid ups and downs on the domestic market. They offer a contract in dollars over the year and deal with large distributors and retailers, which ensures constant demand over the year. This differs from the domestic market where there is no contract.” A2

Social institutions continue to be important for banana growers, transcending into social and co-operative behaviour. Some UARSETPP growers have integrated horizontally, investing in cattle and establishing workshops for in-house maintenance of plantation pulley systems. Such decisions are often interpreted as strategic, to reduce risk and increase revenue, but it is illuminating to consider immediate social history. Mexican tradition is for the eldest son to inherit the family’s land, with younger brothers going into professional careers or becoming apprentices.

“My father lived in Frontera, Tabasco, an important port on the Gulf of Mexico that exports to the south of the US. Blacksmiths supplied parts to local shipyards, made agricultural tools, and so on. My grandmother was a divorcee who had lost her land rights who asked her son, my father, to become a metalworker’s apprentice. In the 1940s he met my mother, who was from a well-known Teapa family. They married in their teens and moved to Teapa, where he established his own smithy. He met local banana growers, part of my mother’s social capital. My father was attracted to the industry and in the late 1970s he and my brother started developing the banana plantation La Gloria. In the 1990s when banana exports increased with NAFTA, a packing line and production automation became necessary. My father built a pulley system and provides maintenance. It was an organic growth.” A1

These organisational arrangements depend more on the unique set of social institutions (family and social history) than political institutions, which are weak in comparison:

“State policy in the banana industry is very limited.” A1

“The success of banana growing in Teapa is mainly due to entrepreneurial effort.

We have only asked the government to maintain the roads.” A3

“We have sufficient freedom to do whatever is needed for the success of the business. The government does not facilitate or constrain operations in the banana industry. There is lack of state policy regulating the banana business or effort to establish trade regulations in Tabasco.” A4

“UARSETPP does not work with local, regional or federal governments. We have demonstrated that we can do it ourselves. The achievements of Teapa’s banana growers are the result of individual efforts. The government accepts that we are independent. However, we need their support for local infrastructure, e.g. draining the river to avoid floods.” A6

The evidence suggests that it is social relations rather than explicit state policies that have had the greatest effect on fomenting ICT learning, enabling and supporting sporadic co-operation among these farmers, helping them to conduct transactions individualistically.

6.1.1.3 Co-operation with Business Partners

Relationships with customers and suppliers develop over years, requiring a consistency of quality and reliability and the grower’s commitment to a contract’s terms and conditions. On occasions when suppliers fail to deliver, remedial action can be taken if adequate communication channels exist. ICTs help to this end, and WhatsApp especially

has been a powerful and immediate, if informal, means of contact that has complemented but not replaced face-to-face communication.

“For perishables, quality is everything. You need to meet customers face-to-face so you can observe them, or at least speak to them. Quality assurance is through inspection. Photos may describe a problem but they do not provide a root cause analysis.” A1

UARSETPP growers stress the importance of producing fruit of consistently high quality to maintain their industry reputation. Negotiating with actors who have an established reputation is another source for learning and transferring skills within the rational pursuit of self-interest.

“If a customer orders a container and pays in cash up front, they are reliable and I need to find the fruit and send it according to their specifications. I tell the truth and deliver on time. Many people find good customers who pay in advance, but then fail to deliver on time or send unacceptable produce. This usually destroys trust.” A4

Export buyers visit plantations before signing contracts. While negotiations are usually through UARSETPP, business relationships often transcend to a personal level. Growers believe that face-to-face meetings are essential, especially when dealing with a new customer. Potential customers are invited to see production practices and review plantation infrastructure, and body language can be observed during face-to-face discussions of terms and conditions.

“Such is our business: ‘face-to-face’. Over the 30 years that we have exported, we have had bad experiences with American, Middle-Eastern and European

customers. For example, we had one American customer... we sold about 100,000 boxes but he said that he could not pay. We tried to collect the money but his business was worth only US\$50k and he owed almost US\$1m.

We agree terms and conditions. Banana producers will sell if the buyer pays in advance... after at least one year when trust has been established, terms and conditions become more flexible, e.g. payment on account. At the beginning the buyer carries the risk by paying in advance. Transactions are weekly, so there will be 52 transactions in advance.

If buyers don't pay in cash there is no business. That is the rule of the game, the traditional way of doing business. It is the result of lessons learned.” A2

6.1.1.4 Reciprocity and Long-Term Ties

Reciprocity is central to the banana industry, a view of equivalence that means “returning ill for ill as well as good for good”. Daily operations demand frequent contact with suppliers and customers, and growers generally maintain good business relationships with the suppliers who provide credit during the low season.

“Transactions are based on trust and honour. Suppliers are our main source of finance; government funding and subsidies are minimal. We do not use loans from the development bank or financial institutions to support us because of their voracious interest rates.” A1

“Annual public funds for supporting the primary sector are not intended to make Mexico's rural areas self-sufficient, to encourage new crops, to reduce costs or to be more competitive... they do not encourage people in rural areas to be more

efficient and productive. Instead their goal is to reduce hunger (e.g. Progres-Oportunidades, Procampo).” A1

A frequent periodicity of economic transactions supports relationships based on quality, trust, and reciprocity, sufficing to generate a sense of obligation. Banana growers remarked that the ability to deliver on time and in accordance with customer expectations is essential for building trust, which is usually passed on by word of mouth. The president of UARSETPP describes how reputation is essential for agricultural business transactions:

“Suppliers understand farmers’ issues and provide credit if the producer has a well-established reputation. Growers can negotiate terms and conditions with suppliers in alignment with the agricultural cycle. There is reciprocity back to suppliers: growers are committed to placing future orders and prioritise payments.” A3

Building a reputation is important because it is the foundation of trust and business continuity.

“Be honest and tell the truth. Be reliable in your commitments. For example, if a customer says that they need a container and pays in advance, they trust me so I must deliver the fruit. If the fruit fails to meet requirements trust will erode, unless I explain why and implement remedial actions.” A4

Building reputation and trust with powerful customers like supermarkets takes time because there are many suppliers in a competitive environment.

“First, you need to be registered as a supplier. Once you become part of their database, you will be presented with tight deadlines. Quality requirements mean

that fruit must be delivered on time at maturity index 3, and the grower must accept the retailer's terms and conditions. There is no annual contract. They publish a spot price determined by their central office, but it compares favourably to the price paid by wholesalers.” A1

Reciprocity is an important element in the relationship between producer and supplier, and between producer and distributor. Reciprocity helps protect against opportunistic behaviour.

6.1.1.5 Certification Bodies

Farmers must acquire technological capabilities and deliver according to high-quality specifications to export reliably. In particular, they must comply with standards defined by contract or certifications bodies. In 2016, three UARSETPP firms secured certification from the Rainforest Alliance, a body that tries to link farmers and businesses with a growing global community of ecologically conscientious consumers. The standard claims to protect ecosystems and safeguard the well-being of local communities by helping farmers to adopt best land-use and business process practices where the use of ICTs in working practices become an inevitable form of operating the business. Other UARSETPP growers have been certified by GlobalGAP.

“We have recently obtained GlobalGAP certification, because it is one of the requirements to become a supplier of Chiquita. We have implemented processes to be fully complaint, for example following health and safety practices on plantations and on the packing production line. It has also helped us to improve our quality.”

6.1.2 ICT Typology and Form

ICTs are enacted throughout the agricultural business process, blurring the boundaries of production and distribution. Farmers have enacted ICTs for the planning and control of production, for intra-cluster co-operation, for customer and supplier negotiations, for external communication, and for learning and co-operation.

6.1.2.1 Production Phase

Management Control Systems. Our UARSETPP interviewees have implemented control systems for the important process of managing working capital, comprising at a minimum accounting, e-banking, inventory management, payroll software and KPI tracking. A deep understanding of costs and productivity are provided by Excel spreadsheets and Microsoft Project. While not interconnected and not equivalent to a dedicated ERP suite, they can be used to control and generate reports from multiple locations: e.g. the office, warehouse or packing hall (Figure 17).

	W-75 Tiendas		W-75		W-19		W-63		W-67		TOTAL CAJA Y PROMEDIO DE VENTA DEL DIA EN PISO TODAS LAS BODEGAS	
	Cajas	Prom	Cajas	Prom	Cajas	Prom	Cajas	Prom	Cajas	Prom	Cajas	Prom
1 Premium	778	\$ 220.00	4	\$ 124.00	0	\$ -	0	\$ -	0	\$ -	4	\$ 124.00
2 Chiquita	42	\$ 230.00	0	\$ -	0	\$ -	0	\$ -	0	\$ -	0	\$ -
4 Chava c/n	512	\$ 129.00	0	\$ -	478	\$ 87.00	469	\$ 86.00	49	\$ 80.00	984	\$ 86.00
5 Dedo Suelto	0	\$ -	0	\$ -	43	\$ 63.00	269	\$ 58.00	52	\$ 51.00	364	\$ 58.00
6 Eco 1*	367	\$ 161.00	1	\$ 45.00	0	\$ -	0	\$ -	19	\$ 90.00	20	\$ 88.00
7 Veracruz	0	\$ -	0	\$ -	20	\$ 70.00	0	\$ -	0	\$ -	20	\$ 70.00
20 Dedo Suelto IP	0	\$ -	24	\$ 43.00	0	\$ -	0	\$ -	0	\$ -	24	\$ 43.00
Total cajas	1,699		29		538		728		120		1,416	

CLIENTE	Premium	Promedio	Chiquita	Promedio	Chava c/n	Promedio	Eco 1*	Promedio	Total Venta	TOTAL DE LA VENTA EN PISO
NVA WAL MART D	551	\$235.26	42	\$238.40	512	\$128.74	290	\$161.13	\$ 246,753.32	\$109,910.00
SORIANA	225	\$193.93	0		0		77	\$195.64	\$ 59,066.75	\$305,761.00
773			42		512		367		\$ 305,764.07	\$344,771.00

	Bodega W75 Estado de madurez							Bodega W19 Estado de madurez							Bodega W63 Estado de madurez							Bodega W67 Estado de madurez																
	1	2	3	4	5	6	7	Totales	1	2	3	4	5	6	7	Totales	1	2	3	4	5	6	7	Totales	1	2	3	4	5	6	7	Totales						
1 Premium	1,632	480	566	802	239		3,919										18							18														
2 Chiquita			30				30										6							6														
3 Adela																	41							41														
4 Chava c/n				28			28				510			510	1,100	326									1,426													
5 Dedo Suelto											146			146			99								99							38						
6 Eco 1*					6		6								864	805	354								2,023	616												
7 Veracruz								800	830					1,630																								
20 vacante	78		78		20		176																															
Sumas	1,910	480	674	802	293		4,120	800	830	656			2,286	864	1,100	1,165	354	99						3,613	616						38						654	

Distribución de la Fruta almacenada																												
ALMACENADO EN LA CÁMARA					ALMACENADO EN LA CÁMARA					ALMACENADO EN LA CÁMARA					ALMACENADO EN LA CÁMARA													
1	2	3	4	5	6	7	8	1	2	3	4	5	6	7	8	1	2	3	4	5	6	7	8	1	2	3	4	Deep
480	802			728	78	480	1112								830	678	500	386		264		704					616	
9	10	Deep	9	10	11	12	13	14	15	16	9	10	11	12	13	14	Deep											
231	194	89								800	364	518				99												
TOTAL 47								TOTAL								TOTAL					TOTAL							

Figure 17 Example of working capital control

Banana growers are acutely aware of the importance of cost accounting. Two types of cost arise on banana plantations, fixed and variable. Fixed costs are independent of production and include wages, fertilisers, and weekly aerial spraying to control disease. Variable costs change with productivity and include freight and packing. Losses during the high productivity season period tend to be offset in winter and spring when prices recover. Nevertheless, growers must generate sufficient revenue to cover the weekly payroll and pay suppliers during summer and autumn when careful management of cash-flow and working capital becomes especially important. To ensure business continuity they may use capital reserves, have diversified through vertical or horizontal integration, or have entered long-term contracts with export customers. Capital reserves and responsible capital management offer flexibility if revenue transiently declines but cannot entirely eliminate exposure to the risk of having insufficient capital to cover ongoing variable costs.

“As with other agricultural products, the main challenges for the banana business are financial and associated with seasonality in the production cycle. In the late summer, the market price declines sharply. Fruit production doubles or even triples and domestic revenue declines as the spot market price is very low. In winter, we need to sell only two containers to break even whereas in summer we must sell at least 10-12 to safeguard the business and our workers. It is in this period when we get most communitarian support from our network. Suppliers finance our operations by increasing the invoice period to 90 days. We pay off our loans when prices recover.” A1

Banana production requires the intensive use of agricultural inputs. Computerised systems track and control production costs and collect KPIs, information that is used by growers to plan daily activities and implement preventive actions.

“Customers are primarily attracted by the quality of our product. Hence, emphasis must be put on production. I have exported to the same customer in Europe for the last five years. This is sustainable because all processes on my plantation are driven by quality.” A3

One of the benefits of ICTs is that they allow producers to easily monitor KPIs, production costs, plant age and health and compare yields at different resolutions, helping to identify zones of underproduction and determine corrective actions. Automation of production is necessarily limited.

Some farmers monitor rainfall to better use artificial irrigation:

“Irrigation is a technology that makes a difference to fruit quality. Bananas unwatered for 15 days usually die. We maintain daily, weekly and monthly records of rainfall and our plantation has a sprinkler system that is activated at sunset if our records show that the plants need water.” A6

Mobile phones. Communication on plantations is by mobile phone or, if there is no signal, by radio. Producers have invested significantly to connect plantations to telecommunication networks and mobile phones are widely used. Plantations typically have access to fixed line, 2/3G mobile networks, and the internet. Mobile phones are useful because of their ubiquity, and they enable co-ordination across the end-to-end production process, helping to reduce negotiation and information search costs. Formal communication with customers and suppliers is via email. Confirmation can be obtained for read emails, which can be sent to multiple recipients. Export producers send tracking information to international customers, for example.

Likewise, **WhatsApp** offers receipt notification and is widely used by producers to communicate with domestic customers and suppliers. It is considered a more informal messaging platform.

Some producers use **smartphone-enabled CCTV** to monitor employees and improve security, an increasing concern in rural Mexico:

“What is the benefit of this technology? When the cat’s away, the mice come out to play. Supervision and control. If the owner is not there, employees do whatever they please.” A2

In 2016 A1, A6 and A7 began to trial drones to monitor plant health in the field, replacing daily (by workers at ground level) or weekly (by crop-sprayer pilots) visual monitoring. The deployment of drones is in the experimental phase, with farmers still assessing any benefit for production:

“I use it [a drone] on the plantation for aerial photos because it helps me to identify areas that are in bad shape. With aerial images, it is easier to distinguish between the broad green leaves of a healthy banana plant and the paler green leaves of weaker plants that need replacing. This will save me money in the future.” A6

The upper photograph in Figure 18 illustrates the foliage density and colour differences between a healthy well-managed [top image, left] and an unirrigated plantation.

“Farms without an irrigation system can be in a better position if they implement a quality control system. The health and ultimately the quality of produce depends on an adequate monitoring system for soil, plant selection, fertilisers, and so on,

which are part of the planning activities in the agricultural production process.”

A6

Early identification of disease can help prevent its spread across a plantation. The lower photograph in Figure 18 illustrates active clearance of part a plantation.



Figure 18 Drone imaging of plantations

6.1.2.2 Distribution Phase

Traditional distribution channels (wholesalers, brokers, distributors, and supermarkets) still dominate Mexico's banana industry. For the domestic market, the sale of unripened fruit direct to the wholesale market remains the most important distribution channel with new customers engaged through trade fairs and networking. Non-traditional distribution channels tend to be ignored by traditional farmers.

“In Mexico, no e-marketplace exists where buyers can place a small purchase order [for bananas], e.g. 100 boxes. We don't deal with small purchase orders because we need to send an entire container, a wholesaler could possibly do this. Here at the factory, producers and buyers interact to agree terms and conditions. We monitor purchase orders, payments and so on with mobile phones, emails, text messages, and WhatsApp. In the past, we used fixed telephone lines, telegrams and surface mail.” A2

The Internet. Producers use the internet to seek information on process improvement (e.g. advice on improving soil fertility or maintaining plant health) and for what they consider free advertising on social media. YouTube, Wikipedia and search engines are frequently consulted as general sources of information. FreshPlaza.com⁷ is a more specialised website where producers can read global news about the industry, monitor international prices, search for and advertise to buyers, and even seek collaborations with global producers. It offers value by better managing complexity and disintermediating more general search engines like Google. However, it does not yet support end-to-end exchanges.

⁷ <http://www.freshplaza.com/>

Co-operative and farm websites can support both internal and external communication in production and distribution, and they help foster mutual assistance. Occasional collaborations enabled by ICTs help farmers reach larger markets and achieve economies of scale, and improve visibility especially for export markets and outsourcing large contracts to large agro-industries. Where members are unable to complete a purchase order alone, they can work collectively with other producers to fulfil the shipment, or recommend another grower if their production is committed elsewhere.

Email. Some disintermediation of distribution channels has occurred through the absorption of certain wholesaler roles. Rather than dis-intermediating through electronic brokerage, ICTs have helped support networking and facilitated face-to-face negotiations under a hierarchical co-ordination. Negotiations with supermarkets are usually via email and sometimes through voice calls. The role of ICTs in these decisions has been to support communication between supplier and buyer, and as a project management tool to follow up actions. To maintain a business relationship with supermarkets, producers must register and supply a weekly quotation via email (Figure 19). Ultimately, the supermarket dictates terms and conditions:

“Supermarkets have a stronger market share in fruit trading in Mexico. As producers, we must be conscious of trends, open-minded and change traditions. It’s an option, but not the solution for the banana distribution channel.” A1

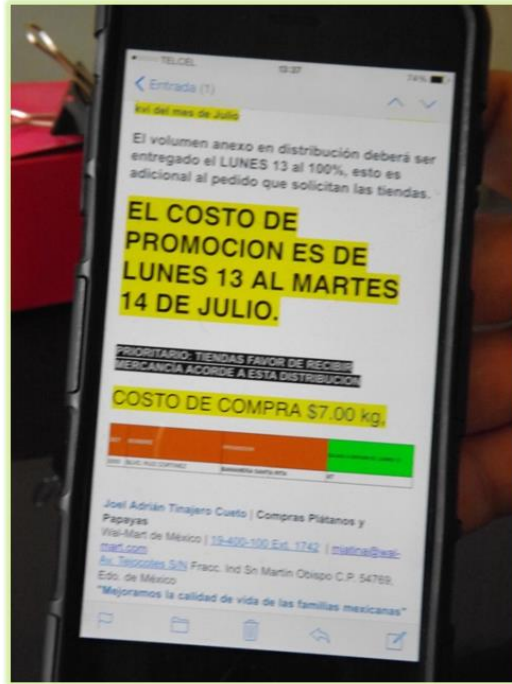


Figure 19 ICT-mediated communication between banana growers and retailers

“We sell directly to Walmart [Wal-Mart Stores, Inc.] and deliver fruit according to the retailer’s requirements. Communication and final agreements are via email. Walmart provides spot pricing and confirms purchase orders. Email offers the time to think before replying, and it is up to each producer to accept or decline a purchase order. If there is an emergency, e.g. quality problems, or a change to the purchase order or something beyond standard conditions, they use the telephone.” A1

Access to new international customers is via traditional distribution channels: brokers and international agribusiness corporations meet at international fairs or through UARSETPP’s connections. ICTs, predominantly email, are used to maintain existing business relationships and for formal communication between producer and customer.

“Mexican producers attend international fairs where we meet potential new customers. In October, the trade fair Fruit Attraction takes place in Madrid, and

[banana grower] Santa Rita *will probably attend. I am aware that a webpage could help us acquire new customers.*” A1

Mobile phones. Brokers typically charge commission and are only used when there is an urgent need to sell fruit quickly, the speed and liquidity they offer the only advantages for the producer. Brokers rely mainly on mobile phones to communicate with producers and markets, and their service depends entirely on spot pricing under market exchanges.

ICTs are key to effective relationship management. Mobile phones are widely used to communicate with customers and suppliers:

“In this business, we require negotiation skills and must manage purchase orders, we need to manage relationships and build trust. Were I to lose my mobile phone I would not go bankrupt, but I would need a way to communicate with my customers and suppliers.” A2

“Communication has always existed, face-to-face and remote. In the past we used surface post or telegrams according to urgency, then it was telephone landlines, now it’s mobile phones, email, and WhatsApp. Communication within the network never stopped. An integrated system that connects the entire banana ecosystem doesn’t yet exist for Teapa, but we might move in that direction.” A3

A4 noted that voice and face-to-face communication are an inextricable part of banana business negotiations:

“Conversation [with customers] is extremely important. I personally visit my customers at least two or three times each year. Every transaction is an investment, and one must spend time on them. Most important is to ensure that the customer is satisfied. It might be a commercial business, but we are also friends.

For example, if you have a glut of fruit you can ask them to buy an additional container, or prices can be negotiated upwards. This is a relationship and communication is quite important. The telephone is important, it facilitates the relationship, but it isn't the be-all and end-all.” A4

Face-to-face meetings are important and have become the norm over three decades of export contract negotiations. Relationships are maintained through email and phone calls. New buyers carry the initial risk by paying in advance; transactions are typically weekly and become more flexible after one year. Now established practice, this helps generate trust and reputation in distribution channels, a relational factor reducing transaction costs mediated by ICTs.

“If an export customer calls me now and needs a container [22 tonnes] I make the arrangement and send it. If I am unable to complete the whole purchase order alone I work with other producers to complete the shipment.” A3

WhatsApp. Negotiations with Chiquita Brands International were face-to-face, with minutes documented and distributed by email. Daily communication (voice, text messages, photos, video) is largely via WhatsApp, where growers have set up a *Project Chiquita* group for transparent internal communication (Figure 20). ICTs have enabled collaboration and communication between producers, but these same producers still depend on clustering to deal with multinational corporations in their pursuit of longer-term contracts and lower price volatility, emphasising the importance of relational perspectives of the economy.

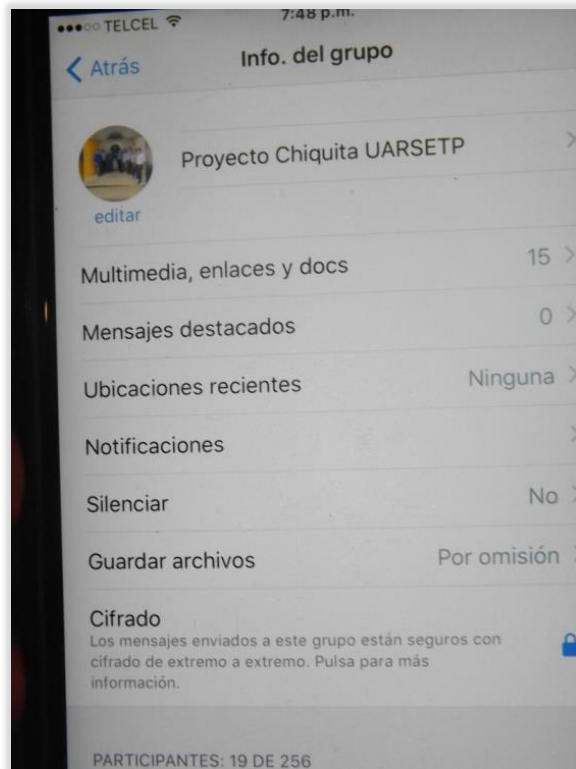


Figure 20 Chiquita contract – intracluster communication using WhatsApp

Long-term contracts with larger distributors like Chiquita reduce price volatility and, with UARSETPP growers' co-operation in production, permit producers to reach new, larger markets and achieve economies of scale: a move to contract farming to reduce transaction uncertainty. ICTs facilitate links between farmers and markets and improve production efficiency through better management control and project planning. Their effect on strategic decision-making has been to encourage investment.

“I will need more land to increase production, therefore I will convert some grazing land to banana cultivation and feed the same number of cattle by improving feeding technology.”A3

Barcodes and RFID tracking systems improve customer service, customer satisfaction and reduce enforcement costs.

Price information and mobile apps. Farm revenue depends both on production and the farmer's ability to negotiate prices. ICT tools help producers maintain records of daily, monthly and annual production and facilitate negotiations, for example using websites published by the *Secretaria de Economia*, SAGARPA and SIAP to provide transparency and track domestic wholesale prices. These platforms also enable producers to connect with new buyers.

The *Sistema Nacional de Integración de Mercados* is published by the *Secretaria de Economía* and is consulted by farmers to monitor domestic prices. However, warehouse owners at La CEDA CDMX are considered a more accurate source of information that is inextricably linked to networks and the trust generated by repeated direct communication, despite their commercial decline in the face of supermarkets. This social mechanism has also helped growers to develop and maintain customer relationships with the wholesale market:

“The best price barometer is the number of transport units registered at the entrance of the wholesale market. More than 50 containers means a negative effect on price, and fewer than 20-25 means a good price for producers [Figure 21]. This seems to be a more accurate parameter than official monitoring by the Secretaria de Economía. Warehouse holders know how many carriers are parked in the banana section. I usually get this information with a mobile phone call, sometimes inaccurate perhaps but more reliable when provided by one of our customers, e.g. La Carmelita. They have first-hand information because they are at CEDA CDMX, for us it is second-hand information. It might not always be accurate, but it's going to be an important factor for price reduction when it's provided by our customers. Real or fiction, this phenomenon occurs.” A1



Figure 21 Relatively few banana containers parked at CEDA in March 2015 when the average price was \$0.35/kg; the lowest recorded price that year was \$0.23/kg.

In July 2016, SAGARPA released two mobile phone apps, *Produce* and *Mercados* [Markets]. They promise to identify the best crops to cultivate in each region, link producers with input suppliers and customers, and supply reliable domestic price data (Figure 22).

Banana growers who sell to the export market use the interactive global website FreshPlaza.com to advertise their products.

While few domestic websites advertise Teapa bananas, UARSETPP has its own webpage and its growers use email as their main means of communication with customers and suppliers. One participant maintains a Facebook page and YouTube channel.



Figure 22 SAGARPA's *Produce* app

The banana sector is quite personal and traditional, favouring direct contact and face-to-face interaction. This may help explain why some producers have failed to find new distribution channels: dismissing or discouraged from using ICTs, they will fail to benefit from the better collaboration and communication among growers and buyers that they can enable. Implemented correctly, ICTs will facilitate a co-operation mode of economic organisation.

Farmers who export are more conscious of the advantages that the internet offers. Despite the number of firms who support the banana industry, only a narrow selection of electronic marketplaces currently exists to connect growers with input suppliers or customers.

While the dominant impact of ICTs in UARSETPP seems to be on production, we must not underestimate the effect that ICTs have had on distribution, especially for conducting negotiations, customer relationship management, obtaining information from customers, and advertising. Given the importance of trust in this sector, the integration of rating and customer feedback systems must add to the attractiveness of e-commerce platforms that are so successful in many industries, but they are still too impersonal for the current mode of traditional agricultural B2B transactions, a social process resiliently dependent on direct contact and face-to-face interaction.

6.1.3 The Impact of ICTs for Farmers: Beneficiaries and Losers

The most substantial contribution of ICTs in the Teapa model has been to allow farmers to better communicate, socialise, learn and acquire knowledge enabling them to maintain periodic co-operation with existing business relationships and social ties, and to comply with certification bodies, facilitating access to the market. While growers are aware that non-traditional distribution channels exist, they have largely persisted with – and indeed strengthened – traditional channels. Both producers and buyers prefer to deal with reputable partners: trust remains particularly important in the banana industry, and physical meetings and voice calls are still important for negotiating and closing deals. While growers recognise the importance of ICTs, they do not consider them a conditional element for increasing their customer base.

My research shows that the use of social media and the internet by banana growers to find new customers has been limited. The amplifier effect of technology has been predominantly operational rather than strategic, a short-term tactical implementation focused on planning and control of daily operations, and to support occasional co-operation between farmers, for example to share knowledge about best practices in

production, for internal and external communication, and for negotiation with customers and suppliers. In traditional agriculture, social elements play a critical role in economic exchanges.

“A combination of face-to-face meetings and voice communication via ICTs drives this business. I cannot say whether I get more customers by using a mobile phone. But I certainly have more options, a greater capacity to react and communicate. If I cannot place fruit with one customer I can call another potential client within my network. In an hour, I will have probably contacted 10 people. If you don't have a mobile phone, fixed line [telephony] becomes extremely important. We also use computers to access email to avoid losing contact with commercial partners. Smartphones are very useful for their combination of email, voice, Twitter, Facebook. For marketing, emails and voice calls are the most important. The mobile phone is an important tool and has facilitated and streamlined communication to forge relationships between customers and suppliers. It has helped us negotiate faster and more efficiently. If we rejected ICTs for purely face-to-face meetings it would be very difficult to conduct business.” A1

6.1.3.1 Beneficiaries of ICTs

Farmers who are more dynamic and recognise the advantages of internet and social media for information searching, problem solving and advertising can benefit powerfully and stimulate their business in both the short and long run. Those who have benefited the most have spurned narrow, limited business relationships for broader connections. Joining efforts with partners has helped them stabilise revenues and cash flow, outsource activities and facilitates learning and the transfer of technological know-how from agro-industries, research institutes, trade associations, and subject matter experts.

“My brand is El Refugio. I am primarily focused on the export market. The internet is very effective for finding information, seeking suppliers, and making yourself known. I have uploaded several videos to YouTube to promote my company and have a Facebook presence linked to their farm webpage⁸, but voice telephony helps me negotiate and close deals.” A3

“San Carlos advertises at MarketPlaza.com to capture more exports. They have almost 2,000 hectares of production. They could supply 100-150 containers per week and achieve economies of scale. They can supply large customers. I have only 130 hectares. I am limited by my production capacity, between 2 and 4 containers per week.” A2

Some UARSETPP members supply international customers like *Chiquita Brands International* alongside domestic buyers. They see longer-term contractual relationships as a means to reduce uncertainties and standardise processes. They invited representatives from *Chiquita* to a dedicated WhatsApp group to discuss and monitor progress of negotiations.

“I don’t feel limited by selling my fruit to Chiquita. The contract will bring us both economic and technical and organisational benefits. Working with a respected organisation and with a long-term contract, I can plan for economic growth because I have long-term contract sales. I would describe this deal as a safe market.” A2

ICTs have certainly not been without effect. Predominantly through operational change to both production and distribution, farmers and buyers have access to better

⁸ www.elrefugio.mx

communication and stronger collaborations, stimulating a modest shift from co-ordination without contract to contract farming, especially for those selling on the export market.

6.1.3.2 The Losers

Farmers who resist sharing knowledge and follow a traditional model of economic exchange with existing acquaintances through established distribution channels developed by linear internal processes, benefit much less from ICTs. This includes not only economically disadvantaged farmers or those with a limited educational background, but also farmers who reject or are ignorant of the advantages of collaborative agreements as a co-operation mode that can be sustained over the long-run and offers broader access to the market than is typically possible through existing traditional distribution channels. Persisting with the same channels also risks dependency.

Banana growers operate in an industry where traditional direct contact and face-to-face interactions are entrenched, a significance of embeddedness that is illustrated by their clustering into UARSETPP for learning and dissemination of information. Social mores, tradition and weak state policies have promoted sporadic collaborative exchanges that suit more individualistic farmers but have failed to encourage sustainable collective effort. The adoption of a collaborative network is incomplete. This unit of study demonstrates the relevance of extending the network form of organisation with Social Embeddedness.

6.2 Case B: Organic Rice Grower – The Palizada Model

6.2.1 The Discovery, Adoption and Implementation of ICTs

6.2.1.1 Learning from Other Actors

Organic farming demands specialisation in both production and distribution. Two generations work at *Organicos del Tropico*, combining tacit knowledge learned from family members experienced in conventional rice production with a formal university-level education in aquaculture engineering. B1 prepared a business incubator proposal to combine crayfish and rice production, and after graduating travelled to Brazil at his father's request to learn more about conventional rice production. His mother's environmental activism and distrust of synthetic chemicals encouraged him to go organic, and he was aware of its potential profitability.

ICTs facilitate the exchange of two commodities whose value is not easily measured: know-how and technological capability. Technological knowledge reinforced by supervision can help farmers improve productivity, and ICTs mean instructors do not need to be onsite. Online courses are a source of information that can be exploited to expand and diversify business. B1, B2 and B3 have all attended virtual courses and been remotely advised by consultants.

“I used to travel a lot to learn how to set prices, including to China, Italy, Spain, and the US. Knowledge can now easily be shared with technology.” B2

Knowledge has been essential for optimising the production process, and B1 has attended courses on organic production and used multiple advisory and consultancy services over the past decade. He searches online for information on organic production using Google, YouTube and Facebook, and communicates with consumers and other producers via

email and through social media. Technology has the capacity to rapidly disseminate knowledge, with new trends and novel ideas increasingly shared through Facebook and YouTube. The younger generation has learned quickly and is more comfortable with these artefacts.

“It is very effective because people interact at a social level and share information that is valuable to the business. This is how I learn how the market is moving, and what customers like.” B1

International co-operation has been critical for *Organicos del Tropico*'s expansion strategy, and ICTs – particularly the internet – have helped him establish new network links. Without ICTs, B1 would not be able to cope with the fast pace of business:

“I have seen a lot of innovation through ICTs. We have been bombarded with many technological innovations. My generation is more flexible with change. We adapt more easily to new technology and I see less resistance to change.” B1

Contact with organic rice growers in other countries has been useful. Posing as a potential buyer rather than competitor, B1 has been able to obtain pricing information to model import costs and set his prices accordingly.

He spends at least 70 percent of his working day at the computer or on his mobile phone, using them to access search engines and social media applications. This has become increasingly important as customers become comfortable with volunteering feedback and offer suggestions. He appreciates that costumers of organic food tend to be more middle class and more likely to communicate and discuss opinions. Through Facebook he can see the profiles of people interested in organic produce and analyse information to identify and follow market trends. He recognises that expertise and specialisation are needed. Like

his father, B1 considers Facebook to be both a marketplace and a platform for communication, a useful source of not only price information but also guidance on what customers like or dislike. He is a member of a group that shares ideas and experience of organic rice production whose members are found across the world, from Australia to Italy to Colombia.

6.2.1.2 Co-operation with Family

Family co-operation involves aspects of dependency but has been crucial for *Organicos del Tropico*'s success, a source of both knowledge and capital. B1 can rent additional land from his father should extra production capacity be needed, and he also has access to production process know-how.

6.2.1.3 Co-operation with Business Partners

Their strategy to court a large, well-established agroindustry partner in parallel with existing market-governed exchanges increases the risk of dependency but has created an opportunity to acquire more technological capability and safely expand production: appropriate long-term agricultural contracts offer substantial security. By establishing long-term outsourcing agreements, *Organicos del Tropico* has improved revenue security, an illustration of the benefits of the network mode of economic organisation that seems to be most applicable to this unit of study. The security and stability that arise from working with trusted long-term partners promote learning and the exchange of information, encouraging the search for more efficient and effective ways of accomplishing tasks to continuously improve knowledge.

Rice growers risk working capital difficulties from uncertainties in demand and a general lack of subsidies for their business. Historically, consumer demand for organic rice has

transiently and unexpectedly collapsed, which obliged *Organicos del Tropico* to sell production as seed stock or at the same price as conventional rice. Partly to mitigate exposure to risk and increase capital liquidity, the plantation diversified into buffalo breeding in 2006. Male buffalo are sold for organic beef, and females are exported to the US. Their manure helps fertilise land rotated for organic rice cultivation.

“I have liquidity issues, but it is even more difficult for my father because he established a palm oil plantation three years ago but must wait five years to see income. It does not generate cash in the short term. He is trying to charge the cost of irrigation to his shareholders. Meanwhile, SAGARPA subsidises only 10-15 percent of his investment. He has since diversified into cassava and yams, which generate income after 9 months.” B1

“My next project will be yams which requires an upfront investment of US\$1.5m but has a short payback period and returns a positive cashflow after only a few years. It will be more successful than organic rice and palm oil. I will do this to help another of my sons as I did with Organicos del Tropico.” B2

6.2.1.4 Reciprocity and Long-Term Ties

B1 had for several years sought a customer and business partner who would invest in his operation and not abandon it should demand for rice temporarily collapse or a harvest fail. Establishing a robust relationship with an investing customer mitigates risk and brings benefits to both parties. To this end he is engaged in contract negotiations with HiPP GmbH & Co. Vertrieb KG, which discovered and approached him through the internet presence he established (website, Facebook page, YouTube channel). Because the 100 hectares he currently works are nearing capacity from domestic demand alone, he will need to lease more land from his father.

“I really appreciate ICTs because I’ve got new customers and information, and I can communicate easily with many people around the world.” B1

“If I tenant my father’s [currently uncultivated] land I can supply a big client. But I need a good relationship for security, I would like them to invest. They [HiPP GmbH] have been involved in discussions and they have said yes. The company has a representative in Costa Rica.” B1

“We’d rather have a contract and a bigger mill: it’s like drilling for oil and having a contract with a big refinery.” B2

Organicos del Tropico is a more radical and innovative business that has introduced novel cultivation techniques and is pursuing a sustainable long run arrangement within a network mode of operation. Co-operation has emerged out of mutual interests based on operational performance and the interchange of information, and should consolidate trust through future repetitive economic exchanges.

6.2.1.5 Certification Bodies

Organicos del Tropico was certified as organic in 2003 and is inspected annually to ensure ongoing compliance with internationally defined processes and specifications. Organic production requires following specific practices, and *Organicos del Tropico* has benefited from tapping the accumulated personal and professional of other organic farmers.

6.2.2 ICT Typology and Form

ICTs have encouraged innovative agricultural production practices and significantly improved market access. The farm’s office is computerised, and business has expanded and diversified through marketing on social media. In the past customers placed orders

by phone; now they communicate mostly via email. Communication with customers has become mostly virtual. Search engines have helped transform this business with new ideas for improving production and profitability.

“We use the internet in every phase, production and distribution.” B1

6.2.2.1 Production Phase

Management Control Systems. *Organicos del Tropico* uses ICTs for management and cost control, tracking revenue for each part of the business. Accounting is largely onsite, with some activities like tax calculations outsourced to an external company. QuickFile accounting software classifies electronic banking transactions into different categories and provides numeric and graphical analyses, e.g. of fuel costs, payroll, machinery parts, fees. Production and operational costs are tracked with Excel. The farm quantifies production costs at different levels to control expenditure and evaluate economies of scale.

“We are trying to institute KPIs, these are a work in progress but will give us criteria for decision-making, e.g. drying and packaging costs, the minimum price to break even, and negotiating seed cost.” B1

They understand that operational complexity in agronomics is high because everything is connected and boundaries often blurred. In accounting, cost activities are ideally recorded according to their associated business, but in practice costs are allocated as estimates.

“We have weekly and monthly plans but need to be flexible and adapt them to climate conditions.” B1

Daily records are maintained and used to forecast cashflow and accounts receivable and payable. Mexican tax regulation requires invoices for economic exchanges, which

Organicos del Tropico issues electronically. Bank transactions are also electronic, reducing costs for both the bank and the farmer. Input suppliers are listed on mobile apps curated by SAGARPA and purchases from local outlets are made by their purchasing manager in person or by phone, with payments processed electronically.

“This will help us to identify where to buy agricultural inputs suitable for organic farms.” B1

Mobile phone. Information technologies provide multiple benefits to agriculture. Weather forecasts on smartphones, for example, inform decisions on sowing, irrigation, harvesting, etc, and technological knowledge and appropriate supervision improve agricultural productivity. Producers working fewer than five hectares are unlikely to adopt every new production technology, and of all ICTs, the mobile phone is the most ubiquitous, and every worker at *Organicos del Tropico* has one.

“You can transfer knowledge from overseas without needing to physically attend training or incur travelling and accommodation expenses, something that in my time was very difficult to do. I used to need to travel to learn... now knowledge is easily disseminated with technology. For example, I am taking a 1-year naturopathic medicine course in English online with twelve other people around the world.” B2

“We need technology to spread knowledge more easily. The younger generation has learned quite quickly and feels more comfortable with electronics. Medium- and large-scale producers might be able to use technology as they become educated.” B2

New technologies, often piggybacking on smartphone technology, continue to transform agricultural production. Drones should help farmers identify disease outbreaks sooner and make their treatment more effective and they expressed their ambition to acquire this technology.

“While it is part of our capital expenditure plan, we haven’t obtained the technology yet. We are aware that we could save costs. We can see whether soil quality is deteriorating, predict how much irrigation is required, and monitor workers in the field. The problem is whether this technology is affordable and easy to use on medium-sized farms, or whether it will be so expensive that only large corporations can use it.” B2

“The technology makes you feel closer to the rest of the world. It’s like we are in the city.” B1

WhatsApp has helped to delegate responsibility by reducing supervision.

“My technical manager sends me reports and photos through WhatsApp. I evaluate work in the field from the photos. I don’t need to go where his team is working to supervise them. Others won’t do this because they are old-fashioned and traditional.” B1

Smartphone CCTV cameras have been installed on ranches, partly for worker monitoring, and partly due to deteriorating rural security.

6.2.2.2 Distribution Phase

ICTs have clearly helped *Organicos del Tropico* reach new customers. Farm turnover has been too low to justify hiring a specialist, and despite lacking formal expertise in marketing and distribution, B1 alone has been responsible for business development. As

the only organic rice grower in the region and with domestic demand for organic produce growing, his objective is to expand production still further.

It is more complex to sell organic produce than conventionally grown crops; it requires, for example, certified warehouses. *Organicos del Tropico* operates through both traditional and non-traditional distribution channels via four main mechanisms. The first is to supply supermarkets and specialist organic shops with unbranded or *Pijije* rice via traditional distributors. Purchase orders are placed by email, via the farm's website, by voice, or using WhatsApp. These same ICTs are used for customer service.

“In the past customers would place orders by phone, but now everything is through the internet. The webpage has increased our revenues and helped us to create more wealth.” B1

The second distribution channel is to sell directly to retailers encountered at trade fairs, mostly independent retailers on the Yucatan peninsula for whom buying directly from a farm is more convenient and cheaper than purchasing through a distributor in Mexico City.

“I often participate in domestic and international trade fairs, forums, groups, and so on. Every time that I participate, information about Organicos del Tropico is recorded online. For example, in 2008 I attended BIOFACH in Germany. They recorded that I am an organic rice producer, my contact details and the year I participated.” B1

A third, non-traditional distribution channel has been made possible by their successful social media presence. Approximately a tenth of *Organicos del Tropico*'s customer base has been acquired through Facebook, a partial disintermediation and escape from

traditional distribution channels. The farm has joined a group whose members share information on organic rice cultivation, generating new international contacts.

“Facebook is a marketplace and a useful platform for communication, a good source of information that offers guidance on what customers like and dislike.”

B1

“People who consume organic food are middle or upper-middle class who are usually keen to provide feedback. Consumers give me new ideas and show where the market is moving.” B1

Operating through this channel, customers place orders through the firm’s Facebook page. Delivery logistics remain the principal challenge; costs are not standardised across Mexico and the farm lies 200km from the nearest delivery hub.

E-marketplace. In 2016 *Organicos del Tropico* was contacted by *Organika*⁹, an online supplier of organic produce from Playa del Carmen in the Riviera Maya. *Organika* provides an e-marketplace that connects organic growers and promises them access to new customers. Growers are responsible for product delivery and managing customer relationships.

“In the first month, it looked good and we received some orders, but then they stopped. In the last couple of months, we haven’t received a single purchase order from the site.” B1

⁹ <https://www.facebook.com/organikamexico/>

Domestic delivery costs of US\$0.30 to US\$1.50 per kilogram are close to the cost of rice itself. It is difficult for a small e-marketplace to lower logistics costs through economy of scale.

The fourth (and also non-traditional) distribution channel arose from their internet presence:

“While we did not set out to reach end consumers directly, we are now developing this distribution channel. It is another way to increase revenue. We began with a small number of customers, but there is the potential for growth. Because distributors no longer provide this service, I thought that I should do it myself with the help of the internet.” B1

“The first question we ask of a potential customer is their city and state. Even small businesses from Peru, Guatemala, Costa Rica have contacted us. I cannot supply them because they are outside Mexico and logistics demands economies of scale. They sometimes ask for a single box [25 kg]. The cost of shipping would exceed that of the product.” B1

WhatsApp, email, Skype video conferencing. Largely due to its nascent partnership with HiPP GmbH, *Organicos del Tropico* is expanding. Communication between the companies is frequent and via multiple ICT artefacts (fixed line telephony and several internet communication modes, including email, WhatsApp and video conference calls). Voice communication is routine but WhatsApp is helpful for project management and offers confirmation of message receipt and opening. Parties can read at their convenience before agreeing next steps. Representatives from HiPP GmbH visited the plantation to validate its organic practices and to verify that they satisfy the company’s requirements.

“We send photos when the japonica rice is harvested, which are simpler to send via WhatsApp than email. When we cannot explain everything in an email or on WhatsApp, we use the telephone, which is useful to collate ideas and explain in detail what we are discussing. This is also why face-to-face meetings are still important.” B1

“In the past, everything was via radio. A two-way VHF radio used to be in a van or the ranch buildings. We haven’t used radio transceivers for at least two years.”

B1

Organicos del Tropico is too small to employ a business development specialist, and recognised that it would be cheaper to develop an internet presence than to employ a dedicated sales representative. The implementation of ICTs has helped them reach new customers.

“To find people who have the right qualifications to sell in traditional channels is difficult. My profits are very small, I cannot pay somebody else to do this type of work.” B1

An effective implementation of ICTs and a strong commitment to developing long-term business relationships has helped *Organicos del Tropico* expand and diversify, mitigating its relative geographical isolation. It operates successfully through a network mode of operation using the internet and especially social media, which has led them to establish a business relationship working towards a longer-term agricultural contract with a large corporation. But this relationship, and the ICTs that have driven it, are still subservient to traditional principles of family: his father owns the land B1 will need, the most challenging resource for a farm that needs to expand.

6.2.3 The Impact of ICTs for Farmers: Beneficiaries and Losers

6.1.3.1 Beneficiaries

ICTs have facilitated and sustained long-term co-operation between *Organicos del Tropico* and other, often remote members of the organic farming community. They have had a potent influence on the management and control of farming operations, not only for short-term profitability but also for continuity and to encourage a network mode of economic exchange with broader connections and better sustainability.

A broadening customer base is reached through both traditional and novel non-traditional distribution channels. Some disintermediation has occurred, with most new customers acquired through the firm's social media and web presence. Sales through these channels are still relatively modest however (1-2 versus nearly 30 tonnes/month through parallel traditional distribution channels), and their collaboration with HiPP is still inchoate. The adoption and adaption of ICTs is ongoing: while their website has simple email connectivity and can be used to raise purchase orders, it does not yet fully support e-commerce and has no mechanism to collect payments automatically. They have access to electronic banking, however.

“We respond to [customers’] emails to confirm that we can deliver to them and tell them the delivery company which we use, FCA Villahermosa. The customer pays freight from Villahermosa to the destination [an additional US\$0.20 to US\$0.30 per kilogram]. If a customer collects rice directly from us, we give them a better price. We want to encourage them to buy our rice and to make the effort to drive to the plantation. People who travel from Villahermosa to Merida in the Yucatan pass by our farm.” B1

The owners of *Organicos del Tropico* participate in online courses and use social media to communicate with producers around the world. Social media and the internet have delivered a measurable disintermediation and facilitated an entrepreneurial escape from traditional agricultural practices.

“It is difficult to quantify the revenue generated by ICTs, but we have built our customer base using the internet. We follow up relationships by telephone or with email. Even if they are small retailers, our customer base is growing.” B1

“Our webpage has attracted larger customers. Small retailers contact us through our Facebook page. YouTube gives us free publicity.” B1

Sales in 2016 were robust, a period when Mexico’s economy had slowed due to a global decline in oil price and weakening consumer demand, especially for organic produce (CIA 2017). A Facebook presence and website have helped *Organicos del Tropico* engage with smaller retailers independently of rather ineffective distributors. ICTs have impacted control costs which were previously absorbed by distributors. A limited disintermediation of distribution channels has helped preserve revenue.

“By taking these [small retailer] customers and developing new ones, I am replacing sales that used to go through the distributor. I continue to promote my own brand through our website and on Facebook.” B1

Regular attendance at trade fairs maintains and refreshes links with the organic food trade and its consumers, often from the middle or upper-middle class and at least superficially interested in healthy foods and lifestyles. It is a demographic that is a particularly rich source of information and big data and which is more likely to engage with and promote

new ideas on social media or leave feedback on a company's webpage. Complaints and suggestions are scrutinised carefully.

A network mode of operation provides a context for learning, with new connections (ties both weak and strong) bringing additional knowledge as new meanings are generated and evaluated.

6.1.3.2 Losers

Collaborative arrangements can add complexity and risk to business operations, and there exists the ever-present threat that only one party will benefit from the relationship. Should *Organicos del Tropico* commit to producing Japonica rice for HiPP GmbH, it may lock itself into a repeat trade contract that in the absence of a mitigation plan exposes them to possible dependence. Committing to cultivation of Japonica rice, which has only limited demand in Mexico's domestic market, effectively restricts access to other opportunities

“The German company wants to purchase the Japonica variety because it is shorter-grained and stickier like clay and more appropriate for baby food. This variety is not cultivated in Mexico because there is no demand except from Sushi restaurants' clientele. Mexican consumers prefer Indica.” B1

It can prove challenging for farms to survive a contract breach if they have neglected diversification in favour of a single large customer.

Chapter 7. Discussion

This chapter is a synthesis of how farmers who work medium-sized farms in Mexico have adopted ICTs, and how these technologies have impacted their work practices and access to the market. I compare themes identified in the literature review with findings from my embedded case study to offer a contribution to theory.

My theoretical framework evolved from TCT and a simple economic dichotomy of market versus hierarchy, which alone fails to satisfactorily capture the logic of Social Embeddedness in my units of study. In this thesis I acknowledge similarities and differences between Powell's Network (the hybrid) mode of organisation and Social Embeddedness.

The collective action portrayed in Powell's network contains the following features (Powell 1990, p. 322):

- *Co-operation can be sustained over the long run as an effective arrangement;*
- *Networks create incentives for learning and the dissemination of information, thus allowing ideas to be translated into action quickly;*
- *The open-ended quality of networks is more useful when resources are variable and the environment uncertain;*
- *Networks offer a highly feasible means of utilising and enhancing such intangible assets as tacit knowledge and technological innovation.*

Powell describes co-operation as an effective arrangement that can be sustained over the long run. In the organisational forms we find in the units of studies, however, co-operation

remains opportunistic and may not be sustainable. Moreover, there has been little regulatory influence.

The findings from this research draw upon the six related themes identified in the literature review. First, an insight into everyday working practices through technology enactment. Second, understanding the evolution of ICT adoption in economic interactions in the context of predictions of intermediary suppression and favouring of arm's-length transactions or a pursuit of long-term cooperative agreements. Third, the effect of ICTs on distribution channels, where virtual non-traditional intermediaries perform the role of traditional intermediaries. Fourth, the culture of connectivity. This describes the development and rise of social networking, which has allowed the creation and exchange of ever more sophisticated user-generated content. This novel form of networked communication has had both positive and negative effects on human interactions. Fifth, the notion of progressive transformation in development, which recognises that ICTs can improve farmers' lives - if uptake is encouraged by socially embedded context. Sixth, an appreciation of socio-economic complementarity to better understand the adoption and enactment of ICTs in farming practices.

7.1 Research Findings

ICTs have clearly not been without effect, seeing sometimes innovative use in rural areas of Mexico. The farmers in my case study use them to support production and distribution, and particularly to maintain contact with their networks, which they rely on for learning, problem solving, and co-operation.

Traditional actors use local and existing connections established on trust and mutual respect, sometimes accrued over several generations of trade. Direct contact and face-to-face communication are established norms for agricultural transactions, important both

for the validation of processes and to build and maintain relationships. Reputation helps economic actors to obtain better terms and conditions and to increase their customer base. Establishing and maintaining reputation and trust requires frequent interactions that reliably satisfy customer specifications, recurrent face-to-face meetings that can be supported by ICTs. Their sense of obligation means social actors often prefer to transact with existing rather than establish novel community connections and business links.

More dynamic actors have instituted the most innovative production changes, moving into organic production and switching towards export. The aggressive pursuit of new knowledge and customers and active digital content generation have helped the most entrepreneurial farmers to thrive and find more robust collaborations outside their local community. Perhaps not surprisingly, younger generations more favourably regard novel communication channels like Facebook and WhatsApp. I have summarised my empirical findings into six headings in alignment with the themes discussed in the literature review.

7.1.1 Technology Enactment in Work Practices

The adoption and enactment of ICTs promotes learning and co-operation, with direct impacts on farming business processes. Farmers tend to follow an individualistic and opportunistic approach in their economic exchanges to maximise profits. They have enacted ICTs to create temporary collaborative working practices, fostering socio-economic relationships that stimulate business development through both traditional community links and novel distant connections: social constructions have emerged as people encounter technologies and enact them in their work practices.

Production. The accumulation of skills and expertise across generations is beneficial in agriculture. Older generations have relevant tacit and technical knowledge and may be the best source of financial capital to invest into for example irrigation technology and additional land for production. Younger generations are more likely to invest in and adopt ICTs for proactive strategic business development.

My findings suggest that two of the more important and consistent contributions of ICTs have been for cost control and the decentralisation of operations. How farmers structure internal processes around ICTs is important: management control systems and planning tools help to monitor land productivity, forecast and manage cash flows, perform gap analyses, and assist in the development of business continuity plans. Information is maintained as electronic spreadsheets (Excel, payroll, and electronic banking), and tracking KPIs offer reliable monitoring of input consumption, costs, and of course production. As relatively modest enterprises, the case study units described in this research use more general software applications rather than the dedicated Enterprise Resource Planning (ERP) or Electronic Data Interchange (EDI) platforms used by larger businesses (Grover et al. 2002). The standardisation of business processes and a delegation of roles and responsibilities has facilitated co-operative relations and therefore communication and collaboration between grower and buyers. That is, ICTs have powerfully facilitated network modes of economic organisation.

The enactment of ICTs has significant relational consequences for mutual trust and can facilitate both ad hoc co-operation and encourages longer-term agricultural contracts. Formal and informal communication through ICT artefacts permits essentially instantaneous exchange and the dissemination of disparate economic and social data (photos, videos, URLs), a powerful means of transferring both tacit and technical knowledge. Access to ever more and better quality information (e.g. more frequent and

more accurate weather forecasts) has become possible. My findings show that innovations like drones are attracting a new generation of farmers keen to trial evolving monitoring technologies. While novel artefacts like drones offer potential, they are immature technologies and must leverage existing physical and market infrastructure to become economically viable. Whether they offer any net benefit remains to be determined.

Distribution. Efficiency gains have accompanied improved ordering and delivery processes. But rather than helping farmers individually, in my case study ICTs have been used mostly as tools for sporadic co-operation with customers, suppliers and other farmers. It is important to recognise that ICTs also support existing “traditional” relationships; they provide alternative (and often easier) means to negotiate and communicate formally and informally. It is tempting to speculate that the widespread and diverse use of social media and WhatsApp reflects the ease with which they combine social and economic functions through sharing voice, text, photos, and videos within carefully defined intra- and intercommunity groups. There is little obvious opportunity cost to the farmer; apps are free and easy to use and give individuals the opportunity to receive content directly and immediately from many useful sources. It is by facilitating communication (with people farmers trust, admire, wish to imitate, or work with for mutual benefit or to comply with industry standards), that ICTs have had their most profound effects on business relationships. Direct effects include establishing and managing relationships through a multitude of novel communication modes, permitting routine follow-up of purchase orders, delivery tracking, and active monitoring of and responding to complaints and suggestions on social media sites. More subtle indirect effects have also occurred. For example, electronic markets have changed information sharing in an industry where face-to-face communication and social interaction continue to be important for business relationships (Schultze and Orlikowski 2004). One grower

created a website to improve visibility to buyers, replacing the function of an imperfect traditional distribution channel. Implementing ICTs has also imposed costs. For the grower who created his own website, there was an immediate resource cost, additional operational burden, a new need for big data analytical skills, and – most significantly in the context of business relationships – disruption of an existing relationship with a long-term buyer.

7.1.2 The Evolution of ICT Adoption in Economic Interactions

Electronic banking has become widely used, at least partly for its security advantages.

While the interviewees in my case study broadly accept that electronic markets offer better visibility and more sales, inefficient logistics and imperfect financial services have constrained end-to-end electronic marketplace transactions in Mexico's domestic agricultural sector. Nevertheless, international global electronic intermediaries (e.g. Freshplaza.com) offer tangible benefits, providing specialised consultant services and partially disintermediating traditional search engines services like Google. They help agents to more easily access appropriate information and have facilitated co-operation with other farmers in a global environment. User content reports prices, advertises produce, and offers new business opportunities.

The role of ICTs in supporting outsourcing deals is clear: farmers have invested in computerised offices with routine monitoring of costs and production, implementing management control systems and ensuring quality certification.

7.1.3 The Effect of ICTs on Distribution Channels

My results are consistent with the general findings of Bakos (1998) and Chircu and Kauffman (1999). Figure 23 describes intermediaries in the agricultural sector:

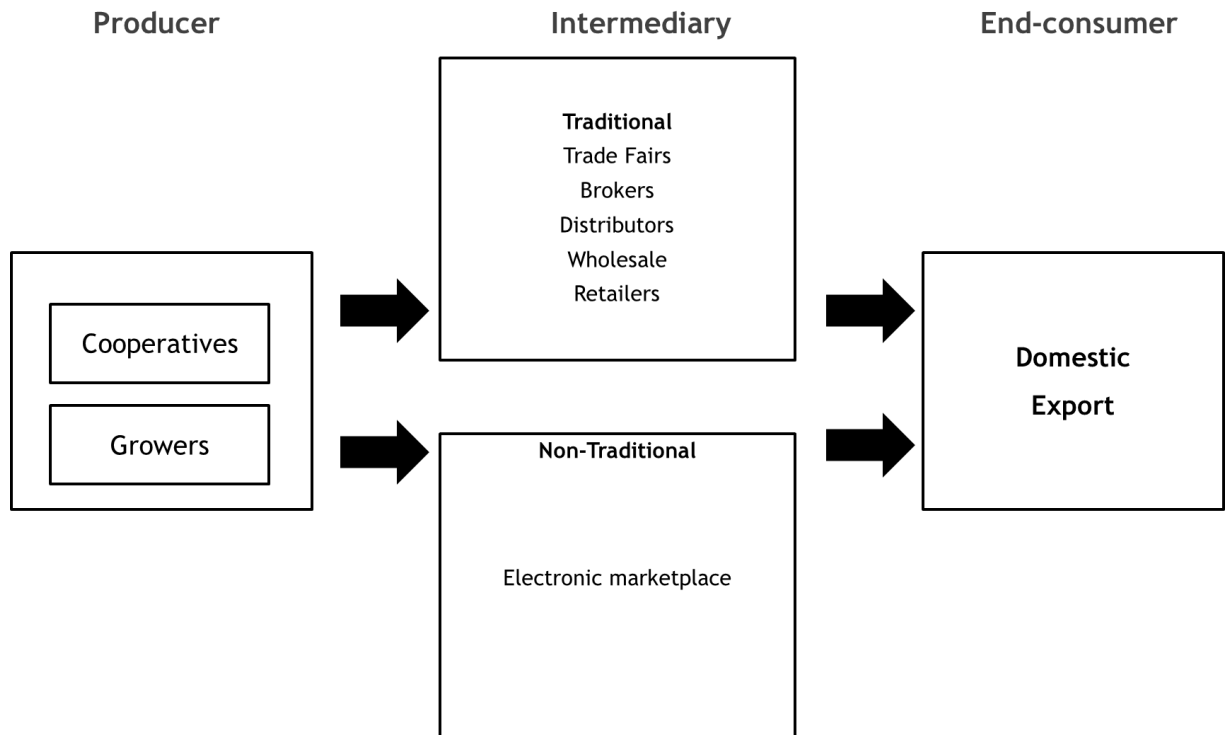


Figure 23 Traditional and non-traditional intermediaries in agricultural distribution channels

ICTs have not entirely displaced traditional intermediaries (trade fairs, brokers, distributors, wholesalers, and retailers), and indeed continue to support them. However, they have enabled market communication and co-operation through non-traditional intermediaries that include farm websites, social media, and global e-marketplaces. These may complement existing traditional distribution channels and provide novel means to meet new partners.

7.1.4 The Culture of Connectivity

Content creation in social media has been the subject of a considerable volume of research, but the literature has tended to neglect the role of social media in agricultural transactions. Virtual social interactions can offer a powerful competitive advantage, and Facebook and YouTube have adopted some business development functions of earlier-generation e-business websites, including advertising and customer feedback. Their role

has become more important than simply helping to identify customer needs, and social media are now actively used to build trust and strengthen co-operation in extensive virtual networks. My findings point towards a surprisingly dominant role for them in marketing by medium-scale farmers.

Technology must of course be affordable if it is to be accessible and available. Because they are applications essentially free at the point of use, adoption rates for Facebook and WhatsApp have been especially high in Mexico's rural areas. Indeed, social media have been an important driver for ICT adoption in general and a principal mechanism for insinuating ICTs into trusted social interaction. Farmers use Facebook and YouTube not only for social purposes as described in the existing literature, but increasingly to host content for the explicit purpose of business growth. Social media are used to diversify into new markets, to search for price data, to share ideas on production techniques, and to overcome physical and social isolation and escape from tradition. This is but another example of the blurring of social and economic boundaries, where the social has become a means for economic and business growth.

My findings suggest that active users of social media are more inclined to expand their agricultural business, but they still require land and the trust and capital of investors. Farmers are aware that customer satisfaction is inextricably linked to quality, and that ICT enactment in production is important to improve yields. They actively recognise the advantages of agricultural contracts and long-term co-operation for revenue stability, and they understand the opportunities that good market knowledge provides for attracting new customers.

7.1.5 Progressive Transformation in Development

The adoption of ICTs has not revolutionised (transformed) economic exchanges in agriculture as predicted by transformative development literature, offering only a modest dis-intermediation of distribution channels to date. Production improvements have proved to be slow, requiring guidance from a global community of technical experts. ICTs have simplified the dissemination and sharing of every greater volumes of knowledge and information amongst both the local community and across the globe. The results of this study confirm previous finding that ICTs, with appropriate supervision, can encourage the adoption of extension services (Van Campenhout 2013). Our findings show that ICTs powerfully facilitate dissemination of tacit agricultural knowledge, often over great distances, especially when recipients are from younger generations.

7.1.6 Socio-Economic Complementarity

ICTs bring improvements to farming business processes by offering not only the means to collect and analyse data but also new mechanisms for learning and co-operation. Farmers enact technologies in production processes based mostly on recommendations from social ties. They consult and support each other.

With limited state regulation to facilitate or encourage collaborative networks, many farmers continue to act as individuals, selling produce through traditional and non-traditional distribution channels and using ICTs to position themselves and survive in the industry. Powell describes co-operation as an effective and sustainable arrangement; in the organisational forms we find in our units of studies, however, co-operation remains opportunistic and may not be sustainable over the long-run. We find no evidence of state policies that effectively facilitate collaborative arrangements, as Powell described for

Emilia-Romagna. Empirical evidence provides a possible answer for how the logic of Social Embeddedness complements the network mode of operations.

7.2 Contribution to Theory

By extending the network organisation model with concepts from Social Embeddedness, I show that relationships – a social component facilitated by trust in existing social ties – are key to mediating and sustaining sporadic collaborative arrangements among individualistic agents, replacing a function of state policy. Norms of co-operation like information sharing and commitment provide the flexibility to cope with risk and uncertainty.

Networks depend significantly on state policies (Powell, 1990) for co-operation to be an effective arrangement that can be sustained over the long run. In the absence of strong policy support, however, farmers may still act collectively, collaborating and supporting each other on an ad hoc basis while still being predominantly individualistic. Social Embeddedness proposes a fundamental role for interpersonal relations in the institutions that drive economic and non-economic activity, transforming an otherwise atomistic rationality of individuals to maximise economic utility (Avgerou and Li 2013). I propose a complementarity between Social Embeddedness and the network form of operation that more accurately describes the socio-economic interactions of farmers: culture and social institutions (family, co-operative associations, etc) facilitate intermittent co-operation. Farmers rely on social connections and business relationships to work and tackle challenges together, learning from each other and cooperating to achieve competitive strength.

7.2.1 The Discovery, Adoption and Implementation of ICTs

Technologies and innovation ideally benefit society. Farmers are not reluctant to use ICTs but they show differences in capability. They learn how to use ICTs from other actors, enacting them in work practices to improve yields through productivity benchmarking against and co-operating with peers and subject matter experts. Economic actors in agriculture rely on social connections and business relationships to co-operate, and both can be powerfully supported by ICTs. Co-operation of family members is particularly important, a source of land, capital, and generational tacit knowledge. Tacit knowledge and social connections are often accumulated over years and support both production and post-production. The foundations of know-how are best learned through involvement at the operational level, and tacit knowledge is best applied via appropriate control mechanisms. Online courses and interactions with customers, suppliers and other farmers are valuable sources of information to expand and diversify farm business. Improvements are often the result of sharing knowledge with other members of the community, and those with stronger ICT capabilities are better equipped to search for knowledge and solutions or to seek support from subject matter experts: ICTs have contributed to the reinvention of agricultural business. ICT capabilities are learned through formal education, from family and social ties and through reciprocity with long-term business relationships. This is consistent with the pursuit of self-interest and has enabled farmers to acquire new capabilities and maintain contact with a large network outside their local community.

We expect a diffusion of new technologies. The younger generation has learned more quickly and is more comfortable with ICTs, readily engaging with novel communication channels like Facebook and WhatsApp and regarding them more favourably.

Actors consult and share specialised resources online. Sophisticated websites host a huge volume of global agriculture data from product advertisements to weather forecasts, pricing data, and the latest global news and process information. Because they better manage complexity, these resources have begun to dis-intermediate generic search engines.

Actors, especially those who export or are registered for organic production, understand the importance of compliance with standards defined by contract or certification bodies for effective long-term co-operation. It has proven valuable to maintain contact with a large network of weaker ties (carrying stronger information about new ideas) who can best guide on optimal land use and business practices. Learning from weak ties and connexions outside their locality helps farmers achieve their goals.

7.2.2 ICT Typology and Form

Traditional farming

Even the most traditional farmer has implemented ICTs to improve business management, primary production, and market access. Business decisions in general, and the adoption of ICTs in particular, are powerfully influenced by social factors that include personal history and family obligation. Our study shows how local social relations affect both farming business process and the adoption and implementation of ICTs. ICT enactment encouraged learning and co-operation, with impacts on both production and distribution. They have been used predominantly for planning and control, and also for intra-cluster co-operation, for negotiation with customers and suppliers, and for external communication.

Farmers have implemented control systems to manage working capital, comprising accounting, inventory management, and payroll software. KPIs enable them to easily compare productivity, a benchmarking of knowledge that assists the identification of inefficiencies in their business processes.

Co-operative and farm websites are an example of internal and external communication that have enabled mutual assistance for production and distribution. Ad hoc co-operation among members of the local community improves visibility and helps farmers reach larger markets and achieve economies of scale, especially for export markets or to outsource large contracts to agro-industry. Where members are unable to complete a purchase order alone, they can work collectively with other growers to fulfil the shipment, or they can suggest alternative producers if they are committed to another buyer.

Business relationships often transcend to a personal and social level. I find that ICTs have enabled collaborations of almost every kind: mobile phones, emails and instant messaging (WhatsApp) support relationships among farmers, customers and suppliers. Despite implementing some quite sophisticated ICTs, some transactions continue to forgo formal signed contracts and are based on trust and reputation instead. Likewise, while dedicated smartphone apps might provide current published price data, many farmers still prefer to canvass warehouse owners. Again, relationships and trust are elevated over the trivial provision of information by an ICT artefact.

Modern and Innovative Farming

Innovative agricultural production practices and market access have benefited from the use of ICTs, which offer an especially powerful means of interaction with people outside the local community. Farmers have exploited the internet to identify new markets and social media for marketing; the latter has proved a surprisingly successful mechanism of

escape from physical isolation, facilitating communication with a vibrant worldwide community. Entrepreneurs have tended to develop the strongest ICT skills, using novel virtual connexions to stimulate innovating business development that better differentiates production and marketing, favouring a network mode of operations where long-term partnerships are an effective arrangement for co-operation.

Dis-intermediation into non-traditional distribution channels has been rather limited, occurring to a meaningful extent only where farmers have successfully combined innovative business strategies with the ICT skills necessary to explore alternative avenues for expanding their customer base.

7.2.3 The Impact of ICTs for Farmers: Beneficiaries and Losers

ICTs have enabled better communication and stronger collaboration between growers and buyers, predominantly through operational change. Information technology has stimulated a modest shift from co-ordination without contract to contract farming, especially for those selling on the export market.

The agricultural sector continues to be traditional and personal, where farmers follow a largely individualistic approach towards transactions. They are assisted by sporadic community support and family ties, favouring direct contact and face-to-face interactions, which may explain why some farmers have failed to find new distribution channels. Social norms are substitutes for complex outsourced contracts and vertical integration.

Those who have benefited the most from ICTs have avoided restrictive business relationships, building multiple relationships that have facilitated learning and the transfer of technological know-how and stabilised revenues and cash flow. These farmers are aware of the advantages of sustaining a long-term co-operation that can bring mutual

benefits. More dynamic farmers recognise the advantages of social media as both sink for and source of information, using it to both advertise their produce and acquire data. Facebook and YouTube are actively used for business development. Farmers are able to participate in online courses and communicate with a global network of subject matter experts, and ICTs have enabled them to build stronger relationships and business alliances through agricultural contracts.

There have been some losers. The most obvious are actors with more limited educational backgrounds or weaker financial means who are less able to adopt ICTs or implement them effectively. Actors who persist in following a traditional model that develops exchanges internally through an incremental and linear process and through existing established distribution channels is most remote from the many advantages that ICTs offer, especially if they resist knowledge and information sharing and avoid long-term co-operation. It is also important to recognise that the pursuit of longer-term relationships is not without cost or risk. Grover and colleagues (2002, p. 235) recognise that “*any long-term relationship can create some level of dependency (and vulnerability) for both partners... asymmetries in the performance of one partner become inextricably linked to the other and conflicts can arise.*”

Chapter 8. Conclusion

This research investigates how farmers working medium-sized farms in a developing country have adopted ICTs, and how these ICTs have impacted work practices. Through an interpretive embedded case study in Mexico with two units of study, I show that the adoption of ICTs has not revolutionised (that is, transformed) economic exchanges as predicted by most literature on progressive transformation in development. ICTs have had a surprisingly weak dis-intermediation effect in distribution channels, but have brought improvements to the overall agricultural business processes, in data collection and analysis and for process learning and implementation.

I advance Powell's concept of the network with Social Embeddedness theory to better understand the context of medium-scale farming in Mexico. It is characterised by an idiosyncratic individualistic approach with a consistent pursuit of self-interest, where the state policies and regulations that Powell considers so important for enabling collaborative arrangements are much more limited. I acknowledge similarities between Powell's Network (the hybrid) mode of organisation and Social Embeddedness (Avgerou and Li 2013; Granovetter 1985; Uzzi 1996) and apply both to better understand the adoption and enactment of ICTs for learning and co-operation, and their effects on the agricultural cycle. Social context, so often neglected in ICT research, is a crucial force for decision-making and dissemination of knowledge and technology, especially in the agricultural context, where social institutions and relationships have facilitated the discovery, adoption, and implementation of ICTs in working practices.

Farming remains inextricably linked to family institutions and community ties, social relationships that complement the enactment of ICTs in agricultural practices. Farmers

communicate, discuss, consult, learn, and co-operate. Social media has expanded their social context quite considerably, making social relationships ever richer and more dispersed across the community and globe. While farmers continue to act as individuals to sell produce, technologies encourage them to innovate and engage new channels, e.g. YouTube and Facebook for marketing, learning, and soliciting customer feedback.

The internet and mobile phones are important means of communications to reach existing and new customers, and farmers use both for this end. ICTs increasingly serve other purposes, however, helping production and distribution processes evolve through better planning and management and more efficient delegation and control.

Overall, this study shows that even traditional farmers have enacted ICTs to improve business management, predominantly through operational change. The greatest beneficiaries have been entrepreneurial and more dynamic farmers who possess technological nous and most recognise the advantage of ICTs for learning and building long-term cooperative alliances. Some have implemented ICTs to great effect, transitioning towards greater relational contracting with an emphasis on security and quality that should provide obvious advantages in the short term. The question remains, however, whether ceding autonomy will induce dependence in the long-term.

8.1 Policy Implications

Hirschman's structuralist approach emphasises the importance of policy and regulation for the transformation of a country: with appropriate public regulations, a trickle-down of "northern" progress should be possible. An understanding of ICT adoption and implementation for learning and co-operation and agricultural production is essential for effective policymaking, especially in Mexico where existing institutions and state policies

are weak. Further research on ICTs and commercial agriculture would be useful in the following areas:

Firstly, the uptake and use of ICTs by farmers is mostly operational, and less so for strategic reasons. One reason that traditional farmers are unable to fully exploit the strategic potential of ICTs is that they persist with the distribution channels in which they have become embedded, a significant inertia that is corroborated in this research. One possible means to integrate these farmers might be for them to exploit social media, the main driver of rising demand for internet access in rural Mexico and increasingly insinuated into their lives.

Secondly, it is not clear how ICTs best help disadvantaged farmers mitigate opportunistic behaviour. While this research shows that learning and co-operation can benefit both production and distribution, we should anticipate that poorer farmers might use the same technologies quite differently. A useful goal might be to encourage smallholders to learn the management skills required to satisfy agricultural contracts with large corporations as co-operatives, resolving a long-standing problem of isolation. Collective representation should be stressed as a powerful means to solve conflict and mitigate opportunistic behaviour, and through ICTs institutions could help smaller-scale producers gain technical and economic expertise and better access subsidies and financial capital.

Thirdly, it would be useful to more fully understand advanced ICTs in the context of other factors that determine a farm's success. Knowledge of and enthusiasm for ICTs is but one part of the agricultural puzzle: farmers must access other factors of production, such as land, irrigation, infrastructure, finance, and subsidy. These may be better provided by institutional support than existing social networks, but this ideally requires professional

management support and investment in ICT integration capabilities to apply the logic of network organisation, enabling business collaborations and alliances.

Finally, why has the implementation of “all-in-one market” platforms that provide combined market and hierarchy-oriented functionality, consulting services and transaction co-ordination adaptable to local needs (Dai and Kauffman 2002; Kambil et al. 1999; Koch and Schultze 2011) been relatively unsuccessful in the agricultural sector? How does this relate to social context and network forms of organisation?

8.2 Limitations

This research must be assessed in the light of its limitations and vulnerabilities. A case study unit may differ from that anticipated at the outset, or the study’s conclusions may lack generalisability. I hope to have achieved generalisability by applying middle-range theory through iterative exploration of empirical data using existing theories, a generalisation framework from empirical description to theory that is testable and empirically valid. Environmental and external economic circumstances may change to negate the conclusions of this research; for example, a renegotiation of NAFTA, the resurgence of global protectionism, or disease outbreaks that affect bananas or rice.

This study offers but a single glimpse in an ongoing digital innovation process where changes in human behaviour (and therefore development) need time, perhaps generations, to fully realise. This is especially the case for the agricultural sector, where users must re-think the ways they conduct day-to-day activities as existing power dynamics shift. Given the slow observed pace of change, an important consideration is whether this study adequately captures the full effects of ICTs; a longer-term ethnographic study design is more appropriate, but costly. Perhaps the only way to identify the complete

transformation is a periodic evaluation of ICTs and their evolving contribution to economic change.

This thesis provides insight into the contribution of ICTs to learning and co-operation. However, it does not provide information on the risks, dependencies, vulnerabilities and conflict issues that can arise from long-term relationships as described by Grover et al. (2002), Koch and Schultze (2011), and Koch et al. (2013). That is, while I have been able to explore how ICTs relate to working practices on farmers working medium-sized farms, further research is required to fully understand any evolving negative consequences. This might be achieved by analysing outsourcing contracts from the alternate perspective of a large agri-business corporation. Furthermore, additional research on large corporation procurement practices would be useful to fully understand better the network form of organisation.

Appendix 1 Interviewees

Case Study A

Case ID	Respondent profile	Farming experience	Respondent's education	Farm type and Size	Farmer ICT adoption stage / firm
A1	Male, grower, 50+	40 years	University degree in Agricultural Engineering	Banana plantation 120 hectares, 3 employees, 120 workers	Office automation: information systems supporting business operations, management accounting systems and forecasting techniques. Computer apps: Microsoft suite, awareness of e-market place: electronic bank, email, mobile phone apps, cameras to supervise operation, RFID, drones, brand: <i>Santa Rita</i>
A2	Male, grower, 40+	Fourth-generation farmer	University degree in Accounting and Finance	Banana plantation 130 hectares, cattle 500 hectares, 2 employees, 130 workers	Office automation: information systems supporting business operations, management accounting systems and forecasting techniques. Computer apps: Microsoft suite, awareness of e-market place: electronic bank, email, mobile phone apps, cameras to supervise operations, RFID, brand: <i>Grupo Alta</i>
A3	Male, grower, 50+	30 years, President of UARSETPP for 8+ years	University degree in Veterinary Science	Banana plantation 180 hectares, cattle 370 hectares, 4 employees, 150 workers	Office automation: information systems supporting business operations, management accounting systems and forecasting techniques. Computer apps: Microsoft suite, awareness of e-market place: electronic bank, email, mobile phone apps, cameras to supervise operations, RFID, social media: Webpage/Facebook, brand: <i>El Refugio</i>

Case Study A

Case ID	Respondent profile	Farming experience	Respondent's education	Farm type and Size	Farmer ICT adoption stage / firm
A4	Male, grower and broker, 40+	10 years	Secondary school	Banana plantation 600 hectares, 15 employees, 420 workers	Office automation: information systems supporting business operations, management accounting systems and forecasting techniques. Computer apps: Microsoft suite, awareness of e-market place: electronic bank, email, mobile phone apps, brand: <i>Tony Bananas</i>
A5	Male, grower, 19	3 years	Undergraduate in Economics	Banana plantation 600 hectares, 15 employees, 420 workers	Office automation: information systems supporting business operations, management accounting systems and forecasting techniques. Computer apps: Microsoft suite, awareness of e-market place: electronic bank, email, mobile phone apps, brand: <i>Tony Bananas</i>
A6	Male, grower, 29	1 year	University degree in Management, Master in Agribusiness	Banana plantation 120 hectares, 3 employees	Office automation: information systems supporting business operations, management accounting systems and forecasting techniques. Computer apps: Microsoft suite, awareness of e-market place: electronic bank, email, mobile phone apps, cameras to supervise operation, RFID, drones, brand: <i>Santa Rita</i>
A7	Male grower, 40+	10 years	University degree in Law, public notary in Teapa	Banana plantation 120 hectares, 3 employees	Office automation: information systems supporting business operations, management accounting systems and forecasting techniques. Computer apps: Microsoft suite, awareness of e-market place: electronic bank, email, mobile phone apps, cameras to supervise operation, drones, brand: <i>Santa Rita</i>

Case Study B

Case ID	Respondent profile	Farming experience	Respondent's education	Farm type and Size	Farmer ICT adoption stage / firm
B1	Male grower, 30+	17 years	University degree in Aquaculture Engineering	Organic rice 100 hectares and buffalo 300, 3 employees, 25 workers	Office automation: information systems supporting business operations, management accounting systems and forecasting techniques. Computer apps: Microsoft suite, awareness of e-market place: electronic bank, email, Skype: video conference calls, mobile phone apps, cameras to supervise operation, RFID, company webpage, Facebook and YouTube Company: <i>Organicos del Tropico</i> . Rancho Pancho Villa. Brand: Pijije
B2	Male grower, 60+	40 years	University degree in Agricultural Engineering	Rice, palm oil, cassava and yam 1,500 hectares	Internet, email, YouTube, virtual learning apps, weather apps, Google maps, mobile phone apps
B3	Male, internet service provider, 50+		University degree in Information Systems Engineering		Rural internet service provider
B4	Male grower, 30+	5 years	University degree in Industrial Engineering	Cassava and yam 600 hectares	Internet, Email, YouTube, mobile phone apps. Rancho Surinam and Rancho Laguna Blanca

Appendix 2 Site Access



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26 February 2015

Dear Julio Cesar,

Emilio Lastra Gil is a PhD student in Information Systems and Innovation, Department of Management, at the London School of Economics and Political Science. His research is about the way information and communication technologies contribute to socio-economic development and his empirical study concerns the use of mobile phones in rural areas of Mexico. More specifically he is interested in exploring the wholesale market Central de Abastos (CEDA) in Mexico City as one of the potential sites for studying the relationship between intermediaries and smallholder farmers. Following this study in CEDA Emilio will conduct further studies in a number of locations of farming communities in Mexico.

Emilio is using in his research qualitative methods which require observation of the way business is conducted in the market and informal conversations with sellers and buyers. His tentative plan is to visit CEDA on the following dates and times:

Itinerary	Date	Time	Objective
Day 1	Mon- 30th March, 2015	8:00am - 14:00pm	Identify a market for analysis
Day 2	Wed -1st April, 2015	8:00am - 14:00pm	Visit the selected market accompanied by staff of CEDA

I would be grateful if you could allow Emilio to visit CEDA on the dates and times indicated above and observe the way the market operates. We would also appreciate your advice and help for identifying the market he could observe and approach. Finally, it would be particularly helpful if he could use a camera during his visit to the market.

Looking forward to hearing from you.

Yours Sincerely

A handwritten signature in black ink, appearing to read 'Chrisanthi Avgerou'.

Chrisanthi Avgerou
Professor of Information Systems
London School of Economics

Sample letter requesting formal permission from a gatekeeper (CEDA CDMX)

Appendix 3 Mobile phone network coverage in Mexico (2017)

Source: http://www.cellularmaps.com/mx_net_compare.shtml



Telcel 2G coverage



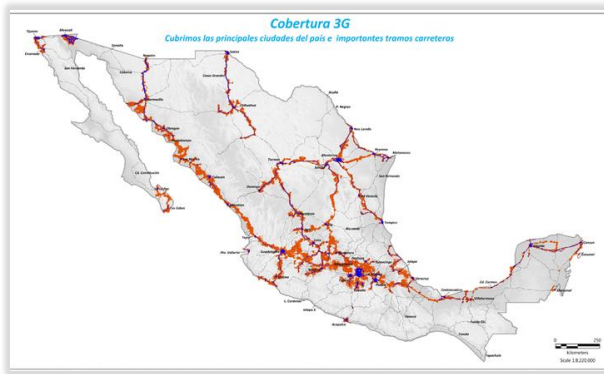
Telcel 3G coverage



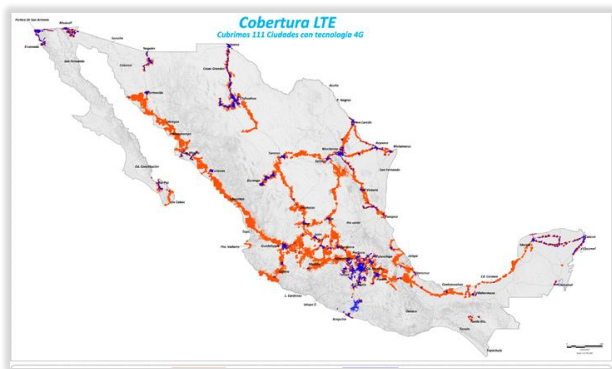
Telcel 4G coverage



Movistar 2G, 3G and 4G coverage



AT&T 3G coverage



AT&T 4G coverage

Bibliography

- Adler, Paul S (2001), 'Market, hierarchy, and trust: The knowledge economy and the future of capitalism', *Organization Science*, 12 (2), 215-34.
- Aker, Jenny C (2008), 'Does digital divide or provide? The impact of cell phones on grain markets in Niger', *Center for Global Development working paper*.
- (2010), 'Information from markets near and far: Mobile phones and agricultural markets in Niger', *American Economic Journal: Applied Economics*, 2 (3), 46-59.
- (2011), 'Dial "A" for agriculture: a review of information and communication technologies for agricultural extension in developing countries', *Agricultural Economics*, 42 (6), 631-47.
- Aker, Jenny C and Mbiti, Isaac M (2010), 'Mobile phones and economic development in Africa', *Center for Global Development working paper*, (24-3), 207-32.
- Alchian, Armen A and Woodward, Susan (1987), 'Reflections on the Theory of the Firm', *Journal of Institutional and Theoretical Economics (JITE)*, 143 (1), 110-36.
- Ali, Jabir and Kumar, Sushil (2011), 'Information and communication technologies (ICTs) and farmers' decision-making across the agricultural supply chain', *International Journal of Information Management*, 31 (2), 149-59.
- Allen, Douglas W and Lueck, Dean (2005), 'Agricultural contracts', *Handbook of New Institutional Economics* (Springer), 465-90.
- Alvarez, Jorge and Nuthall, Peter (2006), 'Adoption of computer based information systems: the case of dairy farmers in Canterbury, NZ, and Florida, Uruguay', *Computers and electronics in agriculture*, 50 (1), 48-60.
- Angelov, Samuil and Grefen, Paul (2003), 'The 4W framework for B2B e-contracting', *International journal of networking and virtual organisations*, 2 (1), 78-97.
- Attride-Stirling, Jennifer (2001), 'Thematic networks: an analytic tool for qualitative research', *Qualitative research*, 1 (3), 385-405.
- Avgerou, Chrisanthi (2002), *Information systems and global diversity* (Oxford University Press).
- (2010), 'Discourses on ICT and Development', *Information Technologies & International Development* (6), 1-18.
- Avgerou, Chrisanthi and Li, Boyi (2013), 'Relational and institutional embeddedness of Web-enabled entrepreneurial networks: case studies of entrepreneurs in China', *Information Systems Journal*, 23 (4), 329-50.
- Avgerou, Chrisanthi, Hayes, Niall, and La Rovere, Renata Lèbre (2016), 'Growth in ICT uptake in developing countries: new users, new uses, new challenges', (Springer).
- Bailey, Joseph P and Bakos, Yannis (1997), 'An exploratory study of the emerging role of electronic intermediaries', *International journal of electronic commerce*, 1 (3), 7-20.
- Bakos, J Yannis (1991), 'A strategic analysis of electronic marketplaces', *MIS Quarterly*, 295-310.
- Bakos, Yannis (1998), 'The emerging role of electronic marketplaces on the Internet', *Communications of the ACM*, 41 (8), 35-42.
- Bakos, Yannis and Brynjolfsson, Erik (1998), 'Organizational partnerships and the virtual corporation', *Information Technology and Industrial Competitiveness* (Springer), 49-66.

- Banker, Rajiv, Mitra, Sabyasachi, and Sambamurthy, V (2011), 'The effects of digital trading platforms on commodity prices in agricultural supply chains', *MIS quarterly*, 35 (3), 599-611.
- Bao, Liwei, et al. (2012), 'On the Supply Chain Management Supported by E-Commerce Service Platform for Agreement based Circulation of Fruits and Vegetables', *Physics Procedia*, 33, 1957-63.
- Baumüller, Heike (2012), 'Facilitating agricultural technology adoption among the poor: The role of service delivery through mobile phones'.
- Bazeley, Patricia and Jackson, Kristi (2013), *Qualitative data analysis with NVivo* (Sage Publications Limited).
- Becker, Howard S (2008), *Tricks of the trade: How to think about your research while you're doing it* (University of Chicago Press).
- Benjamin, Robert and Wigand, Rolf (1995a), 'Electronic markets and virtual value chains on the information superhighway', *Sloan Management Review (Winter, 1995)*.
- (1995b), 'Electronic markets and virtual value chains on the information superhighway', *Sloan Management Review*, 36 (2), 62.
- Bensaou, Michael (1997), 'Interorganizational cooperation: The role of information technology an empirical comparison of US and Japanese supplier relations', *Information Systems Research*, 8 (2), 107-24.
- Berdegúe, JA and Fuentealba, R (2014a), 'The state of smallholders in agriculture in Latin America', in Peter BR Hazell and Atiqur Rahman (eds.), *New Directions for Smallholder Agriculture* (Oxford, GB: Oxford University Press), 574.
- (2014b), 'Chapter 5. The state of smallholders in agriculture in Latin America', in Peter BR Hazell and Atiqur Rahman (eds.), *New directions for smallholder agriculture* (OUP Oxford).
- Bhappu, Anita D (2000), 'The Japanese family: An institutional logic for Japanese corporate networks and Japanese management', *Academy of management Review*, 25 (2), 409-15.
- Bhatnagar, Subhash (2008), 'Benefits from rural ICT applications in India: Reducing transaction costs and enhancing transparency?', *LIRNEasia presentation at public lecture on ICT in Agriculture, Colombo, Sri Lanka*, 25 (02), 2008.
- Boadi, Raymond A, et al. (2007), 'Preliminary insights into m-commerce adoption in Ghana', *Information Development*, 23 (4), 253-65.
- Bourdieu, Pierre (1993), *Sociology in question* (London: Sage).
- Boyd, D Eric and Spekman, Robert E (2004), 'Internet usage within B2B relationships and its impact on value creation: A conceptual model and research propositions', *Journal of Business to Business Marketing*, 11 (1-2), 9-34.
- Brush, Gregory J and McIntosh, Duncan (2010), 'Factors influencing e-marketplace adoption in agricultural micro-enterprises', *International Journal of Electronic Business*, 8 (4-5), 405-32.
- Burrell, Jenna and Oreglia, Elisa (2015), 'The myth of market price information: mobile phones and the application of economic knowledge in ICTD', *Economy and Society*, 44 (2), 271-92.
- Burt, Ronald S (1992), *Structural holes: The social structure of competition* (Harvard University Press).
- Cairncross, Frances (2001), *The death of distance: How the communications revolution is changing our lives* (Harvard Business Press).
- Campbell, Scott W (2007), 'Perceptions of mobile phone use in public settings: A cross-cultural comparison', *International Journal of Communication*, 1 (1), 20.

- Cateora, Philip R (2011), *International Marketing* (15th edn.: Tata McGraw-Hill Education).
- CEDA CDMX (2015), 'Central de Abastos de la Ciudad de Mexico', in Central de Abasto (ed.), *Visititas Guiadas Institucionales* (Mexico, City).
- Chircu, Alina M and Kauffman, Robert J (1999), 'Strategies for Internet middlemen in the intermediation/disintermediation/reintermediation cycle', *Electronic Markets*, 9 (1-2), 109-17.
- Choudhury, Vivek, Hartzel, Kathleen S, and Konsynski, Benn R (1998), 'Uses and consequences of electronic markets: an empirical investigation in the aircraft parts industry', *MIS quarterly*, 22 (4), 471-507.
- Chunmei, Gan and Weijun, Wang (2011), 'Construction of web-based business information service system in China', *International Conference on E-Business and E-Government, May 2011* (Shanghai, China: IEEE), 1-4.
- CIA (2017), 'The World Factbook', in Central Intelligence Agency (ed.).
- Ciborra, Claudio (1993), *Teams, markets and systems: business innovation and information technology* (Cambridge university press).
- Clemons, Eric K and Row, Michael C (1992), 'Information technology and industrial cooperation: the changing economics of coordination and ownership', *Journal of Management Information Systems*, 9 (2), 9-28.
- Clemons, Eric K, Reddi, Sashidhar P, and Row, Michael C (1993), 'The impact of information technology on the organization of economic activity: The "move to the middle" hypothesis', *Journal of management information systems*, 10 (2), 9-35.
- Cloete, Eric and Doens, Martin (2008), 'B2B e-marketplace adoption in South African agriculture', *Information Technology for Development*, 14 (3), 184-96.
- Coase, Ronald H (1937), 'The nature of the firm', *economica*, 4 (16), 386-405.
- Coleman, James S (1988), 'Social capital in the creation of human capital', *American journal of sociology*, S95-S120.
- Collin, Sven-Olof and Larsson, Rikard (1993), 'Beyond markets and hierarchies: A Swedish quest for a tripolar institutional framework', *International Studies of Management & Organization*, 23 (1), 3-12.
- Contreras-Martinez de Escobar, M. A. (2014), 'Historia, Presente y Perspectiva del Sector Bananero en la Region de la Sierra'.
- Cordella, Antonio (2009), 'Transaction costs and information systems: does IT add up?', *Bricolage, Care and Information* (Springer), 386-400.
- Dai, Qizhi and Kauffman, Robert J (2002), 'Business models for internet-based B2B electronic markets', *International Journal of Electronic Commerce*, 6 (4), 41-72.
- Daskalopulu, Aspasia and Maibaum, Tom (2001), 'Towards electronic contract performance', *Database and Expert Systems Applications, 2001. Proceedings. 12th International Workshop on* (IEEE), 771-77.
- Davidson, Elizabeth J and Chismar, William G (2007), 'The interaction of institutionally triggered and technology-triggered social structure change: an investigation of computerized physician order entry', *MIS quarterly*, 739-58.
- De Janvry, Alain, Sadoulet, Elisabeth, and Murgai, Rinku (2002), 'Rural development and rural policy', *Handbook of agricultural economics*, 2, 1593-658.
- De Silva, Harsha and Ratnadiwakara, Dimuthu (2008), 'Using ICT to reduce transaction costs in agriculture through better communication: A case-study from Sri Lanka', *LIRNEasia, Colombo, Sri Lanka*.
- De Soto, H (1989), *The Other Path: The invisible revolution in the third world* (New York: Harper and Row).

- Dedrick, Jason, Gurbaxani, Vijay, and Kraemer, Kenneth L (2003), 'Information technology and economic performance: A critical review of the empirical evidence', *ACM Computing surveys*, 35 (1), 1-28.
- Denzin, Norman K (1989), *The research act in sociology* (Englewood Cliffs, NJ: Prentice Hall).
- Dethier, Jean-Jacques and Effenberger, Alexandra (2012), 'Agriculture and development: A brief review of the literature', *Economic Systems*, 36 (2), 175-205.
- Dey, Bidit, Newman, David, and Prendergast, Renee (2011), 'Analysing appropriation and usability in social and occupational lives: An investigation of Bangladeshi farmers' use of mobile telephony', *Information Technology & People*, 24 (1), 46-63.
- Dey, Bidit, et al. (2013), 'A qualitative enquiry into the appropriation of mobile telephony at the bottom of the pyramid', *International Marketing Review*, 30 (4), 297-322.
- Díaz Andrade, Antonio and Urquhart, Cathy (2010), 'The affordances of actor network theory in ICT for development research', *Information Technology & People*, 23 (4), 352-74.
- Donner, Jonathan (2004), 'Microentrepreneurs and mobiles: An exploration of the uses of mobile phones by small business owners in Rwanda', *Information Technologies and International Development*, 2 (1), 1-22.
- (2007), 'Customer acquisition among small and informal businesses in urban India: Comparing face-to-face and mediated channels', *EJISDC: The Electronic Journal on Information Systems in Developing Countries*, (32), 3.
- (2008), 'Research approaches to mobile use in the developing world: A review of the literature', *The Information Society*, 24 (3), 140-59.
- Dore, Ronald (1983), 'Goodwill and the spirit of market capitalism', *The British Journal of Sociology*, 34 (4), 459-82.
- Dorfman, Jeffrey H (1996), 'Modeling multiple adoption decisions in a joint framework', *American Journal of Agricultural Economics*, 78 (3), 547-57.
- Dorward, Andrew, Kydd, Jonathan, and Poulton, Colin (2005), 'Beyond liberalisation: "Developmental coordination" policies for African smallholder agriculture', *IDS bulletin*, 36 (2), 80-85.
- Douglas, Mary (1986), *How institutions think* (Syracuse University Press).
- Draca, Mirko, Sadun, Raffaella, and Van Reenen, John (2006), 'Productivity and ICT: A Review of the Evidence'.
- Duncombe, Richard (2016), 'Mobile Phones for Agricultural and Rural Development: A Literature Review and Suggestions for Future Research', *The European Journal of Development Research*, 28 (2), 213-35.
- Duncombe, Richard and Heeks, Richard (2002), 'Enterprise across the digital divide: information systems and rural microenterprise in Botswana', *Journal of International Development*, 14 (1), 61-74.
- Duncombe, Richard A (2014), 'Understanding the impact of mobile phones on livelihoods in developing countries', *Development Policy Review*, 32 (5), 567-88.
- Eaton, Charles and Shepherd, Andrew (2001), *Contract farming: partnerships for growth* (Food & Agriculture Org.).
- Eggleston, Karen, Jensen, Robert, and Zeckhauser, Richard (2002), 'Information and communication technologies, markets, and economic development', *Discussion Papers Series, Department of Economics, Tufts University*, 203.
- Eisenhardt, Kathleen M (1989), 'Building theories from case study research', *Academy of management review*, 14 (4), 532-50.
- Emerson, Robert M, Fretz, Rachel I, and Shaw, Linda L (2011), *Writing ethnographic fieldnotes* (University of Chicago Press).

- Engel, Eduardo, Fischer, Ronald, and Galetovic, Alexander (2013), 'The basic public finance of public-private partnerships', *Journal of the European Economic Association*, 11 (1), 83-111.
- Evans, Martin (2014), 'Corporate agribusiness development and small farms', in Peter BR Hazell and Atiqur Rahman (eds.), *New directions for smallholder agriculture* (Oxford University Press).
- Foucault, Michel (1980), 'The history of sexuality: An introduction, volume I', *Trans. Robert Hurley. New York: Vintage*.
- Fowler, Sally W, Lawrence, Thomas B, and Morse, Eric A (2004), 'Virtually embedded ties', *Journal of Management*, 30 (5), 647-66.
- Gold, Raymond L (1958), 'Roles in sociological field observations', *Social forces*, 217-23.
- Goyal, Aparajita (2010), 'Information, direct access to farmers, and rural market performance in central India', *World Bank Policy Research Working Paper Series, Vol.*
- Granovetter, Mark (1985), 'Economic action and social structure: The problem of embeddedness', *American journal of sociology*, 481-510.
- (2005), 'The impact of social structure on economic outcomes', *Journal of economic perspectives*, 19 (1), 33-50.
- Granovetter, Mark and Swedberg, Richard (2011), *The sociology of economic life* (3rd edn.: Westview press Boulder, CO).
- Granovetter, Mark S (1973), 'The strength of weak ties', *American journal of sociology*, 1360-80.
- Grint, Keith and Woolgar, Steve (2013), *The machine at work: Technology, work and organization* (John Wiley & Sons).
- Grover, Varun, Teng, James TC, and Fiedler, Kirk D (2002), 'Investigating the role of information technology in building buyer-supplier relationships', *Journal of the Association for Information Systems*, 3 (1), 7.
- Gutek, Barbara A (1995), *The dynamics of service: Reflections on the changing nature of customer/provider interactions* (Jossey-Bass).
- Halewood, Naomi J and Surya, Priya (2012), 'Mobilizing the agricultural value chain', *World Bank*.
- Hammersley, Martyn and Atkinson, Paul (2007), *Ethnography: Principles in practice* (Routledge).
- Hart, Paul and Saunders, Carol (1997), 'Power and trust: Critical factors in the adoption and use of electronic data interchange', *Organization Science*, 8 (1), 23-42.
- Hatch, J. (2002), *Doing qualitative research in education settings* (SUNY Press).
- Hayes, N and Westrup, C (2012), 'Context and the processes of ICT for development', *Information and organization*, 22 (1), 23-36.
- Hayes, Nicky (2013), *Doing qualitative analysis in psychology* (Psychology Press).
- Hazell, Peter BR and Rahman, Atiqur (2014), 'Chapter 18. The Policy Agenda', in Peter BR Hazell and Atiqur Rahman (eds.), *New directions for smallholder agriculture* (OUP Oxford).
- Heeks, Richard (2010), 'Do information and communication technologies (ICTs) contribute to development?', *Journal of International Development*, 22 (5), 625-40.
- Hennart, Jean-Francois (1993), 'Explaining the swollen middle: Why most transactions are a mix of "market" and "hierarchy"', *Organization Science*, 4 (4), 529-47.
- Henriques, Justin J and Kock, Beaudry E (2012), 'Empowering smallholders and local food markets with smartphones and social networks', *Global Humanitarian Technology Conference (GHTC), 2012 IEEE (IEEE)*, 181-85.
- Hirschman, Albert O (1958), *The strategy of economic development* (Yale University Press).

- (1963), *Journeys Toward Progress. Studies of Economic Policy-making in Latin America* (Twentieth Century Fund).
- Hoffman, Donna L, Novak, Thomas P, and Chatterjee, Patrali (1995), 'Commercial scenarios for the web: opportunities and challenges', *Journal of Computer-Mediated Communication*, 1 (3), 0-0.
- Holland, Christopher P and Lockett, A Geoffrey (1997), 'Mixed mode network structures: The strategic use of electronic communication by organizations', *Organization Science*, 8 (5), 475-88.
- INEGI (2007), 'Censo Agrícola, Ganadero y Forestal 2007'.
- (2010), 'Censo de poblacion y vivienda'.
- Jenkins, David (1980), 'An adversarys account of SAFARIs ethics of case study', *Towards a Science of the Singular: essays about case study in educational research and evaluation*, 147-59.
- Jensen, Robert (2007), 'The digital provide: Information (technology), market performance, and welfare in the South Indian fisheries sector', *The quarterly journal of economics*, 879-924.
- Jones, Candace, Hesterly, William S, and Borgatti, Stephen P (1997), 'A general theory of network governance: Exchange conditions and social mechanisms', *Academy of management review*, 22 (4), 911-45.
- Kallinikos, Jannis (2011), *Governing through technology: Information artefacts and social practice* (Springer).
- Kambil, Ajit, Nunes, Paul F, and Wilson, Diane (1999), 'Transforming the marketspace with all-in-one markets', *International Journal of Electronic Commerce*, 3 (4), 11-28.
- Keys, Eric (2005), 'Exploring market based development: market intermediaries and farmers in Calakmul, Mexico', *Geographical Review*, 95 (1), 24-46.
- Knorr-Cetina, Karin, Schatzki, Theodore R, and Von Savigny, Eike (2001), *The practice turn in contemporary theory* (Psychology Press).
- Koch, Hope and Schultze, Ulrike (2011), 'Stuck in the conflicted middle: a role-theoretic perspective on B2B e-marketplaces', *MIS quarterly*, 35 (1), 123-46.
- Koch, Hope, Leidner, Dorothy E, and Gonzalez, Ester S (2013), 'Digitally enabling social networks: resolving IT–culture conflict', *Information Systems Journal*, 23 (6), 501-23.
- Kraut, Robert, et al. (1999), 'Coordination and virtualization: The role of electronic networks and personal relationships', *Organization Science*, 10 (6), 722-40.
- Krishna, P Radha, Karlapalem, Kamalakar, and Dani, Ajay R (2005), 'From contracts to e-contracts: Modeling and enactment', *Information Technology and Management*, 6 (4), 363-87.
- Kumar, R. (2004), 'eChoupals: A study on the financial sustainability of village internet centers in rural Madhya Pradesh', *Information Technologies and International Development*, 2 (1), 45-74.
- Kydd, Jonathan and Dorward, Andrew (2004), 'Implications of market and coordination failures for rural development in least developed countries', *Journal of International Development*, 16 (7), 951-70.
- Lal, D. (1983), 'The Misconceptions of 'Development Economis'', *Finance and Development*, 10-13.
- Lastra-Gil, LE (2011), 'Mexico's lost Century? Measuring Income Distribution in the 20th Century (unpublished)', (The London School of Economics and Political Sciences).
- (2017), 'The Effect of ICTs on Agricultural Distribution Channels in Mexico', in Richard Duncombe (ed.), *Digital Technologies for Agricultural and Rural development in the Global South* (Oxford: CABE).

- Lave, Jean (1988), *Cognition in practice: Mind, mathematics and culture in everyday life* (Cambridge University Press).
- Leonardi, Paul M (2007), 'Activating the informational capabilities of information technology for organizational change', *Organization science*, 18 (5), 813-31.
- Leonardi, Paul M and Barley, Stephen R (2010), 'What's under construction here? Social action, materiality, and power in constructivist studies of technology and organizing', *Academy of Management Annals*, 4 (1), 1-51.
- Leonardi, Paul M, Nardi, Bonnie A, and Kallinikos, Jannis (2012), *Materiality and organizing: Social interaction in a technological world* (Oxford University Press on Demand).
- Lincoln, Yvonna S and Guba, Egon G (1985), *Naturalistic inquiry* (Beverly Hills, CA: Sage Publications).
- (1989), 'Ethics: The Failure of Positivist Science', *Review of Higher Education*, 12 (3), 221-40.
- López-Calva, Luis Felipe and Lustig, Nora Claudia (2010), *Declining inequality in Latin America: A decade of progress?* (Washington, D.C.: Brookings Institution Press).
- Lowder, Sarah K, Skoet, Jakob, and Singh, Saumya (2014), 'What do we really know about the number and distribution of farms and family farms in the world?', *Background paper for The State of Food and Agriculture*, 8.
- Lusk, M. (1992), 'Social Development and the State in Latin America: A new approach', *Social Development Issues*, 14 (1), 10-21.
- Lyon, Fergus (2000), 'Trust, networks and norms: the creation of social capital in agricultural economies in Ghana', *World development*, 28 (4), 663-81.
- Madill, Anna, Jordan, Abbie, and Shirley, Caroline (2000), 'Objectivity and reliability in qualitative analysis: Realist, contextualist and radical constructionist epistemologies', *British journal of psychology*, 91 (1), 1-20.
- Madon, Shirin (2009a), 'Telecentres for Rural Outreach in Kerala', *e-Governance for Development* (Springer), 121-35.
- (2009b), 'E-Governance for Development', in Shirin Madon (ed.), *E-Governance for Development: A focus on rural India* (London: Palgrave Macmillan).
- (2009c), 'What Do We Mean by Development?', *e-Governance for Development* (Springer), 9-32.
- Mähring, Magnus, et al. (2004), 'Trojan actor-networks and swift translation: Bringing actor-network theory to IT project escalation studies', *Information Technology & People*, 17 (2), 210-38.
- Malone, Thomas W, Yates, Joanne, and Benjamin, Robert I (1987), 'Electronic markets and electronic hierarchies', *Communications of the ACM*, 30 (6), 484-97.
- (1989), 'The logic of electronic markets', *Harvard Business Review*, 67 (3), 166-72.
- Markus, M Lynne (1983), 'Power, politics, and MIS implementation', *Communications of the ACM*, 26 (6), 430-44.
- Mbarika, Victor WA, et al. (2007), 'IT education and workforce participation: a new era for women in Kenya?', *The Information Society*, 23 (1), 1-18.
- Ménard, Claude (2005), 'A New Institutional Approach to Organization', in Claude Ménard and Mary M Shirley (eds.), *Handbook of new institutional economics* (9: Springer).
- Merz, Michael, et al. (1998), 'Supporting electronic commerce transactions with contracting services', *International Journal of Cooperative Information Systems*, 7 (04), 249-74.
- Miles, Matthew B and Huberman, A Michael (1994), *Qualitative data analysis: An expanded sourcebook* (Sage).
- Miller, Daniel and Slater, Don (2000), 'The Internet: an ethnographic approach', (Oxford: Berg).

- Mittal, Surabhi, Gandhi, Sanjay, and Tripathi, Gaurav (2010), *Socio-economic impact of mobile phones on Indian agriculture* (Indian Council for Research on International Economic Relations New Delhi).
- Molla, Alemayehu (2000), 'Downloading or uploading? The information economy and Africa's current status', *Information Technology for Development*, 9 (3), 205-21.
- Molony, Thomas (2006), "' I Don't Trust the Phone; It Always Lies": Trust and Information and Communication Technologies in Tanzanian Micro-and Small Enterprises', *Information Technologies & International Development*, 3 (4), pp. 67-83.
- (2008), 'Running out of credit: the limitations of mobile telephony in a Tanzanian agricultural marketing system', *The Journal of Modern African Studies*, 46 (04), 637-58.
- (2009), 'Carving a niche: ICT, social capital, and trust in the shift from personal to impersonal trading in Tanzania', *Information Technology for Development*, 15 (4), 283-301.
- Munyua, Hilda (2007), 'ICTs and small-scale agriculture in Africa: a scoping study'.
- Munyua, Hilda and Adera, Edith (2009), 'Emerging ICTs and Their Potential in Revitalizing Small-Scale Agriculture', *Agricultural information worldwide*, 2 (1), 3-9.
- Muto, Megumi and Yamano, Takashi (2009), 'The impact of mobile phone coverage expansion on market participation: Panel data evidence from Uganda', *World development*, 37 (12), 1887-96.
- Nahapiet, Janine and Ghoshal, Sumantra (1998), 'Social capital, intellectual capital, and the organizational advantage', *Academy of management review*, 23 (2), 242-66.
- National Development Plan 2013-2018 <<http://pnd.gob.mx/>>, accessed 30/09/2016.
- National Digital Strategy 2013-2018 <<https://www.gob.mx/mexicodigital/>>, accessed 30/09/2016.
- Netting, Robert McC (1993), *Smallholders, householders: farm families and the ecology of intensive, sustainable agriculture* (Stanford University Press).
- Nonaka, Ikujiro (1994), 'A dynamic theory of organizational knowledge creation', *Organization science*, 5 (1), 14-37.
- North, Douglass C (1995), 'The new institutional economics and third world development', *The new institutional economics and third world development* (21: Routledge, London and New York).
- Oreglia, Elisa, Liu, Ying, and Zhao, Wei (2011), 'Designing for emerging rural users: experiences from China', *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems* (ACM), 1433-36.
- Orlikowski, Wanda J (2000), 'Using technology and constituting structures: A practice lens for studying technology in organizations', *Organization science*, 11 (4), 404-28.
- (2007), 'Sociomaterial practices: Exploring technology at work', *Organization studies*, 28 (9), 1435-48.
- Orlikowski, Wanda J and Iacono, C Suzanne (2001), 'Research commentary: Desperately seeking the "IT" in IT research—A call to theorizing the IT artifact', *Information systems research*, 12 (2), 121-34.
- Overå, Ragnhild (2006), 'Networks, distance, and trust: Telecommunications development and changing trading practices in Ghana', *World development*, 34 (7), 1301-15.
- Palackal, Antony, et al. (2011), 'Are mobile phones changing social networks? A longitudinal study of core networks in Kerala', *New Media & Society*, 13 (3), 391-410.
- Palizada_municipality (2009), 'Palizada Development Plan 2009-2012'.
- Pedroza, Carmen (2013), 'Middlemen, informal trading and its linkages with IUU fishing activities in the port of Progreso, Mexico', *Marine Policy*, 39, 135-43.

- Petersen, Mitchell A and Rajan, Raghuram G (1994), 'The benefits of lending relationships: Evidence from small business data', *The journal of finance*, 49 (1), 3-37.
- Pettigrew, Andrew M (1987), 'Context and action in the transformation of the firm', *Journal of management studies*, 24 (6), 649-70.
- Platteau, Jean-Philippe (1994), 'Behind the market stage where real societies exist-part I: The role of public and private order institutions', *The Journal of Development Studies*, 30 (3), 533-77.
- Polanyi, Karl (1944), *The Great Transformation* (New York: Holt, Rinehart).
- Portes, Alejandro (2014), 'Downsides of social capital', *Proceedings of the National Academy of Sciences*, 111 (52), 18407-08.
- Portes, Alejandro and Sensenbrenner, Julia (1993), 'Embeddedness and immigration: Notes on the social determinants of economic action', *American journal of sociology*, 1320-50.
- Poulton, Colin, Kydd, Jonathan, and Dorward, Andrew (2006), 'Overcoming market constraints on pro-poor agricultural growth in Sub-Saharan Africa', *Development policy review*, 24 (3), 243-77.
- Powell, Walter (1990), 'Neither market nor hierarchy', *The sociology of organizations: classic, contemporary, and critical readings*, 315, 295-335.
- Qiang, Christine Zhenwei, et al. (2011), 'Mobile applications for agriculture and rural development', *World Bank, Washington, DC*.
- Radley, Alan (2010), 'What people do with pictures', *Visual Studies*, 25 (3), 268-79.
- Rashid, Ahmed Tareq and Elder, Laurent (2009), 'Mobile phones and development: An analysis of IDRC-supported projects', *The Electronic Journal of Information Systems in Developing Countries*, 36.
- Reardon, Thomas, et al. (2003), 'The rise of supermarkets in Africa, Asia, and Latin America', *American Journal of Agricultural Economics*, 85 (5), 1140-46.
- Rehber, Erkan (1998), *Vertical integration in agriculture and contract farming* (Food Marketing Policy Center, University of Connecticut).
- Reynolds, Jonathan (2010), *E-business: a management perspective* (Oxford University Press, Inc.).
- Robey, Daniel and Boudreau, Marie-Claude (1999), 'Accounting for the contradictory organizational consequences of information technology: Theoretical directions and methodological implications', *Information systems research*, 10 (2), 167-85.
- Robson, Colin (2011), *Real world research* (Blackwell Oxford).
- Romero, S. (2000), 'Weavers go dot-com, and elders move in', *New York Times*, 28.
- Rostow, W.W (1960), *The Stages of Economic Growth: A non-communist manifesto* (Cambridge: Cambridge University Press).
- SAGARPA (2012), 'Plan Rector del Sistema Producto Platano'.
- Sarkar, Mitra Barun, Butler, Brian, and Steinfield, Charles (1995), 'Intermediaries and cybermediaries: a continuing role for mediating players in the electronic marketplace', *Journal of computer-mediated communication*, 1 (3), 1-14.
- (1998), 'Cybermediaries in electronic marketplace: toward theory building', *Journal of Business Research*, 41 (3), 215-21.
- Schultz, Theodore William (1964), 'Transforming traditional agriculture', *Transforming traditional agriculture*.
- Schultze, Ulrike and Orlikowski, Wanda J (2004), 'A practice perspective on technology-mediated network relations: The use of Internet-based self-serve technologies', *Information Systems Research*, 15 (1), 87-106.
- Schwentesius, Rita and Gómez, Manuel Ángel (2002), 'Supermarkets in Mexico: impacts on horticulture systems', *Development Policy Review*, 20 (4), 487-502.

- Seitz, Christian (2013), *The impact of web-based e-commerce on channel strategy in the agricultural sector* (GRIN Verlag).
- Sen, Amartya (1999), *Development as freedom* (Oxford Paperbacks).
- Sen, Ravi and King, Ruth C (2003), 'Revisit the Debate on Intermediation, Disintermediation and Reintermediation due to E-commerce', *Electronic Markets*, 13 (2), 153-62.
- Shirky, Clay (2008), *Here comes everybody: The power of organizing without organizations* (Penguin).
- SIAP (2014), 'Servicio de informacion agroalimentaria y pesquera', <<http://www.siap.gob.mx/cierre-de-la-produccion-agricola-por-cultivo/>>, accessed 26/04/2014.
- (2016), 'Atlas Agroalimentario'.
- (2017a), 'Anuario Estadístico de la Producción Agrícola', *Cierre de la producción agrícola por estado*.
- (2017b), 'Anuario Estadístico de la Producción Agrícola', *Cierre de la producción agrícola por cultivo*.
- Sigrimis, Nick, Antsaklis, Panos, and Groumpos, Peter P (2001), 'Advances in control of agriculture and the environment', *Control systems, IEEE*, 21 (5), 8-12.
- Simmel, Georg (1923), *The sociology of Georg Simmel, Trans by K. H. Wolff* (92892; New York: Free Press).
- Singh, Nirvikar (2008), 'Transaction costs, information technology and development', *Indian Growth and Development Review*, 1 (2), 212-36.
- SNIIM 'Secretaria de Economía', <http://www.economia-sniim.gob.mx/SNIIM-AN/estadisticas/e_fyhAnuario1a.asp?cent=100&prod=PLTA1&ACCION=Aceptar>, accessed.
- Soh, Christina, Markus, M Lynne, and Goh, Kim Huat (2006), 'Electronic marketplaces and price transparency: strategy, information technology, and success', *MIS quarterly*, 705-23.
- Souter, David (2009a), 'The APC ICT policy handbook', *Association for Progressive Communication*, 8.
- (2009b), 'Chapter 19 Internet Services', in David Souter (ed.), *The APC ICT policy handbook* (Association for Progressive Communications (APC)).
- (2009c), 'Chapter 17 Universal Access', in David Souter (ed.), *The APC ICT policy handbook* (Association for Progressive Communications (APC)).
- Souter, David, et al. (2005), 'The economic impact of telecommunications on rural livelihoods and poverty reduction: a study of rural communities in India (Gujarat), Mozambique and Tanzania'.
- Spielman, David J, et al. (2008), 'An innovation systems perspective on strengthening agricultural education and training in sub-Saharan Africa', *Agricultural systems*, 98 (1), 1-9.
- Sreekumar, TT (2011), 'Mobile phones and the cultural ecology of fishing in Kerala, India', *The Information Society*, 27 (3), 172-80.
- Srinivasan, Janaki and Burrell, Jenna (2013), 'Revisiting the fishers of Kerala, India', *Proceedings of the Sixth International Conference on Information and Communication Technologies and Development: Full Papers-Volume 1* (ACM), 56-66.
- Storr, Virgil Henry (2010), 'The social construction of the market', *Society*, 47 (3), 200-06.
- Strauss, A and Corbin, J (1998), *Basics of qualitative research techniques* (Sage publications).

- Sulaiman, VR and Davis, K (2012), 'The New Extensionist: Roles, Strategies and Capacities to Strengthen Extension and Advisory Services', *GFRAS Position Paper. Lindau: Global Forum for Rural Advisory Services*.
- Swedberg, Richard (1997), 'New economic sociology: What has been accomplished, what is ahead?', *Acta Sociologica*, 40 (2), 161-82.
- Taragola, Nicole M and Van Lierde, Dirk F (2010), 'Factors affecting the Internet behaviour of horticultural growers in Flanders, Belgium', *Computers and Electronics in Agriculture*, 70 (2), 369-79.
- Teece, David J (2010), 'Business models, business strategy and innovation', *Long range planning*, 43 (2), 172-94.
- (2014), 'The foundations of enterprise performance: Dynamic and ordinary capabilities in an (economic) theory of firms', *The Academy of Management Perspectives*, 28 (4), 328-52.
- Teece, David J, Pisano, Gary, and Shuen, Amy (1997), 'Dynamic capabilities and strategic management', *Strategic management journal*, 509-33.
- Tenhunen, Sirpa (2008), 'Mobile technology in the village: ICTs, culture, and social logistics in India', *Journal of the Royal Anthropological Institute*, 14 (3), 515-34.
- Tey, Yeong Sheng and Brindal, Mark (2012), 'Factors influencing the adoption of precision agricultural technologies: a review for policy implications', *Precision Agriculture*, 13 (6), 713-30.
- The Economist (2017), 'Technology Quarterly - Civilian Drones: Taking Flight', *The Economist*, 423 (9044).
- Toyama, Kentaro (2011), 'Technology as amplifier in international development', *Proceedings of the 2011 iConference (ACM)*, 75-82.
- Traversac, Jean-Baptiste, Rousset, Sylvain, and Perrier-Cornet, Philippe (2011), 'Farm resources, transaction costs and forward integration in agriculture: Evidence from French wine producers', *Food Policy*, 36 (6), 839-47.
- Trulsson, Per (1997), *Strategies of entrepreneurship: Understanding industrial entrepreneurship and structural change in northwest Tanzania* (Linköpings universitet).
- United Nations (2006), 'Definition of basic concepts and terminologies in governance and public administration'.
<<http://unpan1.un.org/intradoc/groups/public/documents/un/unpan022332.pdf>>, accessed 17/10/2014.
- United Nations Development Programme (2001), 'National human development report 2001', (New York: UNDP).
- Uzzi, Brian (1996), 'The sources and consequences of embeddedness for the economic performance of organizations: The network effect', *American sociological review*, 674-98.
- (1997), 'Social structure and competition in interfirm networks: The paradox of embeddedness', *Administrative science quarterly*, 35-67.
- (1999), 'Embeddedness in the making of financial capital: How social relations and networks benefit firms seeking financing', *American sociological review*, 481-505.
- Uzzi, Brian and Gillespie, James J (2002), 'Knowledge spillover in corporate financing networks: Embeddedness and the firm's debt performance', *Strategic Management Journal*, 23 (7), 595-618.
- Van Campenhout, Bjorn (2013), 'Is there an App for that? The impact of community knowledge workers in Uganda', *IFPRI Discussion Paper 01316*.
- Van Dijck, José (2013), *The culture of connectivity: A critical history of social media* (Oxford University Press).

- Wajcman, Judy (2008), 'Life in the fast lane? Towards a sociology of technology and time', *The British journal of sociology*, 59 (1), 59-77.
- Wajcman, Judy, et al. (2007), 'The impact of the mobile phone on work/life balance', *Canberra: Australian Mobile Telecommunications Association & Australian National University*.
- Walsham, Geoff (1995), 'Interpretive case studies in IS research: nature and method', *European Journal of information systems*, 4 (2), 74 - 81.
- (2006), 'Doing interpretive research', *European journal of information systems*, 15 (3), 320-30.
- (2010), 'ICTs for the broader development of India: An analysis of the literature', *The Electronic Journal of Information Systems in Developing Countries*, 41.
- (2013), 'Development informatics in a changing world: Reflections from ICTD2010/2012', *Information Technologies & International Development*, 9 (1), pp. 49-54.
- Watson, Amanda HA (2011), 'Early experience of mobile telephony: a comparison of two villages in Papua New Guinea', *Media Asia*, 38 (3), 170-80.
- Weick, Karl E (1989), 'Theory construction as disciplined imagination', *Academy of management review*, 14 (4), 516-31.
- Wigand, Rolf T (1997), 'Electronic commerce: Definition, theory, and context', *The Information Society*, 13 (1), 1-16.
- Wigand, Rolf T, Picot, Arnold, and Reichwald, Ralf (1997), *Information, organization, and management: Expanding markets and corporate boundaries* (John Wiley & Sons Inc).
- Wiggins, Steve (2014), 'Rural non-farm economy: current understandings, policy options, and future possibilities', in Peter BR Hazell and Atiqur Rahman (eds.), *New Directions for Smallholder Agriculture* (Oxford, UK: Oxford University Press), 482-523.
- Williamson, Oliver E (1975), 'Markets and hierarchies, analysis and antitrust implications: A study in the economics of internal organization', (New York: Free Press).
- (1979), 'Transaction-cost economics: the governance of contractual relations', *The journal of law & economics*, 22 (2), 233-61.
- (1985), 'The Economic Institutions of Capitalism Firms Markets Relational Contracting', (Free Press).
- (1991), 'Comparative economic organization: The analysis of discrete structural alternatives', *Administrative science quarterly*, 269-96.
- (2005), 'The economics of governance', *The American Economic Review*, 95 (2), 1-18.
- World Bank (1999), 'World development report 1998/99', *Oxford University Press*.
- (2007), *World development report 2008: Agriculture for development* (World Bank).
- (2012) *Information and Communications for Development: Maximizing Mobile* [online text], World Bank
- (2016), *World Development Report: Digital Dividends* (Washington, DC: World Bank).
- (2017a), *GDP ranking* (Washington, DC: World Bank).
- 'World Development Indicators - Mexico', <<http://data.worldbank.org/country/mexico>>, accessed 02/08/2017.
- Yanyan, Wu (2015), 'Construction of Agricultural E-commerce Platform in China', *International Journal of u-and e-Service, Science and Technology*, 8 (1), 1-10.
- Yin, Robert K (2009), *Case study research: Design and methods* (5: Sage).
- (2013), *Case study research: Design and methods* (Sage publications).

- Zanello, Giacomo (2012), 'Mobile phones and radios: Effects on transactions costs and market participation for households in northern Ghana', *Journal of Agricultural Economics*, 63 (3), 694-714.
- Zuboff, Shoshana (1988), *In the age of the smart machine: The future of work and power* (Basic books).