International Food and Agribusiness Management Review

Official Journal of the International Food and Agribusiness Management Association

Volume 15: Issue 3
2012

Congratulations

2012 IFAMA Student Case Competition Winners

Nanjing Agricultural University: From left to right: Chen Yu, Mingxuan Liu, Team Advisor Dr. Chung-Chou Tsai, Qianru Yao, Yiwei Yan and Wuyi Lu

We look forward to seeing you in Atlanta: June 17-20, 2013!

Novus is proud to partner with IFAMA

in developing current and future agricultural leaders.

To learn more about the Novus Vision, "to help feed the world affordable, wholesome food and achieve a higher quality of life," visit novusint.com.

NOVUS®

SOLUTIONS SERVICE SUSTAINABILITY™

International Food and Agribusiness Management Review

Editorial Staff

The IFAMR (ISSN #: 1559-2448) is published quarterly and is available at http://www.ifama.org
For copyright and publishing information, please contact: Kathryn White, Administrative Editor
IFAMA Business Office • P.O. Box 14145 • College Station, TX 77841-4145, USA
Tel: 1-979-845-2118 • Fax: 1-979-862-1487 • E-mail: ifamr@ifama.org • Web: http://www.ifama.org

International Food and Agribusiness Management Review
Volume 15, Issue 3, 2012

Table of Contents

RESEARCH

International Food and Agribusiness Management Review

Supporters and Partners

Santa Clara University
Leavey School of Business

STRONG ROOTS - BRIGHT FUTURE

MARKESTRAT
Value Generation

TEXAS A&M UNIVERSITY

UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN
FOOD AND AGRIBUSINESS MANAGEMENT

The IFAMR Open Access Project is supported in part through contributions from these institutions. Scholars, practitioners, students, and policymakers may now read and download the most current and archival content from the IFAMR website. The Board of Directors of the International Food and Agribusiness Management Association feel that open and immediate access to IFAMR's articles and case studies will dramatically elevate the quality of scientific inquiry and instruction around the world in the field of agribusiness. If you would like to support this effort please contact: Kathryn White, Email: **ifamr@ifama.org**.

International Food and Agribusiness Management Review
Volume 15, Issue 3, 2012

EDITOR'S NOTE

Dear Readers,

Welcome to our third issue of 2012. At this time of year we celebrate and publish the best papers presented during IFAMA's annual World Symposium. IFAMA and the IFAMR work together in a unique way to produce the *Best Paper Award.* Scholars enter the competition by submitting a complete manuscript to the conference organizers in January. The IFAMR then manages a blind review process of the article. Scholars receive the reviewer's comments back in time to improve the paper and presentation prior to the conference in June. At the June conference, two judges attend the top finalists' presentations and submit their evaluation of the research. A committee of peers then reads the manuscript, the reviewers' comments, the response to the reviewers by the author, and the presentation evaluations. From this information they select the winners of the best papers for the conference. The authors receive a nice award, recognition during the conference, and a publication in the IFAMR Special Conference Edition. The two winners this year were Tepic et al. who received the *2012 Best Paper Award* for their writing about farmer networks in the Dutch pork sector, and Masuda and Goldsmith, received the *Conference Theme Award* for their paper on soybean meal demand in China.

So if you're interested in participating in the 2013 Best Paper Competition in Atlanta, USA, I encourage you to submit your full manuscript to the IFAMR on or before **February 4, 2013.**

There are six other super manuscripts in this issue, including a great piece written by the late Daniel Conforte. Kudos to the team at Massey University that stepped in to complete the revisions and make Daniel's hard work a reality.

You will notice something new in this issue, advertising. The IFAMR is funded by its authors. The mission of the IFAMR is to give its authors as much impact as possible. That is why the IFAMR is open access, electronic, registered with every major cataloguing service, has an impact factor, receives 12k article downloads a month, and is distributed to a proprietary mail list of 10k scholars, managers, and policymakers. The journal is growing rapidly and more revenue is needed to continue to elevate the impact of its scholars. With advertising we open a fourth revenue source for the IFAMR in addition to our sponsored issues, publication fees, and IFAMA membership. Please think about advertising your undergraduate or graduate program, business, or consultancy. For more information email **ifamr@ifama.org** subject line: "advertising".

I would also like to introduce our newest Managing Editor, Alessio Cavicchi from the University of Macerata, Italy. The journal cannot run without the tireless work of our twelve editors. Managing Editors serve as the journal's face in a particular region. Submissions have risen dramatically in South America, Africa, and Asia so we would love to keep pace with additional Managing Editors in these regions. Interested scholars with a track record of publication and high quality reviews should contact me.

Peter Goldsmith, Executive Editor, IFAMR

International Food and Agribusiness Management Review
Volume 15, Issue 3, 2012

The Influence of Networking and Absorptive Capacity on the Innovativeness of Farmers in the Dutch Pork Sector

M. Tepic[Φa], Jacques H. Trienekens[b], R. Hoste[c], and S.W.F. Omta[d]

[a]*Ph.D., Management Studies, Wageningen University, 1 Hollandseweg , Wageningen 6706 KN, Netherlands*

[b]*Professor, Management Studies, Wageningen University, 1 Hollandseweg , Wageningen 6706 KN, Netherlands*

[c]*Ing., Agricultural Economics Research Institute (WUR-LEI), P.O. Box 35, Wageningen 6700 AA, Netherlands*

[d]*Professor, Department of Business Administration, Wageningen University, Hollandseweg 1, Wageningen, 6706 KN, The Netherlands*

Abstract

The main objective of this study is to answer the question of how farmers' networking behaviour and their ability to acquire, assimilate, transform and exploit external knowledge is related to their level of innovativeness and profitability. These relations were tested on the basis of structural equation modeling using 444 questionnaires completed by large-scale pig farmers in the Netherlands. Previous studies on the relation between network structure and innovativeness retained the absorptive capacity 'black box' by using proxies for absorption of knowledge. The present study addresses this shortcoming by studying absorptive capacity in terms of organizational capacities (routines and processes) of farmers to use their networks and absorb external knowledge. The findings show that frequency of contact in a specific network range affects innovativeness positively, but also indirectly through acquisition and assimilation capacity. Assimilation capacity turns out to be the most important dimension of absorptive capacity for the innovativeness of pig farmers.

Keywords: absorptive capacity, networking, pig farmers, innovativeness

[Φ]Corresponding author: Tel: +31.0.317.482410
Email: mersiha.tepic@wur.nl J.H. Trienekens: jacques.trienekens@wur.nl
R.Hoste: robert.hoste@wur.nl S.W.F. Omta: onno.omta@wur.nl

+The IFAMR is a non-profit publication. The additional support provided from this issue advertisers, Novus International and GlobalGap help keep us open access and dedicated to serving management, scholars, and policy makers worldwide.

Introduction

In the last decade the Dutch pork sector experienced about a 50% reduction in the number of farms, while the number of pigs per farm almost doubled (LEI and CBS 2011). Such efficiency leaps are part of the reason the Netherlands is able to continue to play an important role in the European pork sector. However, because of increased competition in the sector, the price per kilo pork paid to the farmer is decreasing, which is leading to a continuous drive for the farmers to lower their costs and increase efficiency further. At the same time, the gains in efficiency were often accompanied by compromises in fields such as the environment and animal welfare. Increased societal pressure to invest more in animal welfare and reduce the environmental burden, as well as the economic and market situation in Europe and beyond, has put pressure on the pig farmer to place more emphasis on innovativeness and creativeness. Pig farmers need sufficient innovation capability to retain their competitive advantage and assure survival (Li and Calantone 2002). Although financial capacity is very important, the ability to change and innovate is also dependent on the ability to recognize, understand and apply new developments and technologies. For the purpose of increasing the innovative capacity of farmers, collaboration with different actors is important (Klerkx and Leeuwis 2009), such as knowledge-intensive institutes, universities and technology developers, but also butcheries or supermarkets that can contribute to new product concepts. In this regards it is important to establish how the farmers' networking behaviour and capacity to 'absorb' information relate to innovativeness, in order to determine how farmers can use their network to improve their innovative capacity.

On the basis of previous research it is known that strong ties and network cohesion are important for the transfer of especially complex and tacit knowledge (Coleman 1988; Krackhardt 1992), but that weak ties and structural holes which bridge organizational boundaries are important for the acquisition of diverse, new knowledge, leading to innovation and innovativeness (Burt 1992, 2005; Rosenkopf and Nerkar 2001). Reagans and McEvily (2003) advanced this discussion by establishing that network cohesion (overlapping ties among mutual third parties) and network range (relationships that span multiple knowledge pools) need not come at the expense of each other, but approach an optimal network structure which combines elements of both (Burt 2000; Reagans and Zuckerman 2001; Reagans, Zuckerman and McEvily 2003). With the assumption that knowledge absorption takes place in the presence of overlap in knowledge, Reagans and McEvily (2003) conclude that a strong tie across a structural hole eases knowledge transfer. More importantly, they conclude that an individual surrounded by a diverse network could transfer knowledge across a structural hole even in the case of a weak connection. This indicates that capacities to absorb and transfer knowledge are built through maintenance of a diversity of network ties. Reagans and McEvily (2003) take into account control variables, which are supposed to explain the variance which can be attributed to absorptive capacity differences among individuals. However, as Reagans and McEvily (2003) mention, they did not assess the absorptive capacity or measure individual behaviour directly.

The present paper contributes to existing literature by focusing on the behavioural aspect in terms of organizational capacity to access, assimilate, transform and exploit knowledge (Zahra and George 2002; Volberda et al. 2010), instead of using proxies for absorptive capacity, such as the overlap in the knowledge base of the interacting actors (Zaheer and Bell 2005; Van Gilsing and Nooteboom 2008; Nooteboom et al. 2007). As Lewin et al. (2011) argue, although absorp-

tive capacity is a widely used concept, the organizational routines and processes that constitute absorptive capacity remain a 'black box' (e.g., Lane et al. 2001; Zahra and George 2002; Lewin and Massini 2003; Todorova and Durisin 2007; Lane et al. 2006). The studies which look at the relation between network structure and innovativeness retain this black box by using proxies for studying the effect of absorptive capacity in this relation. In the present paper, we address this shortcoming by studying the relationship between networking behaviour and absorptive capacity, by focusing specifically on the organizational capacities (routines and processes) of farmers to use their networks and absorb external knowledge.

In addition, the relations among the different dimensions of absorptive capacity are tested to find out whether the previous model, which posits sequential relations from recognition and assimilation to transformation and exploitation (Zahra and George 2002; Volberda et al. 2010), also holds in the case of innovation by pig farmers. The absorptive capacity of larger farmers, who could engage in large-scale innovations with sustainability-oriented goals and increase their level of innovativeness, is left unexplored. The question addressed in this paper is how the farmers' networking behaviour and their ability to acquire, assimilate, transform and exploit the external information and knowledge is related to their level of innovativeness and profitability. This question addresses the theoretical issue of behavioural aspects of networking and absorptive capacity, as well as the practical issue of how networking can enhance the innovative capacity and profitability of pig farmers.

Section 2 of the present paper provides an overview of the theoretical background of the conceptual framework. It addresses definitions and previous research about innovativeness and absorptive capacity. In the third section, previous research about the relation between networking and absorptive capacity is addressed. The conceptual framework and hypotheses concerning the relationship between networking frequency, absorptive capacity, innovativeness and profitability are introduced. In section 4, the method of data collection, the measurements, as well as the structural equation modelling as the method of analysis are introduced. In section 5, the results are discussed on the basis of the model and the tested hypotheses. Also, differences in specific pig farmers' networking behaviour, i.e. between farmers with high and low absorptive capacity and a high and low level of innovativeness, are discussed. In section 6, the conclusions and discussions are presented, includiing sector implications based on a reflection on the sector.

Theoretical Background

Innovativeness

Innovativeness and the ability to introduce innovations is regarded as one of the most important aspects of the entrepreneurial process and is considered one of the dimensions of entrepreneurial orientation (Lumpkin and Dess 1996; Schumpeter 1934). Innovativeness reflects a firm's tendency to engage in and support new ideas, novelty, experimentation and creative processes that may result in new products, services or technological processes (Lumpkin and Dess 1996; Rhee et al. 2010). Although innovations can vary in their degree of radicalness (Hage 1980), innovativeness represents a basic willingness to depart from existing technologies or practices and act beyond the current state of the art (Kimberly 1981). When it comes to psychometric properties for measurement of innovativeness (Pallister et al. 1998), it may be relevant to establish the tendency and willingness to change. However, in the effort of establishing the extent to which capacities to

absorb knowledge are present in a company, it may be more useful to determine innovativeness more rigorously by looking at the extent of adoption of innovation. This means that not only the willingness to change, but also the degree to which an innovation is adopted earlier than by others (Rogers 2003) is a reflection of the extent of innovativeness. Accordingly, in the present paper, not only the organization's willingness to change, but also the rate of adoption of innovations by the firm (Hurt et al. 1977, 2004; Calantone et al. 2002) is considered as a reflection of innovativeness.

Absorptive Capacity

For the purpose of raising the level of innovativeness, previous research emphasized the importance of learning (Cohen and Levinthal 1990) and the role of networks in creating access to knowledge, thereby facilitating the learning process (Tsai 2001; Oliver 2001; Lane and Lubatkin 1998; Ahuja 2000; Ahuja and Katila 2004). In their seminal paper, Cohen and Levinthal (1990) point to the importance of the firm's capabilities to assimilate and exploit information in generating innovations (Cohen and Levinthal 1989). Cohen and Levinthal contributed to the existing literature by introducing a set of industrial-organization (IO) economics-based explanations of a firm's absorptive capacity. They argued that if the costs of acquiring external knowledge are small at the time of learning, it is because the firm has already invested in the development of the ability to identify, assimilate and exploit knowledge from the environment, which is called the firm's learning or absorptive capacity (Cohen and Levinthal 1989, 569).

Knowledge has a central position in the literature which deals with absorptive capacity. Knowledge is posited as one of the most important resources of the firm; and prior knowledge is especially important for the ability to accumulate new relevant knowledge and learn from other internal or external resources of knowledge. Increased learning in a particular area enhances the organization's knowledge base in that area, which further increases its absorptive capacity and thus facilitates more learning in that domain (Autio et al. 2000; Barkema and Vermeulen 1998). It is argued that a balance of knowledge similarity and dissimilarity (usually operationalized as complementary resources or capabilities) has been associated with positive alliance outcomes, such as innovation (Ahuja and Katila 2001; Dyer and Singh 1998; Jones et al. 2001; Lane and Lubatkin 1998; Larsson et al. 1998; Shenkar and Li 1999; Simonin 1999). The argument is that absorptive capacity, in terms of the knowledge base and familiarity with new knowledge, results in assimilation of new knowledge (Lane et al. 2006). Besides the importance of the knowledge base and knowledge overlap for absorption of new knowledge, also the intensity of effort (Kim and Lee 2002), embeddedness in knowledge networks (Oliver 2001) and internal integration (Meeus et al. 2001) facilitate organizational learning.

Zahra and George (2002) contributed to the organizational learning capabilities field by introducing a dynamic capabilities perspective of absorptive capacity in terms of four complementary dimensions. They argue that acquisition and assimilation of new external knowledge enable firms to continuously improve, renew and increase their knowledge stocks. In order to complement these long-term pay-offs, firms should also engage in sufficient transformation and exploitation. It is argued that firms' adoption of innovation and willingness to change depends on them effectively developing internal knowledge, utilizing external knowledge and exploiting knowledge to generate innovations (Kogut and Zander 1992; Teece 1996). Firms' ability to as-

similate and exploit external knowledge is related to their use of knowledge in the search for innovation. Cohen and Levinthal (1989, 1990) defined absorptive capacity as a firm's ability to recognize the value of new external knowledge, assimilate it and apply it to commercial ends. Given the greater availability of external knowledge sources in modern economies, a dynamic capability that influences a firm's ability to target, absorb and deploy the external knowledge necessary to feed the internal innovation process becomes a crucial source of competitive advantage (Fosfuri and Tribó 2008). Todorova and Durisin (2007) also point to the capabilities necessary to recognize the value of external information for transformative processes, and regimes of appropriability. Lane et al. (2006) emphasize the dynamic nature of absorptive capacity by pointing to exploratory, transformative and exploitative learning. According to Lane et al. (2006), one of the major shortcomings of the existing absorptive capacity literature is the lack of attention given to the processes underlying absorptive capacity. Most empirical studies refer to R&D (e.g. Veugelers 1997; Rocha 1999; Stock et al. 2001; Tsai 2001), patents (Mowery et al. 1996) or co-authored papers as proxies for absorptive capacity. These indirect measures capture only partially the aspects of capabilities related to valuing new, external information, its assimilation, and its application to commercial ends. There is a lack of direct observation or measurement of the routines that constitute absorptive capacity (Lewin et al. 2011).

In the present study, the view is taken that organizational and combinative capabilities of the firm are important for its access to information and knowledge from external sources and for the ability of the firm to understand and learn from the new information and knowledge. One of the absorptive capacity organizational capabilities is reflected by acquisition, which refers to a firm's capability to identify and acquire externally generated knowledge that is critical to its operations (Zahra and George 2002). The intensity and speed of a firm's efforts to identify and gather knowledge can determine the quality of a firm's acquisitions (Kim 1997a,b). The second organizational capability of the firm is related to its ability to understand and learn from the new information and knowledge. Assimilation capacity refers to the firm's routines and processes that allow it to analyse, process, interpret and understand the information obtained from external sources (Kim 1997a,b; Szulanski 1996). The third combinative capability which is important for the enhancement of innovativeness is transformation capacity. This denotes a firm's capability to develop and refine the routines that facilitate the combining of existing knowledge with the newly acquired and assimilated knowledge. This is accomplished by adding or deleting knowledge or simply by interpreting the same knowledge in a different manner. The ability of firms to recognize two apparently incongruous sets of information and combine these into an innovation reflects their transformation capability. The ability to transform new knowledge is important for reframing of the firm's definition of the industry and competitive strategy (e.g. Christensen et al. 1998). The fourth combinative capability contributes to the innovative output of the firm. Exploitation capacity reflects the routines of the firm to refine, extend and leverage existing competencies or to create new ones by incorporating acquired and transformed knowledge into its operations. Exploitation reflects a firm's ability to harvest and incorporate knowledge into its operations (Tiemessen et al. 1997; Van den Bosch et al. 1999). It requires retrieval of knowledge that has already been created and internalized for use (Lyles and Schwenk 1992). The outcomes of systematic exploitation are the persistent creation of new goods, systems, processes, knowledge or new organizational forms (Spender 1996).

Previous Research and Hypotheses

Networking, Absorptive Capacity and Innovativeness

The relationship between network structure and absorptive capacity has been addressed by previous studies (Tsai 2001; Van Gilsing et al. 2008), but without reference to the organization of networking behaviour. In the present study, social network literature is used to hypothesize on the organization of networking behaviour and its relation with absorption of external knowledge. In a study about networking behaviour of hospitals, it was established by Goes and Park (1997) that the type and degree of ties affect the ability of the firm to integrate and assimilate external knowledge. Frequency of contact, as one of the indicators of strong ties (Granovetter 1982; Krackhardt 1992), is considered an important relational trait, which enables transfer of especially *complex knowledge* and information entailed in innovation (Hansen 1999; Reagans and McEvily 2003; Krackhardt 1992; Uzzi 1997; Van Gilsing and Nooteboom 2005; Nooteboom et al. 2007). At the same time, a wide network range (Reagans and McEvily 2003) is important to gain new external knowledge. An individual with a widespread network of connections across multiple pools of knowledge and expertise bridges holes between people and is exposed to more diverse knowledge (Reagans and McEvily 2003).

For the pig farmers, interaction with different types of actors may be important for accumulation of relevant information and knowledge to realize different types of innovations. Knowledge-intensive institutes, such as universities or innovation centres, may be important because they aim at improving pork production and pork chain organization in the longer term. Technology developers provide new housing concepts, technology for reducing emissions or improvement of animal welfare. For the absorption of knowledge about wishes and requirements from society, exchanges with animal welfare and environmental organizations may be useful. Also, chain actors may make important contributions to the farmers' level of innovativeness. For example, transport companies can influence perceptions of the farmers' innovativeness by means of their advanced, innovative or animal-friendly transportation methods (Wognum et al. 2007).

Reagans and McEvily (2003) conclude that an individual surrounded by a diverse network could transfer knowledge across a structural hole, even when the connection is weak. Apparently, transferring knowledge and maintaining a diverse network are related, as experience with one of the two helps to achieve the other. Farmers engaged in more frequent networking with a wider range of knowledge sources are more likely to experience a rich exchange of knowledge and in this way be more skilled in approaching specific actors for acquisition of the knowledge that they need. Frequency of interaction and information exchange increases the amount of information the farmers accumulate, which contributes to a better ability to identify and understand the pieces of knowledge that are relevant for their own farms and innovations. As the higher level of interaction increases the likelihood of (tacit) knowledge transfer and assimilation (Dhanaraj et al. 2004), it is expected that:

H1a: *Networking frequency of pig farmers is positively related to their acquisition capacity*.
H1b: *Networking frequency of pig farmers is positively related to their assimilation capacity*.

Acquisition capacity of the farmers can be reflected by more skill in collecting knowledge about developments in the sector through discussions with business partners, and through participation

in seminars or conferences. More frequent interaction enlarges the pool of knowledge they acquire and helps them to increase their insight about developments, innovations and their implications. This is expected to contribute to an increase in their ability to recognize changes in rules and regulations, shifts in market competition and new possibilities to serve their clients and customers. Through the time they allocate and skills they develop to establish contact with actors in the chain and network, which can provide them with the relevant knowledge, it is expected that the capacity of these farmers to analyse, process, interpret and understand external changes and developments is positively affected. Therefore, farmers' acquisition capacity is expected to be positively related to their assimilation capacity.

H2: *Pig farmers' acquisition capacity is positively related to their assimilation capacity.*

Furthermore, farmers who are more skilled in the recognition of changes in technical possibilities, and who are always among the first to detect changes in rules and regulations and changes in market competition are considered to have a better ability to analyse, process, interpret and understand external knowledge and information (assimilation capacity). Farmers with higher assimilation capacity are also expected to be more skilful in assessing the relevancy of new information and knowledge for their own farms. Greater ability to understand new possibilities and opportunities is expected to result in more skill in recognizing the usefulness of new and external knowledge for innovations on their own farms and a greater capacity to translate new information and knowledge into changes, adaptations or innovations. Accordingly, it is hypothesized:

H3: *Pig farmers' assimilation capacity is positively related to their transformation capacity.*

It is expected that the capacity to transform and apply knowledge to one's own farm is positively related to exploitation capacity. Skill in assessing the relevancy and usability of new information for innovation on one's own farm, plus the capacity and ability to translate market trends into adaptations on the farm, is expected to result in the ability to make an additional step. The latter is related to exploitation of the innovation. Farmers with high transformation capacity are expected to be more skilful in transposing the information into profitable changes and adaptations on the farm. Farmers who translate new knowledge into actual adaptations usually also have an idea about how the adaptation will contribute to increased profit. Therefore, it is expected that:

H4a: *Pig farmers' transformation capacity is positively related to exploitation capacity.*

The transformation capacity of farmers in the pork sector consists, for example, of the ability to combine external knowledge about the changes in the market with their internal knowledge to make changes to their feed systems, business models or stable (hardware) arrangements. It is also demonstrated by their approach to saving knowledge for later use, and their resources and skills to build on existing knowledge and translate it into adaptations to their businesses. For example, a farmer who is used to regularly discussing changes and trends in the market with advisors or personnel is more trained to regard and understand the same knowledge in a different manner, acquire new insights, recognize new opportunities and adapt the image of his or her own farm and those of competitors. This ability to transform external knowledge into useful applications indicates that the farmer has a greater insight into the possibilities of new developments and technologies. This greater insight is expected to be positively related to adoption of (People, Planet, Profit and Pigs) innovations. Accordingly, it is expected in the present study that:

H4b: *Pig farmers' transformation capacity is positively related to innovativeness.*

Farmers who require little effort to implement new processes on their farms are expected to have a more systematic ability to exploit external knowledge by incorporating it into their own operations. Those farmers who are more proficient in converting external knowledge into profitable applications on their own farms are expected to increase their profitability. Higher profitability due to implementation of new systems, processes and organizational forms is a reflection of a higher capability to exploit external knowledge. The ability of these farmers, not only to introduce an innovative application or adaptation into their own company, but also to ensure that the gains of the change exceed the costs leads to the expectation that:

H5a: *Pig farmers' exploitation capacity is positively related to profitability.*

Innovations in the pork sector introduced by farmers are usually process and organization-related innovations. These are characterized by a higher level of adoption of technological, managerial and organizational innovations. In the present study, innovativeness is interpreted as the level of investment in new (technological) possibilities or (hardware) improvements in the stables. Within this concept, pig farming systems are developed to cover the needs of the animal, the environment, the farmer and the citizen-consumer. Innovative farmers who are able to combine these four objectives are expected to be more profitable. A high level of innovativeness is required to assure low costs, a speedy production process and/or a low amount of labour per pig, while at the same time assuring animal-friendly treatment of pigs and processes which reduce the burden on the environment (Li and Calantone 1998). Reducing costs and raising value by offering products which result from an animal and environment-friendly production process is expected to result in higher profitability for the farmer. Accordingly, it is expected that:

H5b: *Pig farmers' innovativeness is positively related to profitability.*

The hypotheses above are captured in the following Figure 1. This conceptual model will be used to analyse the relations between networking and absorptive capacity with innovativeness and profitability among the pig farmers.

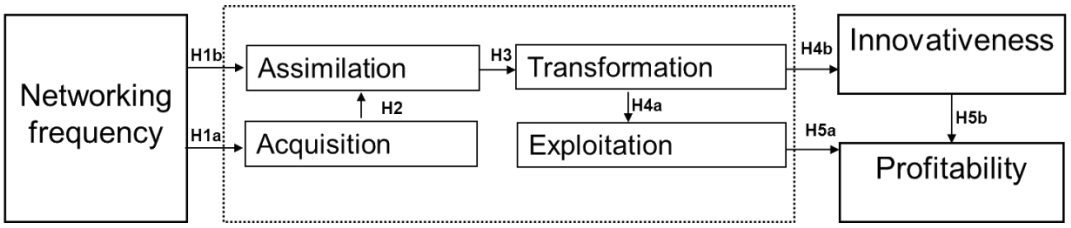

Figure 1. Conceptual Model

Methods and Data

In 2010, the Netherlands produced around 24.9 million pigs at about 7,000 farms (PVE 2011a). About 1.0 million pigs were imported and 11.3 million were exported. The meat export was three times the volume of the meat import (PVE 2011b). Germany, Italy and the United Kingdom are important export countries. The competitive position of the pork sector in the Netherlands is

largely based on its increasing efficiency levels (Hoste 2011). In the last decade the sector experienced about a 50% reduction in the number of farms, while the number of pigs per farm almost doubled (LEI and CBS 2011). At the same time, the efficiency gains were often accompanied by compromises in factors such as the environment and animal welfare. The increasing attention of policy makers and society to environmental problems and animal welfare concerns resulted in adjustments to legislation, requiring different measures and investments by farmers to reduce food-safety-related risks, mineral output and ammonia emissions, and to improve animal welfare. The Dutch government adopted new regulations with regard to animal welfare[1] and the environment[2] which will go into effect by the year 2013 (Baltussen et al. 2010). These require, for example, that all pregnant sows be accommodated in group housing (in line with European legislation), fattening pigs have more space, and that ammonia emissions and the use of antibiotics is reduced. These changes put strains on farmers, some of whom will not invest in the adaptations required by the stricter regulations (Baltussen et al. 2010). Financial capacity[3] is among the main reasons that these farmers experience difficulty to fulfill the animal welfare and environment criteria, but practical problems have also been encountered.

For the purpose of increasing the innovative capacity of farmers, information exchange and collaboration with different chain and network actors are important (Klerkx and Leeuwis 2009). Simply studying the interaction with different kinds of actors does not provide sufficient information as to whether the farmers are using and assimilating the acquired information from the network. Therefore, the absorptive capacity of farmers must also be studied directly. The ability to change and innovate is also dependent on the ability to recognize, understand and apply developments, new techniques and technologies within one's own company. The fact that the farmers in the pork sector are increasingly pressured to place emphasis on innovation, through learning and integration of innovative ideas and knowledge from the external environment, makes this sector an appropriate field of study to find out how networking behaviour and absorptive capacity relate to innovativeness and profitability.

Sample

For the present study, 1657 medium- to large-size farms were selected because they represent the largest group of pig farmers in the Netherlands and provide most insight into how animal welfare and environment-friendly (4P) innovations can be applied on a larger scale. The selection criterion for the 1657 farms was that the farm would count 300 or more sows and/or 1500 or more fattening pigs. Farms with at least 300 sows cover 73% of the sows in the Netherlands; and farms with at least 1500 fattening pigs cover 62% of the fattening pigs in the Netherlands. About one third of the pig farms have both sows and fattening pig (CBS 2011).

A large-scale survey was administered to these farmers by post. A return envelope was enclosed to enable the farmer to send back the completed questionnaire. The response rate was 27. 9% or 462 responses. The analysis was performed based on completed questionnaires from 444 farms, after deletion of unusable cases. Of these 444 farms, 407 had sows and 402 had fattening pigs.

[1] The Pig Decree
[2] The Ammoniac Emission Decree for Housing
[3] In 2008, 56% of the pig farms had a good to reasonable financial position and 13% of the farms ran a great risk of having to stop for financial reasons. The remaining 31% of the farms could continue to produce but were in a poor financial position (Baltussen et al. 2010).

Around two-thirds of the farms had 300 or more sows and/or 1500 or more fattening pigs. This indicates that some farms had sows as well as fattening pigs, but they did meet the selection criterion of at least 300 sows or at least 1500 fattening pigs. Table 1 gives an overview of the sample of farms used in this study. Farmers in the sample had an average age of 47, with a range between 27 to 67 years. In terms of age, the sample seems rather representative, as farmers who have confined farms (pigs, cattle, poultry) show a similar breakdown in age[4] (LEI and CBS 2011). The largest group of farmers in our sample had mid-level vocational training, which is also representative of farmers in the Netherlands (between 50 and 60%) (Van der Meulen et al. 2011). In general, the average turnover of breeding farms was 336 000 euros; and the average turnover of the fattening pig farms was 546 300 in 2010 (LEI and CBS 2011). Our sample includes medium-to large-size companies, which explains why around 48% of the farms had a turnover of 1 million euros or more. About 60% of the farmers in our sample had a designated successor.

Table 1 Sample Overview

Farmer							
Age	**Average Age**	**Range**					
	47	27 - 67					
Education	**N**		**N**		**N**		**N**
Secondary school	50	**Mid-level vocational training**	309	**Higher-level vocational training**	58	**Academic**	5
Farm /company							
#of sows	**N**	**# of fattening pigs**	**N**	**Turnover**	**N**		**N**
300 <	138	1500 <	135	1 million <	233	1 million = >	180
300 = >	269	1500 = >	267				
Age company	**N**		**N**	**Successor**	**N**		**N**
20 years <	63	20 years = >	379	No	266	Yes	163

Note. Not all the numbers collected from the 444 surveyed cases are included in this example. Some where missing values.

Measurements

The measurements of absorptive capacity developed by Jansen et al. (2005) were used as a starting point for the 7-point Likert scale questionnaire. The statements were adapted in such a way as to assure that the pig farmers would recognize their own situation within the statements and be able to complete the questionnaire within 15 minutes. For example, the questions about acquisition developed by Jansen et al. (2005) take into account the interactions and exchange of knowledge among the different divisions and units in large firms. However, as even the large pig farms in the Netherlands do not have different divisions of employees, only those items which reflect the farmer's own organizational capacity to interact with external actors are taken into account. In the case of acquisition, two of the items from Jansen et al. (2005) were adapted[5] and

[4] It is possible that the farmers who replied to our questionnaire were more inclined to do so because they are more open towards innovation. However, tests that compared the responses of the group of farmers who replied in the first two weeks after the questionnaire was sent (before we started to approach the remaining farmers by telephone to ask for their participation) and the farmers who replied after that did not show a significant difference in the level of innovativeness.

[5] Regarding Jansen et al., "We collect industry information through informal means, e.g. lunch with industry friends, talks with trade partners" (Jansen et al. 2005, 1014). Our item: 'We collect information about developments in the sector through discussions with business partners from the sector.'

two items were added which focus on the capacity (time and skills) of the farmer to engage in interactions with external actors. The questionnaire was tested by two academic experts on the pork sector in the Netherlands. In addition to questions about absorptive capacity, the questionnaire contained questions about the networking frequency of farmers and questions which provide general information about the farmer and the farm/company (see Table 2 for an overview of the operationalizations of the measurements and the Appendix for an overview of the questionnaire). In this section the variables used in the model will be described.

Networking Frequency

For the measurement of networking frequency a list of potentially relevant actors in the chain and the wider network for pig farmers was included in the questionnaire (see the Appendix for the exact list of actors included). The farmers were asked to indicate the frequency of contact with each of these actors. In addition to chain actors, the list included (financial) advisors, governmental institutions, branch organizations, knowledge institutes, certifying organizations and animal welfare and environmental organizations. As networks create access to new knowledge and facilitate the learning process (Cohen and Levinthal 1990), it is considered that frequency of contact with relevant actors in a potential network has an effect on absorptive capacity and level of innovativeness. New knowledge, for example about technology, is often proprietary, tacit, and difficult to value and transfer (Winter 1987). Frequent interactions allow for greater openness, and, hence, facilitate transfer of knowledge (Kale et al. 2000). The overall networking frequency is considered in the model by calculating the average frequency of contact with a wide range of actors. The higher the overall average score on networking frequency, the higher the level of interaction between the farmer and a wider range of actors. In order to study which specific actors are most important for farmers' innovativeness with respect to People, Planet, Profit and Pigs (the 4 Ps), the largest differences between innovative and less innovative farmers (based on differences in innovation investments) are also discussed.

Absorptive Capacity

Different measures of absorptive capacity can be found in the literature. Cohen and Levinthal (1989; 1990) used R&D intensity. Veugelers (1997) and Cassiman and Veugelers (2002) measured it based on the presence of a fully staffed R&D department. Others have regarded the human capital level, such as Mowery and Oxley (1995) and Keller (1996) who considered investment in scientific and technical training and the number of scientists and engineers as indicators. Zaheer and Bell (2005) separated the effect of firm-specific capabilities / absorptive capacity on innovativeness from the effect of a firm's structural network position on innovativeness by regressing innovativeness on network structure and using the residuals from this regression as the measure of absorptive capacity of the firm. In the present study, the focus is confined to the definition of absorptive capacity in terms of organizational capacities and routines (Jansen et al. 2005) as developed by Jansen et al. (2005). Acquisition capacity was measured using four items concerning contact with partners for the purpose of collection of information about developments in the sector, attending of meetings organized by the sector, allocation of time and skilfulness in establishing contact with the relevant parties in the network. Six items were used to measure assimilation capacity. The statements concerned the skills and capacity to be among the first to detect changes in the market, regulations and technical possibilities, as well as time spent and skilfulness in deliberating with advisors to detect changes in the market, and the way in which ad-

justments were made at farm level to react to these changes. Five items were used to determine transformation capacity. Farmers were asked to what extent they store information for later use, how skillful they are in assessing the usability of external information, how much time they spend and how skilful they are in translating acquired information into changes and adjustments in the business of their own farms. Three items were used to measure exploitation capacity. The farmers were asked about their capacity to translate external information into new and improved business applications, whether the use of the acquired information contributes to their profitability, how much time they spend and how skilful they are in converting acquired information into profitability.

Innovativeness

In the case of pig farming, pressure from society and policy makers to increase attention to sustainability issues led to innovations which balance People, Planet and Profit aspects. In order to emphasize the animal welfare aspect, the additional aspect of 'Pigs' was added to this list, resulting in the People, Planet, Profit and Pigs concept (Hoste 2010; 2011). This means that aside from paying attention to the health and wellbeing of workers and the general population, environmental impact and economic sustainability for all participants in the chain, the welfare of the pigs was given specific attention in innovation (Hoste 2010; 2011). Many of the 4P innovations are not necessarily new to the world, but when applied in combination they are new to pig farms. For example, when applied together on a farm, solar collectors, wind energy and biomass plants constitute indicators of a higher level of innovativeness on the 4P innovation scale. Accordingly, extent of adoption of 24 possible 4P innovations is considered to reflect the level of innovativeness of farmers in the present study. For an overview, see the questionnaire in the Appendix. The farmers were asked to indicate to what extent they invest in these 24 innovations on their farms. In the model, the average score on the 24 innovations is considered as the measure of innovativeness. All 24 innovations have the potential to eventually contribute to profit.

Profitability

Due to the farmers' sensitivity about revealing financial information, three 7-point Likert scale items were used to measure profitability. The farmers were asked to indicate how profitable they are compared to their competitors and whether their turnover and growth are higher or lower than their competitors'. These types of questions (with a choice of answer on a Likert scale) have been used often (Powell 1996) and have been demonstrated historically to be highly correlated to accounting measures of performance (Baker and Sinkula 1999; Balakrishnan 1996; Dess and Robinson 1984; Venkatraman and Ramanujam 1987), such as return on sales or return on assets (Powell 1996). They have also been regarded as a reliable means of assessing performance (Pearce, Freeman and Robinson 1987).

Method of Analysis

The computations of inter-factor correlations, all the path coefficients, the coefficient of determination (R^2) and goodness of fit measures were performed using structural equation modelling and Lisrel 8.72. Structural equation modelling was performed to estimate direct and indirect effects. This type of analysis has the advantage of correcting for unreliability of measures. Table 2 provides an overview of the mean scores per item and construct, as well as the validity, reliabil-

ity and internal consistency of the measurement model. The constructs display satisfactory levels of reliability, indicated by composite reliabilities ranging from 0.79 to 0.87 (Kline 2010). All multi-item constructs met the criterion of convergent validity, with loadings significantly related to the underlying factor in support of convergent validity (Kline 2010).

Table 2. The Measurement Model

	μ[6]	sd	λ	R^2	α & CR
Networking frequency					
Average frequency of contact with a list of actors	2.8	0.5	.90	.80	
Acquisition	4.5	1.3			α = .79
We collect information about developments in the sector through discussions with business partners from the sector.	5.0	1.3	.48	.23	CR = .82
Our farm participated last year at least twice in meetings organized by the sector.	5.1	1.8	.68	.46	
We allocate a lot of time to the establishment of contact with parties who can provide us with knowledge and information about innovations in the sector.	4.3	1.5	.83	.69	
We have sufficient skills to establish contact with parties who can provide us with knowledge and information about innovations in the sector.	4.0	1.6	.88	.77	
Assimilation	3.7	1.2			α = .87
Our farm is always among the first to recognize shifts in technical possibilities.	3.7	1.4	.87	.75	CR = .90
Our farm is always among the first to recognize regulatory changes.	3.8	1.4	.81	.65	
Our farm is always among the first to recognize changes in market competition.	3.8	1.4	.82	.67	
Our farm is very skilful in detecting new possibilities to serve new customers.	3.6	1.6	.83	.69	
Transformation	4.1	1.2			α = .86
We allocate a lot of time to discussion with advisors about new trends in the market.	4.4	1.6	.70	.50	CR = .86
New information about developments in the sector is being stored for future reference.	4.4	1.7	.54	.29	
We are very skillful in quickly recognizing the usefulness of new, external knowledge.	4.4	1.5	.73	.53	
We confer monthly with external advisors about how changes in the market can be used to improve business at our farm.	4.3	1.7	.61	.38	
We attribute a lot of time to translation of external information into adaptations to our business.	4.2	1.6	.78	.61	
We translate external information directly into new business applications.	3.3	1.4	.71	.50	
Exploitation	4.2	1.3			α = .87
The use of externally acquired information contributes often to our profitability.	4.1	1.5	.76	.58	CR = .87
We allocate a lot of time to applying of acquired information in order to realize profitability.	4.3	1.5	.88	.78	
We have sufficient skills to convert external information into profitability.	4.1	1.5	.85	.73	
Innovativeness	2.0	0.7	.95	.90	
The average extent of investment in 24 specified hardware applications in the stables.					
Profitability	4.4	1.0			α = .81
How do you estimate your profitability compared to your competitors"?	4.6	1.1	.85	.72	CR = .85
Compared to our most important competitors our turnover is higher.	4.4	1.1	.79	.62	
Compared to our most important competitors our growth percentage is higher.	4.2	1.3	.78	.60	

Note. μ= mean score (range 1-7); λ = Standardized Structural Coefficient; R^2= Reliability; α = Alpha Cronbach; C.R. = Compound Reliability

[6] The use of Likert scale for analyses with arithmetic computations is criticised because of the possible psychological "distances" between the Likert-scale points or the inequality in the distance between the points. However, many studies support the treatment of such scales as if they are equal to interval data (e.g. Aaker et al. 2004 p. 285; Burns and Bush 2000 p. 314 ; Dillon et al. 1993 p. 276; Hair et al. 2006 p. 365-366).

Results

The mean scores in Table 2 indicate that the absorptive capacity of the pig farmers turns out to be mainly represented by deliberation with advisors for the purpose of acquisition and understanding of external developments and changes, which makes them simultaneously strong in the identification of the relevant sources of information. So in general it is these aspects of acquisition and assimilation capacity which are the strongest in terms of absorptive capacity of pig farmers. The capacity to transform and exploit is generally a weaker side of the farmers' absorptive capacity. Overall, they have a moderate capacity to be among the first to recognize technical, regulatory and market competition changes and possibilities to serve new customers, and to translate external information into new business applications and convert these into profit.

Table 3 provides the inter-factor correlation matrix for the studied variables. All of the different absorptive capacity dimensions turned out to be rather highly correlated. This confirms that they accurately represent the different dimensions of absorptive capacity. Correlations with other variables are significant, but provide for discriminant validity.

Table 3

Variable	NF	ACQ	ASS	TRA	EX	INN
Networking frequency (NF)	x					
Acquisition (ACQ)	.50**	x				
Assimilation (ASS)	.41**	.57**	x			
Transformation (TRA)	.28**	.61**	.72**	x		
Exploitation (EX)	.22**	.49**	.58**	.79**	x	
Innovativeness (INN)	.30**	.29**	.38**	.34**	.27**	x
Profit (PRO)	.17**	.31**	.38**	.49**	.59**	.31**

Note. Correlations ∗∗ $p < 0.01$; N = 444

Figure 2 provides a visual overview of the structural model and the structural coefficients. The significance of the paths is shown in this diagram. The relative importance of the variables is reflected in the magnitude of the coefficients. The overall fit measures indicate that the model fits the data well ($\chi 2$ (191) = 399.85 ,p < .001; GFI = .92; AGFI = .90; RMSEA = .05; RMR = .091; NFI = .97; NNFI = .98; CFI = .99). All of the modification indices for the beta pathways between major variables were small, which suggests that adding more paths would not significantly improve the fit.

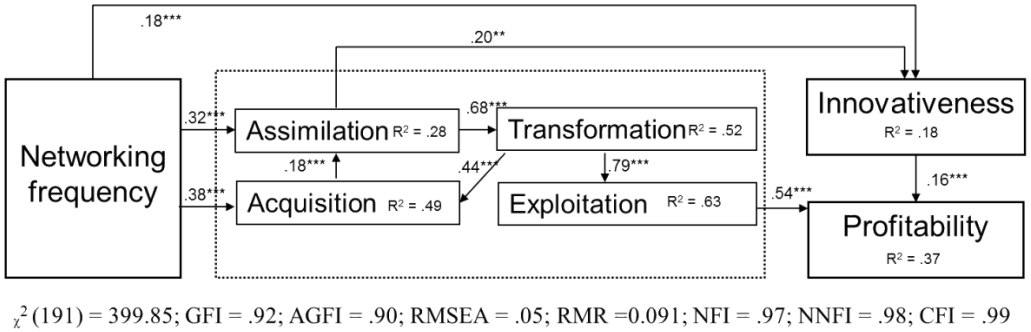

Figure 2. Structural Model
Note. ∗∗ p < 0.05; ∗∗∗ p < 0.01

Networking and Absorption

The findings from the parameter estimates show that, as expected, networking frequency is positively related to acquisition capability. Pig farmers with higher acquisition capacity have approximately bi-monthly to semi-annually contact with breeding companies, breeding farms, other pig farmers, slaughterhouses, consultancies, the branch organizations LTO[7] and NVV[8], Wageningen University (WUR) and Pigs Innovation Centre Sterksel[9]. An overview of these interactions is presented in Table 4. The pig farmers with lower acquisition capacity have less frequent contact with these organizations, namely about once a year. More frequent contact, through discussions and participation in sector-organized meetings with the mentioned actors, helps the farmers become more skilful in collecting relevant information and knowledge about developments and innovations in the sector.

Table 4. Comparison of networking frequency between innovators with high and low acquisition capacity

Acquisition	high	low		high	low		high	low
Breeding companies	■	●	Slaughterhouses	■	●	NVV	■-●	●-∞
Breeding farms	♠	■	Consultancies	♠	■	WUR	∞	⌂
Other pig farms	♠	♣	LTO	■	●	Sterksel	■	∞

Note. ♣ = monthly; ♠ = bi-monthly; ■ semi-annual; ● = annual; ∞ = less than annual; ⌂ = never or almost never

Frequent network contact is also positively related to assimilation capacity. As Table 5 shows, pig farmers with high assimilation capacity have the highest level of contact (approximately bi-monthly) with breeding farms and consultancies (for example related to feed, technical applications and installation, technical wholesale trade services or business advice).

Table 5. Comparison of networking frequency between innovators with high and low assimilation capacity

Assimilation	high	low		high	low		high	low
Breeding farms	♠	■	GD	■	●	ELI	●	∞
Slaughterhouses	■	●	Consultancy	♠	■	Sterksel	●	∞
Butcheries	●	∞	Product Boards Livestock and Meat (PVV)	●	∞	WUR	∞	⌂

Note. ♣ = monthly; ♠ = bi-monthly; ■ semi-annual; ● = annual; ∞ = less than annual; ⌂ = never or almost never

Slaughterhouses and health services for pigs (GD) are contacted approximately twice a year; and butcheries, Product Board Livestock and Meat (PVV), the Ministry of Economic Affairs, Agriculture and Innovation (ELI) and Sterksel are consulted approximately once a year. These farmers have contact with WUR less than once a year, whereas farmers with low assimilation capacity never or almost never have contact with the University. It is remarkable that farmers with the highest capacity to recognize shifts in technical possibilities, regulation and market competition

[7] LTO Nederland (Land- en Tuinbouw Organisatie) is the Dutch Federation of Agriculture and Horticulture, an entrepreneurial and employers' organisation, supporting their economic and social position.
[8] Dutch Pig Farmers' Union (NVV) is established to protect the interests of the pig farmers.
[9] Pigs Innovation Center Sterksel is a multi-functional research centre for modern, innovative and sustainable pig farming. The research covers all aspects of pig farming, including nutrition, welfare, health issues, housing and minerals management.

changes have only annual or less than annual contact with the research institutes. However, this frequency is still higher for farmers with high assimilation capacity than for those with low assimilation capacity.

In addition to the expected relations, it was found that networking frequency is positively related to innovativeness directly. Innovative farmers, who invest in 4P innovations, have more frequent contact with actors in the supply chain, banks, advisors and accountants as well as the health services agency for animals (Gezondheidsdienst voor Dieren - GD). This contact ranges bi-monthly to semi-annually in more innovative farms, while it is semi-annually to yearly in case of less innovative farms.

In addition to the higher networking frequency among farmers who invest more in 4P innovations, differences between different types of innovations were observed. As Table 6 shows, farmers who invest to a larger extent in pig welfare innovations have semi-annual contact with breeding farms and Sterksel, and less than annual contact with an additional number of actors, such as supermarkets, butchers, a government innovation institution (NL Agency[10]), knowledge and education institutions and animal welfare organizations. Farmers who invest in planet-profit innovations meet more or less semi-annually with Sterksel and butcheries, and slightly (less than annual instead of never) more frequently with breeding farms, supermarkets, the Ministry of Infrastructure and Environment (IM), NL Agency, Milieudefensie[11] and the Foundation for Nature and Environment (SNM). Pig farmers who invest more in people-profit-oriented innovations have about semi-annual contact with breeding farms, slaughterhouses and Sterksel and less than annual contact with butcheries, NL Agency, environment and animal welfare organizations such as Milieudefensie, SNM and foundation Wakker Dier, and knowledge and education institutions (such as Van Hall Larenstein).

Table 6. Comparison of the networking frequency between groups of innovators with high and low investment levels in Pigs, Planet, People and Pigs innovations

Investment in:	**Pigs**		**Planet**		**People**	
	high	low	high	low	high	low
Breeding farms	■	●	∞	⌂	■	●
Slaughterhouses					■	●
Sterksel	■	●	■	●	■	●
Butcheries	∞	⌂	■	●	∞	⌂
Supermarkets	∞	⌂	∞	⌂		
IM			∞	⌂		
NL Agency	∞	⌂	∞	⌂	∞	⌂
Knowledge and education inst.	∞	⌂			∞	⌂
Animal welfare organization	∞	⌂				
Wakker Dier					∞	⌂
Milieudefensie			∞	⌂	∞	⌂
SNM			∞	⌂	∞	⌂

Note. ■ semi-annual to annual ● = annual to less than annual; ∞ = less than annual; ⌂ = never or almost never

[10] NL Agency is the contact point for businesses, knowledge institutions and government bodies on issues related to sustainability, innovation, international business and cooperation. It provides information and advice on financing, networking and regulatory matters to entrepreneurs, (knowledge) institutions and government bodies.

[11] Milieudefensie is a movement of people who are committed and engaged, locally, nationally and internationally to contributing to the resolution of environmental problems (it is a foundation and member of Friends of the Earth International).

Absorptive Capacity

As expected, a positive relation was found between acquisition and assimilation. A higher capacity to establish contact with partners who can provide relevant information about changes and innovations in the sector (acquisition) impacts positively on the capacity to be among the first to recognize technical, regulatory and market-related developments and to evaluate how changes can be applied to one's own farm (assimilation). Pig farmers indicated that they acquire their information about developments in the sector mainly from discussions with business partners and participation in meetings organized by the sector (such as LTO).

Another expectation which was confirmed is that assimilation capacity has a significantly positive effect on transformation capacity. However, most farmers indicated that they have a low to moderate capacity/skilfulness to detect possibilities to serve new customers and only a smaller group indicated a moderate to high capacity to do this.

The capacity to transform knowledge into applications turns out to have a strongly positive effect on the capacity to acquire knowledge. This finding is logical since the transformation capacity of pig farmers is mostly reflected by their skill to quickly recognize the usefulness of new, external knowledge for applications on their own farms (e.g. by deliberation with advisors with regard to feed, technical applications and installation, technical wholesale trade services or business advice). Skilfulness in assessing the usability of new information, as well as regular deliberation with advisors about the way in which changes and trends in the market can be applied to one's own business, can lead to enhanced capacity to establish contact with the relevant sources of information. Table 7 indicates that farmers with higher transformation capacity have a higher frequency of contact with breeders and breeding companies, slaughterhouses and butcheries, but also with feed and feed system companies, other pig farmers, supermarkets, banks, consultancies and accountants, ELI, IM, NL Agency, NVV, PVV[12], WUR, knowledge institutes (Van Hall Larenstein), Sterksel, GD and SNM.

Table 7. Comparison of networking frequency between innovators with high and low transformation capacity

Transformation	high	low		high	low		high	low
Breeders	■	●	Supermarkets	∞	⌂	NVV	●	●-∞
Breeding farms	♣-■	♠-●	Banks	♣-●	■-●	PVV	●	∞
Feed companies	♣	♠	Consultancies	♣-●	■-●	WUR	∞	⌂
Feed system companies	■	●	Accountants	♣-●	■-●	Sterksel	●	∞
Other pig farms	♣	■	ELI	●	∞	Knowledge inst	∞	⌂
Slaughterhouses	■	●	MI	∞	⌂	GD	■	■-●
Butcheries	■	●	NL Agency	●	∞	SNM	∞	⌂

Note. ♣ = monthly; ♠ = bi-monthly; ■ semi-annual; ● = annual; ∞ = less than annual; ⌂ = never or almost never

As expected, transformation capacity also has a strongly positive effect on exploitation capacity. Skilfulness in assessing the usability and translation of new information for the purpose of application to changes in one's own farm contributes positively to the capacity to apply the acquired

[12] Productschap Vee en Vlees (product board for livestock and meat)

information to improvements and changes in one's own business in such a way as to realize profitability. The farmers indicated that especially the allocation of time to the application of acquired information reflects their exploitation capacity.

Absorption and Innovativeness

The general picture of investment in 4P innovations by pig farmers is as follows. Of the 444 farmers in the study, 41% have invested in fresh air farrowing pens, 31.2% in daylight, 36.6% in additional space per animal, 16.8% in conditioned air inlet and 15.4% in mist cooling. These are all pig-welfare-oriented innovations. In terms of planet-oriented innovation, 20.7% have invested in animal warmth recovery and 12.9% in solar panels. In terms of people-oriented innovation, 24.4% have invested in individual registration of feed and water intake and 16.1% in a Corn Cob Mix (CCM) feed facility.

While it was expected that transformation capacity would be positively related to innovativeness, we found that assimilation capacity is especially positively related to innovativeness. Transformation capacity is positively related to innovativeness, but only at the 0.10 significance level. This means that for pig farmers the capacity to recognize changes in technologies, regulations, market competition and consumer demands is most important to increase their level of innovativeness. Early recognition of these changes increases the likelihood that farmers will invest in 4P innovations. The farmers with higher assimilation capacity invested significantly more in fresh air farrowing pens, daylight, additional living space, conditioned air inlet, individual registration of feed and water intake and mist cooling. In addition, they invested slightly but significantly more in direct separation of urine and manure, solar collectors, micro-filtering of air, spraying robots, mixing space for sows and rubbing boards.

As already mentioned, networking frequency is also directly related to innovativeness. Table 8 shows that farmers with the highest networking frequency invested more in a larger number of innovations, while farmers with higher assimilation capacity invested specifically in pig welfare innovations. Farmers with high assimilation capacity invested in five pig- welfare- and one people-oriented innovation, while the farmers with high networking frequency invested in six pig-welfare-, two planet- and one people-oriented innovations. This indicates that assimilation capacity affects farmers' innovativeness by directing them more specifically towards animal welfare.

Table 8 Investments of farmers with high networking frequency ♣; and high assimilation capacity □

High networking frequency and high assimilation capacity					
Fresh air farrowing pens	♣	□	Mist cooling		□
Daylight	♣	□	Direct separation of urine and manure	♣	
Additional living space	♣	□	Solar collectors	♣	
Conditioned air inlet	♣	□	Animal warmth recovery	♣	
Individual registration of feed and water intake	♣	□	Rubbing boards	♣	

Profitability

The expectation that innovativeness is positively related to profitability is confirmed. However, this relationship is not very strong. One of the explanations for this may be that profitability in the case of 4P innovations does increase but that the return on investment takes more time, having a limited positive effect on short-term profitability. Of course, profitability is also a condition for financial room to invest in 4P innovations. However, the aim of the present paper is to establish whether higher innovativeness in the field of 4P innovations is positively related to profitability. The more general exploitation capacity of acquired information turns out to be much more strongly related to profitability than investment in these innovations. The capacity and skilfulness to exploit new information and knowledge in terms of their application to immediate business improvements contributes positively to the profitability of farms.

Table 9 Overview of the rejected and not rejected hypotheses

H1a: Networking frequency of pig farmers is positively related to their acquisition capacity.	Not Rejected
H1b: Networking frequency of pig farmers is positively related to their assimilation capacity.	Not Rejected
H2: Pig farmers' acquisition capacity is positively related to their assimilation capacity.	Not Rejected
H3: Pig farmers' assimilation capacity is positively related to farms' transformation capacity.	Not Rejected
H4a: Pig farmers' transformation capacity is positively related to exploitation capacity.	Not Rejected
H4b: Pig farmers' transformation capacity is positively related to innovativeness.	Rejected
H5a: Pig farmers' exploitation capacity is positively related to profitability.	Not Rejected
H5b: Pig farmers' innovativeness is positively related to profitability.	Not Rejected

Conclusions and Discussion

Networking and Innovativeness

Previous research established that weak ties and structural holes bridging organizational boundaries (Burt 1992; Rosenkopf and Nerkar 2001) provide access to diverse knowledge and information and are critical for innovation and innovativeness (Burt 2005). However, stronger ties, with frequency of contact as one of the indicators (Granovetter 1982; Krackhardt 1992), are considered important for the transfer of especially *complex knowledge* and information entailed in innovation (Hansen 1999; Reagans and McEvily 2003; Krackhardt 1992; Uzzi 1997). Reagans and McEvily (2003) advanced this discussion by establishing that network cohesion (overlapping ties among mutual third parties) and network range (relationships that span multiple knowledge pools) need not come at the expense of each other, but approach an optimal network structure which combines elements of both (Burt 2000; Reagans and Zuckerman 2001; Reagans, Zuckerman and McEvily 2003). The current research confirms the importance of stronger ties for the transfer of detailed knowledge by showing a positive relation between networking frequency and pig farmers' innovativeness. Furthermore, it can be concluded that diversity of knowledge is important but confined to a specific range of actors. In the case of investment in pig welfare, frequent contact with innovation centre Sterksel and breeding farms in particular, but also with supermarkets, butcheries, innovation, knowledge and education institutions, as well as animal welfare organizations is important.

In the case of planet-oriented innovations, it is important to maintain frequent contact with these same institutions, as well as the Ministry of Infrastructure and Environment and environment-oriented organizations such as Milieudefensie and SNM. The latter play a role in issues such as

reduction of manure surplus and ammonia emissions. The list of frequent contacts of farmers who invest in people-oriented innovations resembles that of farmers who invest in planet-oriented innovations. The somewhat wider networks of the farmers who are engaged in planet- and people-oriented innovations than of those who invest in pig welfare may be related to the somewhat higher interest of the planet and profit innovators in the efficiency aspect. While pig welfare also contributes to better and healthier pigs, innovations which are aimed at planet (environment) and people (labour) have somewhat more emphasis on efficiency and higher returns than the pig welfare innovations. Greater interest in efficiency in general may lead the planet and people innovators to explore a larger number of possibilities in a wider network.

The Role of Absorptive Capacity in the Relation between Networking and Innovativeness

The model in Figure 2 confirms the strong relationship between the use of the network (sources), learning and absorption (Goes and Park 1997; Powell, Koput and Smith-Doerr 1996) by a significantly positive relation between networking frequency and absorptive capacity. While confirming the importance of the combination of strong ties and network cohesion with weak ties and structural holes (Reagans and McEvily 2003), the present study addresses the shortcoming of previous research which used proxies to account for absorptive capacity. In contrast, we took the actual organizational capacities to absorb knowledge into account. Escribano et al. (2009) and Tsai (2009) identify the moderating role of absorptive capacity in the relationship between collaborative networks and product innovation performance. However, in these studies absorptive capacity is again measured by means of proxies, such as a firm's total expenditure on in-house R&D activities and training programmes for technological activities in the past three years divided by the total number of employees in a current year. Caloghirou et al. (2004) find that, besides R&D intensity and number of employees that have an academic degree in a scientific or engineering field, also organizational attributes in terms of openness towards knowledge sharing (searching patent databases, reading scientific or business journals and joining strategic alliances) constitute important aspects for the enhancing of a firm's innovation performance. The findings of the current study show that frequency of contact in a specific network range affects innovativeness positively, but also indirectly through acquisition and assimilation capacity. Incidental deliberation with advisors is not enough. Instead, a proactive and strategic approach towards absorption of knowledge and use of the network is needed to assure that sufficient interest and dynamism are created to incite change.

Acquisition, Assimilation and Innovativeness

As already indicated, assimilation capacity is the most important dimension of absorptive capacity for innovativeness of pig farmers. This indicates that the factor "knowing" or the understanding of actor *i* of the knowledge and skills of actor *j* (Borgatti and Cross 2003) is among the most important dimensions of absorption. Also acquisition contributes to innovativeness through its positive effect on assimilation capacity. The capacity to identify the most important knowledge sources, discuss with business partners and participate in sector meetings (acquisition capacity) contributes positively to the ability to recognize relevant changes and possibilities. The capacity to be among the first to recognize changes and developments in technical possibilities, regulations and the market, and skilfulness to recognize new possibilities to serve (new) customers are most effective in increasing the likelihood that a farmer will invest in People, Planet, Profit and

Pigs innovations. The capacity to understand and assimilate more technical, legislative and business-related knowledge among these farmers affects their innovativeness by directing them more specifically towards animal welfare innovations.

Farmers with higher assimilation capacity have a wider network of less than annual and more regular contacts, which helps them to recognize changes in technical possibilities, regulations, market competition and consumer demands. The most important sources of information about new developments in the sector turn out to be other pig farmers and slaughterhouses in the chain, and the wider network including consultancies, the branch organization LTO, and knowledge and research institutions (WUR and Sterksel). This selection of actors indicates that farmers with higher assimilation capacity are indeed highly interested in increasing their understanding of technical, regulatory, market and consumer changes.

Transformation and Acquisition Capacity

Previous studies (Zahra and George 2002) indicate that potential (acquisition and assimilation) absorptive capacity has a positive effect on the realized (transformation and exploitation) absorptive capacity, which has a direct positive link to firm performance (Volberda et al. 2010). However, little attention is devoted to the relation in the other direction. The current study shows that there is also a significantly positive effect of transformation on acquisition capacity. The capacity to transform and apply knowledge to one's own farm is positively related to a farmer's capacity to skilfully make contact with the network actors who can provide knowledge about innovations in the sector. Farmers with higher transformation capacity look specifically at how breeding can contribute to improvements on their farm and how innovations can be translated into increase in returns through negotiations about prices (with slaughterhouses). At the same time, the differences in frequency of contact with a large number of other chain parties and stakeholders indicate that farmers with higher transformation capacity are aware of the value of each actor for a particular innovation and of the effectiveness of frequent contact.

Transformation, Exploitation and Profitability

As previous studies pointed out that potential and realized absorptive capacity need to be balanced because potential absorptive capacity is more long-term oriented and realized absorptive capacity focuses on the more short-term-oriented goals (Zahra and George 2002), the current study also leads to the conclusion that the two dimensions of realized absorptive capacity, transformation and exploitation capacity, are the more important dimensions for profitability. The current research shows that investment in People, Planet, Profit and Pigs innovations is positively related to profitability. However, the general capacity to exploit external information and knowledge is more important for profitability than investment in these innovations. Allocation of time to apply the acquired information and sufficient skill to convert external information into profitability are highly important for realization of profit.

Practical Implications and Suggestions for Further Research

In their study Hult, Hurley and Knight (2004) confirm that not only learning, but also entrepreneurial and market orientation are antecedents of innovativeness. The findings of the current

study support this conclusion. Assimilation capacity and networking frequency explain 18% of variance in innovativeness, which means that other aspects also affect innovativeness. Entrepreneurial antecedents of pig farmers' innovativeness could be represented by their level of risk adversity. How much risk a farmer is willing to take, which type of innovation he is willing to engage in and how long he would like to continue his business could affect his level of innovativeness. These issues need further investigation.

Farmers' level of innovativeness is dependent not only on their ability and willingness to engage in innovation, but also on the type of innovation and the chain-wide organizational requirements (Wiskerke and Roep 2007; Broring 2008). In the present paper, innovativeness among farmers is defined as investment in (hardware) People, Planet, Profit and Pigs innovations. However, there are different types of innovations and especially those which go further than optimization require a very proactive attitude, continuous learning and a drive to change, as well as collaboration with and the support of other chain actors. Given the surplus of pig meat in Europe and strong competition in the entire supply chain, cooperation is needed to realize innovation on chain level. The question is what role the pig farmers need to play in each of the different types of innovations and which (chain) actor should be leading. A good example is the Beter Leven (better life) concept, developed by the animal protection society (Dierenbescherming), in cooperation with retailer Albert Heijn and meat company Vion. Animals are produced at a higher welfare standard and sold at a slightly higher price. This kind of marketing concept based on sustainability items has been developed further by other retailers and companies. The supermarkets play a major role in the establishment of the meat price and are important in organizational terms for the realization of innovation in this area. Interesting for future research is thus the mapping of the role of different chain actors with respect to different types of innovation and the specific knowledge (types) required to enable these different types of innovation. Specific knowledge and collaboration among specific actors for the purpose of solving the welfare problem is different from knowledge and collaboration with actors in development of new market concepts, since innovations take place at the farm, instead of just at the meat processing level.

In addition to the learning and entrepreneurial orientation, as well as the organizational requirements attached to the type of innovation a farmer engages in, the financial capacity and general economic situation need to be taken into account as determinants of innovativeness. The extent to which farmers are successful in acquiring financial means for innovation from their network is difficult to establish, but 48% of the farmers indicated that they make use of their network intensively for the purpose[13] of acquiring funding or subsidies. With respect to investments in (hardware) stable changes, a poor economic situation provides little room for investment. For this reason, farmers need the security of knowing that added value concepts will last long enough to pay back the additional investments.

The current model reflects the situation for pig farmers in north-western Europe, whereas farmers in southern and eastern Europe find themselves at a different level of development in terms of entrepreneurship, professionalization and efficiency. The relationships between networking behaviour, absorptive capacity and innovativeness are probably very different in these regions as

[13] Furthermore, 68% uses the network intensively for information about veterinary issues, 55% to gather information about rules and regulations, 38 % for (information about) animal welfare, 35% for collaboration purposes and 29 % for marketing ends.

they have other routines and perceptions about the sharing of information (e.g. study clubs where farmers learn from each other are common in the Netherlands but much less so in countries like Poland or Spain)[14]. Further research is needed to find out how networking, learning and innovativeness are related in these different contexts.

References

Ahuja, G. 2000. Collaboration Networks, Structural Holes, and Innovation: A Longitudinal Study. *Administrative Science Quarterly* 45(3): 425-455.

Ahuja, G. and R. Katila. 2001. Technological Acquisitions and the Innovation Performance of Acquiring Firms: A Longitudinal Study. *Strategic Management Journal* 22: 197– 220.

Ahuja, G. and R. Katila. 2004. Where Do Resources Come From? The Role of Idiosyncratic Situations. *Strategic Management Journal* 25: 887–907.

Aaker, D., V. Kumar and G.S. Day. 2004. *Marketing Research*. New York: John Wiley and Sons.

Autio, E., H. J.Sapienza and J.G. Almeida. 2000. Effects of Age at Entry, Knowledge Intensity, and Imitability on International Growth. *Academy of Management Journal* 43: 909–924.

Baker, W.E. and J.M. Sinkula. 1999. The Synergistic Effect of Market Orientation and Learning Orientation on Organizational Performance. *Journal of Academic Marketing Science* 27 (4): 411–427.

Balakrishnan, S. 1996. Benefits of Customer and Competitive Orientations in Industrial Markets. *Industrial Marketing Management* 25: 257–269.

Baltussen, W.H.M., R. Hoste, H.B. van der Veen, S. Bokma, P. Bens and H. Zeewuster. 2010. *Economic Impact of Existing Regulations on Farms with Pigs* (In Dutch). The Hague, LEI, Report 2010-010.

Barkema, H. G. and F. Vermeulen. 1998. International Expansion through Start-Up or Acquisition: A Learning Perspective. *Academy of Management Journal* 41: 7–26.

Borgatti, S. and R. Cross. 2003. A Relational View of Information Seeking and Learning in Social Networks. *Management Science* 49: 432-445.

Bröring, S. 2008. How Systemic Innovations Require Alterations Along the Entire Supply Chain: The Case of Animal-Derived Functional Foods. *Journal on Chain and Network Science* 8:107–120.

[14] Moreover, production in these and many other countries often takes places in vertical integrations, where innovations are differently organized.

Burns, A.C. and R. F. Bush. 2000. *Marketing Research.* Prentice Hall.

Burt, R. S. 1992. *Structural Holes: The Social Structure of Competition*. Cambridge, MA: Harvard University Press.

Burt, R.S. 2000. The Network Structure of Social Capital. *Research in Organizational Behavior* 22: 345–423.

Burt, R. S. 2005. Brokerage and Closure. Oxford: Oxford University Press.

Caloghirou, Y., I. Kastelli, and A. Tsakanikas. 2004. Internal Capabilities and External Knowledge Sources: Complements or Substitutes for Innovative Performance? *Technovation* 24: 29-39.

Calantonea, R.J., Cavusgil, S.T. and Zhaob, Y. 2002. Learning Orientation, Firm Innovation Capability and Firm Performance. *Industrial Marketing Management* 31 (6): 515-524.

Cassiman B. and R.Veugelers. 2002. R&D Cooperation and Spillovers: Some Empirical Evidence from Belgium. *American Economic Review* 92(4): 1169-1184.

Centraal Bureau voor de Statistiek (CBS). 2011. Pig Pile. CBS, Den Haag/Heerlen.

Centraal Bureau voor de Statistiek (CBS). 2011. Agriculture; economic size according to size-categories and type of firm. CBS, Den Haag/Heerlen.

Christensen, C., F. Suarez, and J. Utterback. 1998. Strategies for Survival in Fast Changing Industries. *Management Science* 44 (12): S207-S220.

Coleman, J.S. 1988. Social Capital in the Creation of Human Capital. *American Journal of Sociology* 94: S95-S120.

Cohen, W. M. and Levinthal, D. A. 1989. Innovation and Learning: The Two Faces of R&D. *Economic Journal* 99: 569-596.

Cohen, W. M. and D. A. Levinthal. 1990. Absorptive Capacity: A New Perspective on Learning and Innovation. *Administrative Science Quarterly* 35: 128-152.

Dess, G.G. and R. B. Robinson. 1984. Measuring Organizational Performance in the Absence of Objective Measures: The Case of the Privately Held Firm and Conglomerate Business Unit. *Strategic Management Journal* 5: 265–273.

Dhanaraj, C., Lyles, M.A., Steensma, H.K. and Tihanyi, L. 2004. Managing Tacit and Explicit Knowledge Transfer in IJVs: The Role of Relational Embeddedness and the Impact on Performance. *Journal of International Business Studies* 35: 428-442.

Dillon, W.R., T. J. Madden and N. H. Firtle. 1993. *Essentials of Marketing Research*. Homewood: Irwin.

Dyer, J. H. and H. Singh. 1998. The Relational View: Cooperative Strategy and Sources of Inter-Organizational Competitive Advantage. *Academy of Management Review* 23: 660– 679.

Escribano, A., Fosfuri, A. and Tribo, J. 2009. Managing External Knowledge Flows: The Moderating Role of Absorptive Capacity. *Research Policy*, 38(1):96–105.

Fosfuri, A. and J. A.Tribó, J.A. 2008. Exploring the Antecedents of Potential Absorptive Capacity and its Impact on Innovation Performance. *Omega* 36 (2): 173-187.

Gilsing, V. and B. Nooteboom. 2005. Density and Strength of Ties in Innovation Networks: An Analysis of Multimedia and Biotechnology. *European Management* Review 2:179–197.

Gilsing, V. A., B. Nooteboom, W. Vanhaverbeke, G. M. Duysters and A. van den Oord. 2008. Network Embeddedness and the Exploration of Novel Technologies: Technological Distance, Betweenness Centrality and Density. *Research Policy* 37: 1717–1731.

Goes, J. B., and S. H. Park. 1997. Inter-organizational Links and Innovation: The Case of Hospital Services. *Academy of Management Journal* 40: 673-696.

Granovetter, M.S. 1982. The Strength of Weak Ties: A Network Theory Revisited. In *Social Structure and Network Analysis*, edited by P. V. Marsden and N. Lin, Beverly Hills, CA: Sage.

Hage, J. 1980. *Theories of Organizations*. New York: Wiley.

Hair, J. F., R.P. Bush, and D.J. Ortinau. 2006. *Marketing Research*. Boston: McGraw Hill.

Hansen, M. T. 1999. The Search-Transfer Problem: The Role of Weak Ties in Sharing Knowledge Across Organization Subunits. *Administrative Science Quarterly* 44(1): 82-111.

Hoste, R. 2010. Prospects for Pig Farming in Europe – Challenges and Opportunities. The Hague, LEI, Report LEI 10-126.

Hoste, R. 2011. Production Costs of Pigs; Results of InterPIG in 2009 (In Dutch). The Hague, LEI, Report 2011-012.

Hult, G.T.M., R. F. Hurley. and G. A. Knight. 2004. Innovativeness: Its Antecedents and Impact on Business Performance. *Industrial Marketing and Management* 33: 429–438.

Hurt, T.H., K. Joseph and C. D. Cook. 1977. Scales for the Measurement of Innovativeness. *Human Communication Research* 4 (1): 58– 65.

Jansen, J., F. Van Den Bosch and H. Volberda. 2005. Managing Potential and Realized Absorptive Capacity: How do Organizational Antecedents Matter? *The Academy of Management Journal* 48(6): 999–1015.

Jones, G. K., A. Lanctot and H.J. Teegen. 2001. Determinant and Performance Impact of External Technology Acquisition. *Journal of Business Venturing* 16: 255–283.

Kale, P., H. Singh and H. Perlmutter. 2000. Learning and Protection of Proprietary Assets in Strategic Alliances: Building Relational Capital. *Strategic Management Journal* 21: 217-237.

Keller,W. 1996. Absorptive Capacity: on the Creation and Acquisition of Technology in Development. *Journal of Development Economics* 49: 199–227.

Kim, L. 1997a. The Dynamics of Samsung's Technological Learning in Semiconductors. *California Management Review* 39 (3): 86-100.

Kim, L. 1997b. *From Imitation to Innovation: The Dynamics of Korea's Technological Learning*. Cambridge, MA: Harvard Business School Press.

Kim, Y. and Lee, B. 2002. Patterns of Technological Learning Among the Strategic Groups in the Korean Electronic Parts Industry. *Research Policy* 31: 543–567.

Kimberly, J. R. 1981. Managerial Innovation, In *Handbook of Organizational Design,* edited by P. C. Nystrom & W. H. Starbuck, New York: Oxford University Press.

Klerkx, L. and C. Leeuwis. 2009. The Emergence and Embedding of Innovation Brokers at Different Innovation System Levels: Insights from the Dutch Agricultural Sector. *Technological Forecasting and Social Change* 76(6): 849-860.

Kline, R.B. 2010. *Principles and Practice of Structural Equation Modeling* (Third Edition). New York: Guilford Press.

Kogut, B. and U. Zander. 1992. Knowledge of the Firm, Combinative Capabilities and the Replication of Technology. *Organization Science* 3: 383-397.

Krackhardt, D. 1992. The Strength of Strong Ties. In *Networks and organizations: Structure, form and action*, edited by N. Nohria & R. G. Eccles. Boston: Harvard Business School Press.

Lane, P. J. and M. Lubatkin. 1998. Relative Absorptive Capacity and Inter-Organizational Learning. *Strategic Management Journal* 19 (5): 461-477.

Lane, P.J., J. E. Salk and M. A. Lyles. 2001. Absorptive Capacity, Learning, and Performance in International Joint Ventures. *Strategic Management Journal* 22(12): 1139–1161.

Lane, P.J., B.R. Koka and S. Pathak. 2006. The Reification of Absorptive Capacity: A Critical Review and Rejuvenation of the Construct. *Academy of Management Review* 31 (4): 833–863.

Larsson, R., L. Bengtsson, K. Henriksson and J. Sparks. 1998. The Interorganizational Learning Dilemma: Collective Knowledge Development in Strategic Alliances. *Organization Science* 9: 285–305.

Laursen, K. and A. Salter. 2006. Open for Innovation: The Role of Openness in Explaining Innovation Performance Among UK Manufacturing Firms. *Strategic Management Journal* 27(2):131–150.

LEI and CBS. 2011. Agri- and Horticulture figures 2011. The Hague, LEI, Report 2011-029

Lewin, A. Y. and S. Massini. 2003. Knowledge Creation and Organizational Capabilities of Innovating and Imitating Firms. In *Organizations as Knowledge Systems: Knowledge, Learning and Dynamic Capabilities,* edited by H. Tsoukas, N. Mylonopoulos, Palgrave/Macmillan, New York.

Lewin, A., S. Massini and C. Peeters. 2011. Microfoundations of Internal and External Absorptive Capacity Routines. *Organization Science* 22(1):81– 98.

Li, T. and R. J. Calantone. 1998. The Impact of Market Knowledge Competence on New Product Advantage: Conceptualization and Empirical Examination. *The Journal of Marketing* 62 (4): 13– 29.

Lumpkin, G. T. and G. G. Dess. 1996. Clarifying the Entrepreneurial Orientation Construct and Linking it to Performance. *The Academy of Management Review* 21 (1): 135-172.

Lyles, M. A. and C. R. Schwenk. 1992. Top Management, Strategy and Organizational Knowledge Structures. *Journal of Management Studies* 29: 155-174.

Meulen, H.A.B., C.J.A.M. van der, de Bont, H.J.Agricola, P.L.M. van Horne, R. Hoste, A.van der Knijff, F. R. Leenstra, R.W.van der Meer and A. de Smet. 2011. Upscaling in Agriculture and Horticulture; Effects in Livestock Sectors and Greenhouse Horticulture (In Dutch). The Hague, LEI, Report 2010-094.

Meeus, M. T. H., L. A. G. Oerlemans and J. Hage. 2001. Patterns of Interactive Learning in a High-Tech Region. *Organization Studies* 22: 145–172.

Mowery, D. C. and J. E. Oxley. 1995. Inward Technology Transfer and Competitiveness: The Role of National Innovation Systems. *Cambridge Journal of Economics* 19: 67-93.

Mowery, D. C., Oxley, J. E. and Silverman, B. S. 1996. Strategic Alliances and Interfirm Knowledge Transfer. *Strategic Management Journal* 17: 77–91.

Nooteboom, B., W. Vanhaverbeke, G. Duysters, V. Gilsing, and A.v.d. Oord. 2007. Optimal Cognitive Distance and Absorptive Capacity. *Research Policy* 36: 1016–1034.

Oliver, A. L. 2001. Strategic Alliances and the Learning Life-Cycle of Biotechnology Firms. *Organization Studies* 22: 467-489.

Pallister, J.G. and G.R. Foxall. 1995. Psychometric Properties of the Hurt – Joseph –Cook Scales for the Measurement of Innovativeness. *Technovation* 18(11): 663– 75.

Pearce, J., E. Freeman and R. Robinson. 1987. The Tenuous Link between Formal Strategic Planning and Financial Performance. *Academy of Management Review* 13(4): 658-75.

Powell, T.C. 1996. How Much Does Industry Matter? An Alternative Empirical Test. *Strategic Management Journal* 17 (4): 323–334.

Powell, W.W., K.W. Koput and L. Smith-Doerr. 1996. Interorganizational Collaborations and the Locus of Innovation: Networks of Learning in Biotechnology. *Administrative Science Quarterly* 41: 116–145.

PVE. 2011a. Livestock, Meat and Eggs in the Netherlands; Annual Survey 2010; Edition 2011. Zoetermeer, Product Boards for Livestock, Meat and Eggs.

PVE. 2011b. Pig sector; Provisional Statistical Year Report 2010 (In Dutch). Zoetermeer, Product Boards for Livestock, Meat and Eggs.

Reagans, R. and B. McEvily. 2003. Network Structure and Knowledge Transfer: The Effects of Cohesion and Range. *Administrative Science Quarterly* 48 (2): 240-267.

Reagans, R. and E. Zuckerman. 2001. Networks, Diversity and Performance: The Social Capital of R&D Units. *Organization Science* 12: 502-517.

Reagans, R., E. Zuckerman and B. McEvily. 2003. How to Make the Team? Social Networks vs. Demography as Criteria for Designing Effective Projects. Working Paper, Columbia University Graduate School of Business.

Rhee, J., T. Park and D.H. Lee. 2010. Drivers of Innovativeness and Performance for Innovative SMEs in South Korea: Mediation of Learning Orientation. *Technovation* 30: 65–75.

Rocha, F. 1999. Inter-Firm Technological Cooperation: Effects of Absorptive Capacity, Firm-Size and Specialization. *Economics of Innovation & New Technology* 8(3): 253-271.

Rogers, E. M. 2003. *Diffusion of Innovations* , 5th Edition, New York: Free Press.

Rosenkopf, L. and A. Nerkar. 2001. Beyond Local Search: Boundary Spanning, Exploration and Impact in the Optical Disk Industry. *Strategic Management Journal* 22: 287-306.

Rugman, A. M. and A. Verbeke. 2001. Subsidiary-Specific Advantages in Multinational Enterprises. *Strategic Management Journal* 22: 237–250.

Shenkar, O. and Li, J. T. 1999. Knowledge Search in International Cooperative Ventures. *Organization Science* 10: 134–143.

Simonin, B. L. 1999. Ambiguity and the Process of Knowledge Transfer in Strategic Alliances. *Strategic Management Journal* 20(7):595-623.

Spender, J.C. 1996. Making Knowledge the Basis of a Dynamic Theory of the Firm. *Strategic Management Journal* 17: 45-62.

Stock, G.N., N.P. Greis, and W.A. Fischer. 2001. Absorptive Capacity and New Product Development. *Journal of High Technology Management Research* 12 (1): 77-91.

Szulanski, G. 1996. Exploring Internal Stickiness: Impediments to the Transfer of Best Practice within the Firm. *Strategic Management Journal* 17: 27-43.

Teece, D.J. 1996. Firm Organization, Industrial Structure and Technological Innovation. *Journal of Economic Behaviour and Organization* 31: 193-224.

Tiemessen, I., H. W. Lane, M. Crossan and A. C. Inkpen. 1997. Knowledge Management in International Joint Ventures. In *Cooperative Strategies: North American Perspective*, edited by P. W. Beamish & J. P. Killing, San Francisco: New Lexington Press.

Todorova, G and B. Durisin. 2007. Absorptive Capacity: Valuing a Re-Conceptualization. *Academy of Management Review* 32(3): 774–786.

Tsai, W. 2001. Knowledge transfer in intra-organizational networks: Effects of network position and absorptive capacity on business unit innovation and performance. *Academy of Management Journal* 44: 996-1004.

Tsai, K.H. 2009. Collaborative Networks and Product Innovation Performance: Toward a Contingency Perspective. *Research Policy* 38: 765–778.

Uzzi, B. 1997. Social Structure and Competition in Interfirm Networks: The Paradox of Embededness. *Administrative Science Quarterly* 42(1): 35-67.

Van den Bosch, F., H. Volberda, and M. de Boer, 1999. Coevolution of Firm Absorptive Capacity and Knowledge Environment: Organizational Forms and Combinative Capabilities. *Organization Science* 10: 551-568.

Venkatraman, N. and V. Ramanujam. 1987. 'Measurement of Business Economic Performance: An Examination of Method Convergence. *Journal of Management* 13 (I): 109-22.

Veugelers, R. 1997. Internal R&D expenditures and external technology sourcing. *Research Policy* 26(3): 303-315.

Volberda, H.W., N.J. Foss and M.A. Lyles. 2010. Absorbing the Concept of Absorptive Capacity: How to Realize its Potential in the Organization Field. *Organization Science* 21(4): 931–951.

Van Wijk, R., J. J. P. Jansen, and M. A. Lyles. 2008. Inter- and Intra-Organizational Knowledge Transfer: A Meta-Analytic Review and Assessment of its Antecedents and Consequences. *Journal of Management Studies* 45: 830–853.

Winter, S. 1987. Knowledge and Competence as Strategic Assets. In *The Competitive Challenge-Strategies for Industrial Innovation and Renewal*, edited by D. Teece Cambridge, MA: Ballinger.

Wiskerke, J.S.C. and D. Roep. 2007. Constructing a Sustainable Pork Supply Chain: A Case of Technoinstitutional Innovation. *Journal of Environmental Policy and Planning* 9(1): 53-74.

Wognum, P.M., M. Wever and R. Nijhoff-Savvaki. 2007. General Description of Pork Chains in The Netherlands. Q-Pork Chains, Management Studies Group-Wageningen University.

Zaheer, A. and G.G. Bell. 2005. Benefiting from Network Position: Firm Capabilities, Structural Holes and Performance. *Strategic Management Journal* 26(9): 809–825.

Zahra S.A. and G. George. 2002. Absorptive Capacity: A Review, Reconceptualization, and Extension. *Academy of Management Review* 27:185–203.

Appendix 1

The Questionnaire

Function	**Age**
Education *Circle one option*	Secondary school / Mid-level vocational training / School of applied sciences / University
Number of pigs	**Number of sows**
Number of employees	**Number of employees involved in innovation**
Our company has existed for	❑ 0 to 5 years ❑ 5 to10 years ❑ 10 to 15 years ❑ 15 to 20 years ❑ 20 years or longer
In the event that you would retire in five years, is there a designated successor to take over your company?	❑ No ❑ Yes, my son / a buyer

Turnover in the year 2010 (in euros) was	*Please choose one of the options*
❑ Less than 300,000	❑ 1 - 2 mil.
❑ 400,000 - 600,000	❑ 2 - 4 mil.
❑ 600,000 – 800,000	❑ 4 - 8 mil.
❑ 800,000 - 1 mil.	❑ 8 mil. or more

Networking Frequency

How often do you have contact with each (category of) organization(s) for your access to external knowledge and information?

Please choose the option that best approaches the actual situation.
1= never 2= less than annually 3= annually 4=semi-annually 5= bi-monthly 6= monthly 7 = weekly

Company/organization	**Certifiers**	**Knowledge institutions**
Feed companies	PVV -CBD/VERIN[15] (IKB Pigs)	Wageningen University
Feed systems companies	De Green lobbyist (DGB) (IKB Netherlands Pigs)	Van Hall Larenstein
Veterinaries	SKAL (EKO)	HAS Den Bosch
Pig / sow farmers	Foundation Milieukeur	Pigs Innovation Centre Sterksel
Abattoirs / slaughterhouses	**Government institutions**	**Animal welfare and environment**
Meat processors	Ministry of Economic Affairs, Agriculture and Innovation	Animal protection
Transport companies	Agentschap.NL	Health services agency for animals (GD)
Supermarkets	**Branch organizations**	Milieudefensie
Butcheries	Agriculture organization Netherlands (LTO)	Foundation Wakker Dier
Banks	Dutch pig farmers' union (NVV)	Party for Animals
Consultancies	Product Board Livestock and Meat (PVV)	Society for Nature and Environment (SNM)
Accountants		

[15] Verification Institute Quality systems

Appendix 1. The Questionaire-*Continued*

Indicate to what extent you make use of external sources, knowledge and information for the following issues:

1 = very poorly and 7 = intensively

- *Animal welfare*
- *Veterinary issues*
- *Marketing*
- *Regulation*
- *Environmental issues*
- *Subsidies*
- *Collaboration*

Indicate to what extent you agree with the following statements: 1 = completely disagree and 7 = completely agree

Acquisition capacity
- *We collect information about developments in the sector through discussions with business partners in the sector.*
- *Our farm participates at least twice a year in seminars and sector-organized conferences to upgrade our expertise and knowledge.*
- *We allocate a lot of time to the establishment of contact with parties who can provide us with knowledge and information about innovations in the sector.*
- *We have sufficient skills to establish contact with parties who can provide us with knowledge and information about innovations in the sector.*

Assimilation capacity
- *Our farm is always among the first to recognize shifts in technical possibilities.*
- *Our farm is always among the first to recognize shifts in regulation.*
- *Our farm is always among the first to recognize shifts in market competition.*
- *Our farm is very skilful in detecting new possibilities to serve new customers.*
- *Our farm allocates a lot of time to deliberating with advisors in order to recognize changes in the market early.*
- *Our farm has sufficient skills to deliberate with advisors about how changes in the market can be used to make changes to the business on our farm.*

Transformation capacity
- *We record and store newly acquired knowledge for future reference.*
- *Our farm quickly recognizes the usefulness of new external knowledge to our existing knowledge.*
- *We discuss monthly with external advisors how trends in the market could be used to improve our business.*
- *We allocate a lot of time to translation of external information into adaptations to our business.*
- *We have sufficient skills to translate external information into adaptations to our business.*

Exploitation capacity
- *We translate external information directly into new business applications.*
- *Application of external information to our business contributes to our profitability.*
- *We have sufficient skills to convert external information into profitability.*

Profitability 1=much lower and 7=much higher
- *How do you estimate your profitability compared to your competitors'?*
- *Compared to our most important competitors our turnover is:*
- *Compared to our most important competitors our growth percentage is:*

Appendix 1. The Questionaire-*Continued*

Innovativeness

We are investing in: 1 = not at all; 4= in a part of the company; 7=in the entire company

o Balance farrowing pens	o Micro-filtering of air
o Fresh air farrowing pens	o Conditioned air inlet
o Watras farrowing pens	o Individual registration of feed and water intake
o Direct separation of urine and manure	o LED light
o Biomass plants	o CCM facility
o Wind energy	o Mechanical broadcast
o Solar collectors / solar panels	o Spraying robot
o (Animal) warmth recovery / exchanger	o Mixing room sows
o Daylight - more than 2% stable surface	o Mist cooling
o Additional space per animal	o Pad-cooling
o Exit to open air	o Shoulder cooling
o Rooting place	o Rubbing board

International Food and Agribusiness Management Review
Volume 15, Issue 3, 2012

China's Meat and Egg Production and Soybean Meal Demand for Feed: An Elasticity Analysis and Long-Term Projections

Tadayoshi Masuda[a] and Peter D. Goldsmith[Φb]

[a]*Senior Research Analyst, Research Institute for Humanity and Nature*
457-4 Kamigamo Motoyama, Kita-ku, Kyoto 603-8047, Japan

[b]*Associate Professor, Department of Agricultural and Consumer Economics, University of Illinois at Urbana, Champaign 1301 West Gregory Drive, Urbana, Illinois, 61801, USA*

Abstract

China is a large meat and egg producer and correspondingly a large soybean meal consumer. Dual forces affect the derived demand for soybeans; rising livestock production to meet consumer demand for protein and the shift to commercial feed by the livestock industry. We employ a unique elasticity approach to estimate these dual forces on soybean meal demand over the next 20 years. We then discuss the implications of these forecasts with respect to the modernization of China's feed industry, land use changes in South America, and the need for yield research to reduce pressure on increasingly scarce land resources.

Keywords: meat production; soybean meal; feed demand; elasticity; forecasting; land use

ΦCorresponding author: Tel: +217-333-5131
Email: P.D. Goldsmith: pgoldsmi@illinois.edu

+The IFAMR is a non-profit publication. The additional support provided from this issue advertisers, Novus International and GlobalGap help keep us open access and dedicated to serving management, scholars, and policy makers worldwide.

Introduction

Background

The "livestock revolution" (Delgado et al. 1999) is causing dramatic growth of feed demand. FAO (2006) though projects moderate annual growth rates of world cereals feed demand at 1.6% in 1999/01-2030 and 0.8% in 2030-50 (FAO, 2006). Others argue that world cereal feed demand will be significantly higher in the coming 30 years than was originally projected by international organizations (Keyzer et al. 2005).

One key component of the derived demand for feed grains and oilseeds is soybean meal, derived directly from soybeans. Soybeans are the fastest growing broad acre crop in the world in terms of hectares under cultivation. The growth is fueled directly by rising livestock demand for soy-based protein in their diet, and indirectly by income-based shifts to greater meat consumption around the world. The expansion of soybean hectares is a nontrivial event as most of the expansion involves land use changes in developing regions of the world, such as South America. The motivation for our research is twofold: first, to provide the industry and policy makers with valid estimates of long term soybean meal demand; and second, to draw attention to the important linkages between income growth, meat consumption, livestock industry and demand for feed crops, land use, and the need for yield-improving agricultural research.

China's[1] Meat[2] and Egg Production: Historical View (1961-2010)

In 2010, world meat and egg production respectively reached 280 million metric tons and 66 million metric tons, with compound annual growth rates (1961-2010) of 2.9% and 3.1%, respectively (Figure 1). Meat and egg production quadrupled over the last 50 years of the 20th century. Resulting grain demand and the pressure on land resources will be high if the demand elasticities, the subject of this research, for feed grains and oilseeds are high. FAO estimates may in fact be low as was suggested by Keyzer et al. (2001, 2005). Pressure will be acute on output increasing crop strategies such as expanding crop hectares, increasing yield, double cropping, and reducing harvest and post-harvest loss.

Chinese producers play a major role in this steady meat and egg production quantity increase during the study period, especially after transitioning to a market economy beginning in the late 1970s (Ortega et al. 2009). The transition involves a number of components supportive of the expansion of the livestock sector, and as result lays the ground work for the expanded use of soybean meal. Most notably the ability to freely migrate from low paying rural occupations to higher paying urban opportunities gives rise to an urban middle class that is wealthier and consumes more protein. The transition to a market economy also allows greater flows of capital. As a result both domestic and international firms dramatically increased their investment in the food and agribusiness sector to meet the growing demand. Much of this investment was originally led by international food and retail firms that require high quality, uniform, and large supply volumes of animal products. There is a natural fit between modern livestock systems, their sole use of commercial feeds utilizing soybean meal, and emergence of the larger retailers and food companies (Xing 2009).

[1] Mainland China + Hong Kong + Macau

[2] In this study meat consists of pork, poultry meat, bovine meat, goat & mutton meat, and other meat. The data source is FAOSTAT.

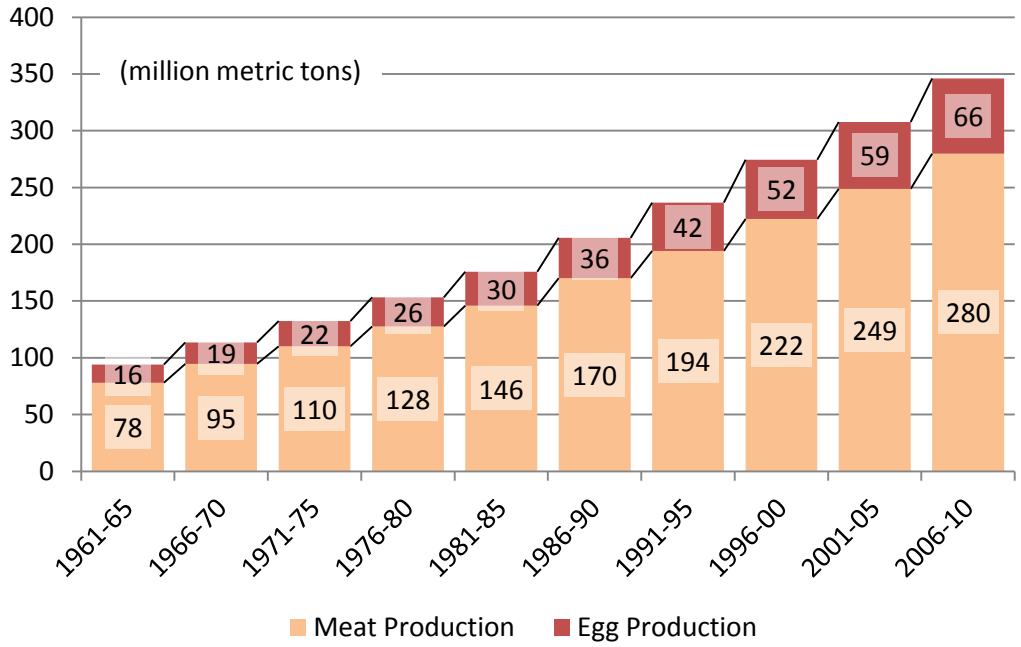

Figure 1. World Meat and Egg Production Quantity: 1961-2010
Source. FAOSTAT and Authors' Calculation.

China's Meat Production Composition and its Characteristics

Annually during the 2006-10 period, the world produced 104 million metric tons of pork (37% of the total meat production), 91 million metric tons of poultry (33%), and 65 million metric tons of beef & buffalo (23%). Pork (64%) and poultry (21%) comprise most of China's meat production. China produces 46% (48 million metric tons) of the world's pork and 17% (16 million metric tons) of the world's poultry. Since the 1980s, pork's share of all the meat produced in China has gradually declined from 83% during the 1981-85 period to 64% in 2006-10. Pork is still the preferred meat in China though the shares of poultry and beef have increased. The country's egg production has grown dramatically since the mid-1980s, increasing annually 6.7% between 1985 and 2010.

China's Feed Market

Low fiber high quality protein feeds are preferred for pork, poultry and egg production. Monogastric animals, such as pigs and chickens do not digest well most dietary fibers. Soybean meal is the world's predominant plant protein source, and is remarkable for its high quality nutrient makeup (Waldroup 2010). As a result soybean meal is the number-one protein source used in poultry and pork production throughout the world (Stein et al. 2008). Soybean meal, because of its relatively low fiber content and superior mix of amino acids, uniquely complements the other major feed ingredients such as cereals and starchy roots that are high in energy but low in protein. A high level of inclusion (30-40 percent) is used in high performance monogastric diets (FAO, 2002). The rapid rise of pork, poultry, and egg production in China has creates a derived demand for soybean meal and soybeans.

It is worth noting that soybeans are a protein crop that requires processing before feeding to livestock. The crushing process uses heat, pressure and chemical extraction to turn soybeans into two high quality, stable, and readily transportable products: 1) soybean meal- 78% of the soybean; and 2) soybean oil- 18% of the soybean.

China's soybean meal demand for feed averaged 29.2 million metric tons over the 2006-07 period (Table 1). It was ranked as the 3rd largest plant-based feed source and comprised 10.9% of total feed fed. China's domestic demand of soybean meal for feed in 2006-07 was 18 times larger than as it was in 1961-65 (1.6 million metric tons). The research presented in this paper focuses on this tight relationship between China's meat & egg production and the soybean meal demand for feed.

Table 1. China's Feed Composition (2006-07 year average)

Feed Ingredients*	mil. metric tons	share
Maize	99.0	37.0%
Sweet Potatoes	35.6	13.3%
Soybean Meal	29.2	10.9%
Vegetables, Other	27.1	10.1%
Cassava	15.4	5.7%
Rice (Milled Equivalent)	10.1	3.8%
Brans	9.4	3.5%
Potatoes	6.5	2.4%
Wheat	6.2	2.3%
Rape and Mustard Cake	6.1	2.3%
Other ingredients	23.2	8.7%
Total	267.7	100.0%

Notes.*Include cereals, starchy roots, sugar crops, pulses, oilcrops, and vegetables. Regarding oilcrops, beans/seeds, cake (meal), and vegetable oils are distinguished as different ingredients in this table. Animal-originated ingredients (livestock and aquatic products) are not included.
Source. FAOSTAT and authors' calculation.

World Soybean Supply-Demand Balances and China's Soybean Meal Demand

The world annually produced 28.6 million metric tons of soybeans in 1961-65, and reached an annual average of 231.5 million metric tons over the 2006-10 period. World annual production of soybeans is predicted to increase by 2.1% to 359.7 million tons by 2030 (Masuda and Goldsmith 2009).

The world annually fed 150.2 million metric tons of soybean meal on average over the 2006-07 period (Table 2). The largest users of soybean meal are the United States (32.5 million metric tons, 21.6% of the world total), China (29.2 million metric tons, 19.5%), Brazil (10.6 million metric tons, 7.1%), Spain (5.5 million metric tons, 3.7%), and France (4.3 million metric tons, 2.9%). These five soybean meal consuming countries account for more than half (55%) of world soybean meal demand.

Table 2. World Soybean Supply-Demand Balances (2006-07 year average)

Element	Soybeans		Soybean oil		Soybean meal	
	mil. tons	ratio	mil. tons	ratio	mil. tons	ratio
Domestic Production	219.0	99%	35.9	105%	152.6	100%
International Trade	71.3	32%	12.0	35%	59.6	39%
Stock Variation	3.0	1%	-0.6	-2%	0.2	0%
Domestic Supply	220.7	100%	34.3	100%	152.5	100%
Feed	8.7	4%	0.3	1%	150.2	99%
Seed	6.6	3%	-	-	-	-
Waste	3.5	2%	0.9	3%	-	-
Processing	191.3	87%	0.0	0%	-	-
Food	10.2	5%	24.1	70%	-	-
Other Utility	0.4	0%	9.0	26%	2.3	1%

Notes. 1. Each ratio of domestic supply quantity (Soybeans, Soybean oil, and Soybean meal) is set to 100%.
2. 35.9 million metric tons of soybean oil and 152.6 million metric tons of soybean meal were processed from 191.3 million metric tons of soybeans in the world. 3. Average of world total exports and imports.
Source. FAOSTAT and authors' calculation.

China has steadily increased its share in the world of soybean meal utilization since the second half of the 1980s, (Goldsmith et al. 2004). China domestically produces 29.4 million metric tons of soybean meal and is able to meet its demand with domestic supplies (Table 3). However, out of 45.5 million metric tons of soybeans demanded, more than two-third (69%, 31.5 million metric tons) are imports. China's domestic production of soybeans (14.1 million metric tons) accounts for less than one-third (31%) of the total domestic supply quantity of soybeans.

Table 3. China's Soybean Supply-Demand Balances (2006-07 year average)

Element	Soybeans		Soybean oil		Soybean meal	
	mil. tons	ratio	mil. tons	ratio	mil. tons	ratio
Domestic Production	14.1	31%	6.4	75%	29.4	101%
Net Import (IM-EX)	31.5	69%	2.2	25%	-0.2	-1%
Stock Variation	0.0	0%	0.0	0%	0.0	0%
Domestic Supply	45.5	100%	8.6	100%	29.2	100%
Feed	2.5	5%	0.0	0%	29.2	100%
Seed	1.2	3%	-	-	-	-
Waste	0.6	1%	-	-	-	-
Processing	35.9	79%	-	-	-	-
Food	5.4	12%	4.1	48%	-	-
Other Utility	0.0	0%	4.5	52%	-	-

Notes. 1. Each ratio of domestic supply quantity (Soybeans, Soybean oil, and Soybean meal) is set to 100%.
2. 6.4 million metric tons of soybean oil and 29.4 million metric tons of soybean meal were processed from 35.9 million metric tons of soybeans in China..
Source. FAOSTAT and authors' calculation.

Objectives

In this research we examine the close relationship between meat/egg production and soybean meal demand for use as feed in China. Specifically we have three objectives in this paper: 1) to estimate the long-term elasticity of soybean meal demand for feed with respect to egg and meat production in China; 2) to forecast the long-range meat and egg production quantities and soybean meal demand through 2030 in China; and 3) to discuss the implications of animal production growth in China on international soybean markets, land use, and yield-improving agricultural research.

Methodology

Estimates and projections of supply/demand for feed grains in China commonly utilize the implied demand approach where multiplying feed-meat conversion ratios by animal numbers yields feed grain demand quantities (Zhou et al. 2008). The feed-meat conversion ratios vary due to animal variety, feed composition, use of additives, animal raising practices, and animal accommodation (Zhou et al. 2003; Xin et al. 2005). Researchers apply a wide range of ratios (see Zhou et al. 2008) and there is no agreement for estimating current and future feed grain demand. We diverge in this paper with an alternative approach that estimates an elasticity of soybean meal demand for feed with respect to meat and egg production quantity.

First we use an error-correction model to estimate the cointegrating equation between domestic meat and egg production and soybean meal demand in China. The parameter in the cointegrating equation represents the long-term elasticity of soybean meal feed demand due to changes in the livestock production. The error correction mechanism (ECM), following Hendry et al. (1984) and Mills (1990, pp.273-276), is expressed as:

$$(1)\quad \Delta\ln(soym_t) = \phi\Delta\ln(mtegprod_t) - \gamma(\ln(soym_{t-1}) - \alpha - \beta\ln(mtegprod_{t-1})) + \delta + \varepsilon_t$$

Where:

$\ln(soym_t)$ = natural logarithm of China's soybean meal demand quantity for feed in year t,
$\ln(mtegprod_t)$ = natural logarithm of China's meat and egg production quantity in year t,
ε_t = error term, and
α, β, γ, δ, and ϕ are parameters.

$$(2)\quad \ln(soym_{t-1}) = \alpha + \beta\ln(mtegprod_{t-1})$$

is the cointegrating equation and β is the long-term elasticity.

There are several methods for estimating the specific cointegration parameters. Gonzalo (1994) shows that Johansen's (1988) maximum likelihood approach clearly has better properties than the other estimators such as; ordinary least squares by Engle and Granger (1987), nonlinear least squares by Stock (1987), principal components by Stock and Watson (1988), and canonical correlations by Bossaerts (1988). Adopting Johansen's (1988) approach, we use a vector error-correction model (VECM) including the time series of soybean meal demand and meat and egg

production quantity in China. Following Johansen (1995), the trend parameter is either set to zero or unrestricted. The same is done for the constant terms, α and δ.

With the estimated long-term elasticity $\hat{\beta}$, the next year's soybean meal demand for feed is projected using a recursive form as follows:

(3) $ln(soym_{t+1}) = \hat{\beta}\ln(mtegprod_{t+1}) + \hat{\alpha}$

(4) $ln(soym_t) = \hat{\beta}\ln(mtegprod_t) + \hat{\alpha}$

Subtracting equation (4) from (3) results in:

(5) $ln(soym_{t+1}) = ln(soym_t) + \hat{\beta}\Delta\ln(mtegprod_{t+1})$.

Taking the exponential of both sides provides the forecast equation:

(6) $soym_{t+1} = soym_t * e^{\hat{\beta}\Delta\ln(mtegprod_{t+1})}$.

where $mtegprod_{t+1}$ is estimated beforehand.

Exponential Smoothing with a Damped Trend

We employ exponential smoothing with a damped trend[3] to estimate meat and egg production quantities using a Box-Jenkins or ARIMA type univariate time series model. Introducing a damped trend into an exponential smoothing model makes sense to allow for decreasing rates of growth (a plateau) over time. Following Gardner and McKenzie (1985) and Gardner (1985), the general damped-trend linear exponential smoothing model is as follows:

(7) $P_t = \mu_t + \beta_t t + \epsilon_t$

where P_t is China's meat and egg production quantities at time t, μ_t is the mean level of production at time t, β_t is parameter at t, t is the time trend or year, and ϵ_t is error term at t.
The smoothing equations are:

(8) Level: $L_t = \alpha P_t + (1-\alpha)(L_{t-1} + \phi T_{t-1})$, and

(9) Trend: $T_t = \gamma(L_t - L_{t-1}) + (1-\gamma)\phi T_{t-1}$

where L_t = smoothed level at t of the series, computed after P_t is observed,
α = smoothing parameter for the level of the series,
ϕ = trend modification or damping parameter,
T_t = smoothed trend at the end of period t, and
γ = smoothing parameter for trend.
The error-correction form of the smoothing equations is:

[3] Refer to Gardner and McKenzie 1985; Hyndman et al. 2008; Masuda and Goldsmith 2009.

(10) $L_t = L_{t-1} + \phi T_{t-1} + \alpha e_t$, and

(11) $T_t = \phi T_{t-1} + \alpha\gamma e_t$

where $e_t = P_t - \hat{P}_t(1)$ is a one-period-ahead forecast error.
The forecast for *k* period(s) ahead from origin *t* is:

(12) $\hat{P}_t(k) = L_t + \sum_{i=1}^{k} \phi^i T_t$.

If $0 < \phi < 1$, the trend is damped and the forecasts approach an asymptote given by the horizontal linear line or plateau: $L_t + T_t\phi(1-\phi)$. The equivalent process is ARIMA (1, 1, 2)[4] which can be written as:

(13) $(1-\phi B)(1-B)P_t = (1-\theta_1 B - \theta_2 B^2)\epsilon_t$,

where $\theta_1 = 1 + \phi - \alpha - \alpha\gamma\phi$, and $\theta_2 = (\alpha - 1)\phi$.
If $\phi = 1$, the model is equivalent to the standard version of Holt's model[5] and the trend is linear. The equivalent process is ARIMA (0, 2, 2):

(14) $(1-B)^2 P_t = (1-\theta_3 B - \theta_4 B^2)\epsilon_t$

where $\theta_3 = 2 - \alpha - \alpha\gamma$, and $\theta_4 = \alpha - 1$.

For damped trend estimation the default is set at $\phi = 0.98$. The level and trend parameters are grid-searched to minimize the mean square error (MSE). Estimations are conducted using Stata 12.

Data

There are two distinct challenges for scholars conducting research on China's livestock and feed supply and demand. First are problems associated with Chinese estimates of their own agricultural output and food and feed utilization. Numerous scholars have wrestled with China's data quality problem. Second, there is a lack of a comprehensive dataset that uses a common methodology and covers all years and all necessary livestock, meat, grain, oilseed, meal, and oil commodities.

Many researchers discuss the accuracy and reliability of China's statistics. They point out that livestock production data are overstated, especially through 2000 (Fuller et al. 2000; Ma et al., 2004; Wang et al., 2005). Under some assumptions, Fuller et al. (2000) construct a more accurate adjusted dataset (1985-96) for livestock production than the State Statistics Bureau (SSB) reported in the China Statistical Yearbook. Ma et al. (2004) use the 1997 Ag Census and other sources to create a revised China National Statistical Bureau (CNSB) livestock demand and supply series (1980-99). Zhou et al. (2003) report that the Chinese government adjusted downward the 1995-97 official meat output figures on several different occasions. Such actions

[4] In the general ARIMA (1, 1, 2), $-1 < \phi < 1$.
[5] Refer to Holt 1957; Holt 2004; Holt et al. 1960. Holt (2004) is a reprinted version of Holt (1957).

confirm researchers' suspicions that some data are overstated. Wang et al. (2005) derive a supply-demand balance sheet for 2000 using official animal production data but had to adjust the consumption side of the equation. They use the net export data from the United States Department of Agriculture (USDA), carcass-retail weight loss parameters from Putnam and Allshouse (1996), and away-from-home and processed-products consumption proportions from Wang et al. (2004).

The poor quality of data forces researchers to employ creative means to develop a valid dataset. Yet even today, there does not exist a valid domestic set of data across time and across commodities sufficient to allow for the estimation of derived demand for soybean meal. Therefore we need to rely on the international FAOSTAT dataset. The comprehensiveness of the FAOSTAT data we use is important for time series forecasting because the data cover 1961-2007 for soybean meal demand and 1961-2010 for meat and egg production quantities. While clearly not optimal, FAOSTAT data are comprehensive across time and commodities. The critical requirement then for this research is to validate these data in order to ensure that the data are reliable for a forecast model.

FAOSTAT data deal with net stock variation and domestic allocation as either food or feed by explicit usage. FAOSTAT data for the 1999-2001 period though show significant differences with government meat and egg consumption and production data from the State Statistics Bureau of China (SSB). We employ Wang et al. (2005) and Putnam and Allshouse (1996) adjustment methods on the SSB data. The FAOSTA data are valid as the adjusted SSB are now comparable. (See Table 4 in Appendix).

Results

Elasticity of Soybean Meal Demand

Our first objective is to estimate the long-term elasticity of soybean meal demand for feed with respect to egg and meat production in China. The estimation result of equation (2) indicates strong support for a cointegrating equation such that

$$(15)\quad ln(soym_t) = 0.909 * ln(mtegprodt_t) + 0.888$$

should be a stationary series (see Table 5). The coefficient 0.909 represents the long-term elasticity of soybean meal demand for feed with respect to the domestic meat and egg production in the livestock industry. The result suggests that China's soybean meal demand increases by 0.909% as the domestic meat and egg production quantity increases by 1.000%.

This makes sense as the usage of commercial feeds (soybean meal) is growing rapidly at the same time the livestock sector is expanding rapidly (Xing and Goldsmith 2012). China has a long standing tradition as one of the world's leading fish and livestock producers in the world. Historically fish and livestock producers utilized informal feed sources such as domestic household waste. Commercial feed usage was small. Increasing fish, meat, egg, and dairy demand triggered new investment in the livestock sector and the construction of larger scale commercial farms, in recent years. These new facilities utilize commercially produced feeds, which almost universally use soybean meal as the main source for protein. So the adoption rates

of soybean meal result from both the rise in livestock production, but are also accelerated by the switch to commercial feeds (Xing and Goldsmith 2012). Therefore over the medium term it is expected that the rate of growth of soybean demand may even outpace the rate of growth of China's livestock production. This acceleration effect should moderate over time as the industry achieves high commercial feed adoption levels.

Table 5. Estimation Result: Elasticity of Soybean Meal Demand for Feed in China

	Coef.		Std. Err.
ln(soymeal demand)	1.000		(fixed)
ln(meat&egg production)	0.909	***	0.330
const.	0.888		5.635
Log Likelihood	85.386		
# of observation	41	(1963-2003, # of lags = 2)	

Note. *** Denotes significant at 1%.

Meat and Egg Production Forecast Results

China's meat and egg production quantities were 80.8 and 28.0 million metric tons respectively, and total 108.8 million metric tons in 2010 (Table 6). The summed production quantity grew annually at 2.6% during the 1999-2010 period.

Table 6. China's Domestic Meat and Egg Production Quantity: Projection Summary

	Production Quantity (mil. metric tons)				Compound Annual Growth Rate		
	1999/01	2010	2020	2030	1999/01-10	2010-20	2020-30
Meat & Egg Total	83.9	108.8	127.1	141.9	2.6%	1.6%	1.1%
Meat Total	61.7	80.8	92.9	102.8	2.7%	1.4%	1.0%
Pig Meat	40.8	51.7	56.1	59.6	2.4%	0.8%	0.6%
Poultry Meat	12.3	17.0	22.1	26.2	3.3%	2.7%	1.7%
Beef & Buffalo Meat	5.1	6.5	7.8	8.8	2.5%	1.7%	1.2%
Sheep & Goat Meat	2.6	3.9	4.9	5.6	4.1%	2.1%	1.4%
Other Meat	0.9	1.6	2.1	2.6	6.1%	3.0%	1.9%
Eggs	22.1	28.0	34.2	39.1	2.4%	2.0%	1.4%

Note. 1. The forecast period is 2011-2030. 2. Other meat includes all other consumed animal proteins. Does not include fish.
Source. FAOSTAT and authors' estimation.

Following equations (10) and (11), China's meat and egg production quantities were estimated[6] as univariate time series and projected through 2030. Over the near future (2010-20) we forecast a decline to a level of 0.8% annual growth in pork production while other meat production quantities' growth rates keep steady: poultry 2.7%, beef and buffalo 1.7%, and lamb, mutton and goat 2.1%. This change by consumers away from just pork to greater protein variety reflects a maturation of preferences as incomes rise over time. Total meat production quantity grows annually at 1.4% and reaches 92.9 million metric tons in 2020. During the same period (2010-20), egg production quantity grows annually at 2.0% and reaches 34.2 million metric tons in 2020.

[6] See Appendix 2 , Table 8 for details.

Over the distant future (2020-30), we forecast continued moderate increases in both meat and egg production. Pork production's annual growth remains at 0.6% and other meat production quantities' growth rates keep above 1.0 percent: poultry meat 1.7%, beef and buffalo meat 1.2%, and sheep and goat meat 1.4%. Pork's share of total meat production continues above 50%. Total meat production quantity grows at an annual rate in the period of 1.0%, and reaches 102 million metric tons in 2030.

During the same period (2020-30), annual egg production quantity also continues to increase at 1.4% and reaches 39 million metric tons in 2030. The summed (meat + egg) production quantity is estimated to increase continuously with gradually declining annual growth rates to 1.6% in 2010-20, and 1.1% in 2020-30. The total production quantity reaches 127 million metric tons in 2020 and 141 million metric tons in 2030.

Soybean Meal Utilization Forecast Results

China's annual growth rate for soybean meal demand is projected at 2.9% over the 2000-2030 period. Soybean meal annually grew at 5.7% between 2000 and 2010. We forecast a slowing to 1.7% in 2010-20 and 1.3% in 2020-30 (Table 7). Note the dramatic decrease of 70% going forward in the annual growth rate in the demand for soybean meal. Meat production during the same period increases only at an annual rate of 2.6% (Table 6). Also remember the tight long run relationship between meat production and soybean meal demand in the form of a high estimated livestock demand elasticity of 0.91. While certainly not definitive, there appears to be some evidence that the switch to commercial feed played a significant role in in soybean meal demand in the recent past. Soybean meal demand's growth rate outpaces meat and egg production's growth rate because of the industrial feed phenomenon currently underway in China (Xing and Goldsmith 2012). As China's livestock industry matures soybean meal will be driven increasingly more by livestock production growth and the derived demand for meat, rather than the shift to commercial feeds, as is common in developed countries.

Table 7. China's Domestic Soybean Meal Demand for Soybean Meal: Projection Summary

	Million Metric Tons				Compound Annual Growth Rate		
	1999/01	2010	2020	2030	1999/01-10	2010-20	2020-30
Soy Meal Domestic Feed Demand	14.4	25.1	29.7	33.7	5.7%	1.7%	1.3%
Soybean Equivalent	17.6	30.7	36.4	41.2	-	-	-
				+24 MMT			
Land Required							
@ 2.3 t/ha				10 Mil. Ha			
@ 3.0 t/ha				8 Mil. Ha			
@ 4.0 t/ha				6 Mil. Ha			

Notes. 1**.** (Soybean meal Domestic Feed Demand)/0.817. For Soybean meal/Soybean Ratio: 0.817 = 19.6/24.0, see Table 3. 2. Direct soybean demand for feed is not included.
Source. FAOSTAT and authors' estimation.

The domestic soybean meal supply/demand quantity was 14.4 million metric tons in 2000 and estimated at 25.1 million metric tons in 2010 (Table 7). The soybean meal demand for feed in China is forecasted to reach 29.7 million metric tons in 2020 and 33.7 million metric tons in 2030.

The projected quantity in 2030 is more than 30% greater than that in 2010 and it is equivalent to 41.2 million metric tons of soybeans. In other words, more than 41 million metric tons of soybeans will be needed from either domestic production or imports to meet China's domestic soybean meal feed demand in 2030. Those soybeans would require an additional 4.6 million hectares of land, assuming current world average yield.

Results Summary and Implications for Food and Agribusiness Managers and Firms

Results Summary

Our estimate of China's livestock demand elasticity for soybean meal at .91 results in an overall estimate of an increase in Chinese soybean meal utilization of 34 million metric tons in 2030, a 30% increase. The drivers of this demand too are undergoing change as well. The demand increase for soybean meal will increasingly be due to the shift to meat in Chinese diets and less from the increasing use of commercial feeds. This shifts parallels developed countries where soybean meal demand results from the twin forces of domestic and export meat demand.

China's additional soybean meal demand of 19 million metric tons in 2030 compared with 2000 will require an additional 24 million metric tons of soybeans, or 10 million hectares at the current world average yield levels (2.3 t/ha). Currently Illinois, a leading soybean state in the United States, produces soybeans on 4 million hectares. We model just one large country here, but similar shifts to higher levels of animal protein consumption are occurring throughout the developing world. So meeting just the world's needs for protein feeds will be a significant force affecting the soybean complex over the next 20 years.

Implications for Food and Agribusiness Managers and Firms

We use a model to better understand the relationship between livestock production and soybean meal demand. Countries differ with respect to their adoption of commercial feeds in general and the inclusion of soybean meal in particular. We argue that our structural estimate of elasticity is superior to a simple own-variable time series regression forecast, because we take into account both historical trends in soybean meal demand and the tight relationship between livestock production and feed demand. And as a result we provide managers a more robust forecast of overall soybean meal demand. Specifically we estimate this relationship to be 0.91, which suggests that China's soybean meal feed demand increases by 0.9% as the domestic meat and egg production quantity increases by 1.0%. This is consistent with related elasticity estimates. Researchers estimate high income elasticities of demand for pork and poultry in China: respectively, .72 and .80 (Global Food in 3-D^{tm} 2010) and .86 and 1.01 (Ortega et al. 2009). Thus there is a tight linkage between Chinese income growth and meat consumption. There is obviously a unitary relationship between meat and livestock production, thus it is logical to expect a tight relationship between livestock production and soybean meal demand.

China's meat production capacity depends on modernizing livestock and feed manufacturing industries as well as securing feed grains and oilseed crops. Models that ignore the switch from non-commercial to commercial feed sources will understate future soybean meal demand. Thus

managers need to be aware that two driving forces are at play here, one due to the rise in livestock production and a second due to the switch to commercial feeds.

Regarding soybean meal, China re-imposed the 13% value added tax, effective July 1, 1999, for soybean meal imports to discourage its imports and encourage more imports of whole soybeans (Hsu 2000). Imported soybeans serve as the raw material for more than two-thirds of China's soybean meal, partially as a result of the government support to promote domestic crushing, feed and food manufacturing (Goldsmith et al. 2004). In addition, China's traditional food self-sufficiency policy places great importance on staple cereals such as rice, wheat, and maize rather than industrial crops like soybeans. Thus local crush and the importation of soybeans, not imported soybean meal or expansion of domestic soybean production, will meet future soybean meal demand.

China's soybean imports reached 37.1 million metric tons in 2006-09 and commanded 49.6% of global imports (Figure 2). China's soybean imports originate from the Western Hemisphere: 38% from the US, 35% from Brazil, and 26% from Argentina (2006-07). The tight linkage in China between; income growth, meat demand, domestic livestock production, feed industry modernization, will drive land use decision making in the key soybean exporting regions in the Americas. Simultaneously in many of the same regions expansion of biofuel production drives similar land use decision making in the context of maize and sugarcane. Expansion in soybean hectares is unlikely in the United States as biofuel demand continues to indirectly incentivize US farmers, the world's largest producers of both corn and soybeans, to plant corn. The approach of the "blend wall" of 15% ethanol blend or a decrease in crude oil prices though would serve as dampening forces.

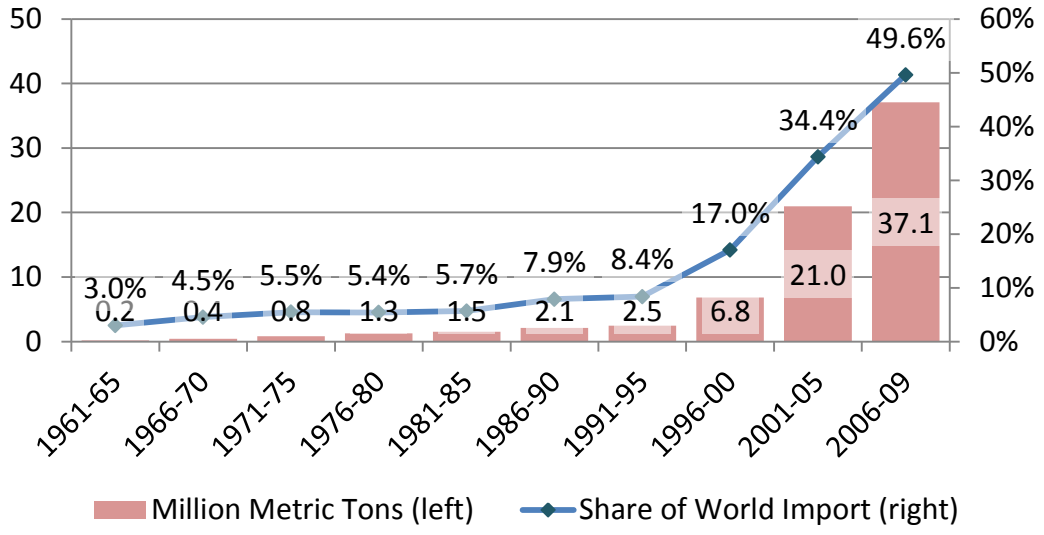

Figure 2. China's Soybean Imports (1961-2009)
Note. China = Mainland China + Hong Kong + Macau.
Source. FAOSTAT and authors' calculation.

Finally, soybean yield growth contributes about 1/3rd of the overall increase in the global supply of soybeans, with the expansion of soybean hectares contributing the other 2/3rds (Masuda and Goldsmith 2009). But yield growth is only forecasted at about .5% per year through 2030 (Masuda and Goldsmith 2009). The implications for managers are twofold. First there will continue to be increasing pressure in South America to shift land use to soybean cultivation. In more temperate countries currently producing sunflower, canola and maize, such as Argentina, more acres will switch to soy. In tropical regions such as Brazil, pasture, native vegetation such as *cerrado* and dry land forests will be transformed to crop production, often to soybeans as well. Land prices and incentives to double crop in Brazil will rise as environmental concerns, land use policies, and more effective enforcement of land reserve laws constrain land clearing for use in crop production. Opportunities will open up for African production of soybeans, not necessarily as an exporter but to meet domestic and regional needs previously met by imports. Reducing harvest and post-harvest losses of soybeans, estimated at 4% in the center-west region of Brazil (Sebben 2010), would also help ease the supply constraint.

The second implication of poor soybean yield growth involves the need for agricultural research to increase soybean yields beyond their current .7% per year. We forecast soybean meal demand growth rates in China at about 1.5% per year. Rising soybean demand will necessitate increasing land under soybean cultivation if producers in the major soybean producing regions of the world cannot intensify soybean production. Certainly double cropping soybeans and

Under the present conditions soybean seed research is vulnerable to intellectual property theft. The high growth soybean regions have weak intellectual property rights, and cumbersome policies with respect to genetically modified crops. This poor research and development environment dampens the incentives for private sector investment in soybean technologies (Goldsmith et al, 2006). So yield growth lags, and puts pressure on land use shifts to soybean production to meet global feed demand. The challenge then for managers and policy makers is how to expand research and development to intensify production, such that growing demands can be met on the same or smaller land base. Land dedicated to soybean production could actually decline by 2030 if global soybean yield could increase from its current level of 2.3mt/ha to 4.0 mt/ha (Goldsmith, 2009). While the public sector has historically played a significant role in agricultural R&D, government resources now are limited and higher priorities preclude significant public investment in agricultural research. The private sector will need to fill the void, but requires a business environment in the new agricultural growth regions conducive for research and development investment.

Future Areas of Research

An understanding of the maturation process of meat and fish demand in emerging economies requires further study. The plateauing of demand for meat and the shifts among proteins has significant implications for the soybean complex. Currently market demand growth outpaces rates of yield improvement, but convergence will occur. But high population country demand will slow in the emerging countries such as China, while it will accelerate in the fast growing counties of sub Saharan Africa. The soybean industry, so dependent on meat demand, needs to better understand the supply-demand dynamics of developing economies to prepare for the next generation of new markets.

References

Bossaerts, P. 1988. Common Nonstationary Components of Asset Prices. *Journal of Economic Dynamics and Control* 12: 347-364.

Delgado, C., Rosegrant, M., Steinfeld, H., Ehui, S., and C. Courbois. 1999. Livestock to 2020: The Next Food Revolution. *Food, Agriculture, and Environmental Discussion Paper* 28. IFPRI, Washington, D.C.

Engle, R.F. and C.W.J. Granger. 1987. Co-integration and Error Correction: Representation, Estimation, and Testing. *Econometrica*. 55 (2): 251-276.

FAO. 2002. Protein Sources for the Animal Feed Industry. Expert Consultation and Workshop, Bangkok, April 29 - May 3.

FAO. 2006. World Agriculture: Towards 2030/2050 (Table 3.7). Interim Report. Rome.

FAO. FAOSTAT. http://faostat.fao.org/

Fuller, F., D. Hayes, and D. Smith. 2000. Reconciling Chinese Meat Production and Consumption Data. *Economic Development and Cultural Change* 49 (1): 23-43.

Gardner, E. S. Jr. 1985. Exponential Smoothing: The State of the Art. *Journal of Forecasting* 4: 1-28.

Gardner, E. S. Jr. and E. McKenzie. 1985. Forecasting Trends in Time Series. *Management Science* 31 (10): 1237-1246.

Global Food in 3-D^{tm}. 2010. Innovosoy, Inc., Champaign, IL. http://globalfoodin3d.com/ (accessed June 2010).

Goldsmith, P.D., B. Li, J. Fruin, and R. Hirsch. 2004. Global Shifts in Agro-Industrial Capital and the Case of Soybean Crushing: Implications for Managers and Policy Makers. *International Food and Agribusiness Management Review* 7 (2): 87-115.

Goldsmith, P.D., G. Ramos, and C. Steiger. 2006. Intellectual Property Piracy in a North-South Context: Empirical Evidence. *Agricultural Economics* 35 (5): 335-349.

Goldsmith, P.D. 2009. The 21st Century and the Post-Modern Challenges for the Global Soybean Industry. Plenary speech at the VIII World Soybean Research Conference, Beijing, August.

Gonzalo, J. 1994. Five Alternative Methods of Estimating Long-run Equilibrium Relationships. *Journal of Econometrics* 60: 203-233.

Hendry, D.F., A.R. Pagan, and J.D. Sargan. 1984. Dynamic Specification (Ch.18). In *Handbook of Econometrics Vol. II*, edited by Grilishes, Z., and M. D. Intrigator. Elsevier.

Holt, C.C. 1957. Forecasting Seasonal and Trends by Exponentially Weighted Moving Averages. *ONR Research Memorandum* 52: 1-10. Pittsburgh, PA: Carnegie Institute of Technology.

Holt, C.C., F. Modigliani, J.F. Muth, and H. A. Simon. 1960. *Planning, Production, Innovation, and Work Force*. Prentice-Hall, Englewood Cliffs, NJ.

Holt, C.C. 2004. Forecasting Seasonal and Trends by Exponentially Weighted Moving Averages. *International Journal of Forecasting* 20: 5-10.

Hsu, H.H. 2000. China Switches from Soybean meal to Soybean Imports. USDA, ERS, Washington, D.C. *International Agricultural and Trade Reports: China* WRS-99-4: 13-16.

Hsu, H.H. and F.W. Crook. 2000. China's Feed Manufacturing Industry Is Booming. Washington, D.C.: USDA. *International Agricultural and Trade Reports: China* WRS-99-4: 29-39.

Hyndman, R.J., A. B. Koehler, J. K. Ord, and R.D. Snyder. 2008. *Forecasting with Exponential Smoothing: The State Space Approach*. Springer.

Johansen, S. 1995. *Likelihood-Based Inference in Cointegrated Vector Autoregressive Models*. Oxford University Press, New York.

Johansen, S. 1988. Statistical Analysis of Cointegration Vectors. *Journal of Economic Dynamics and Control* 12: 231-254.

Keyzer, M.A., M.D. Merbis, I. F. P. W. Pavel, and C.F.A. van Wesenbeek. 2005. Diet shift towards meat and the effects on cereal use: can we feed the animals in 2030? *Ecological Economics* 55: 187-202.

Ma, H.G., Huang, J.K., and S. Rozelle. 2004. Reassessing China's Livestock Statistics: An Analysis of Discrepancies and the Creation of New Data Series. *Econonomic Development and Cultural Change* 52: 445-473.

Masuda, T. and P. D. Goldsmith. 2009. World Soybean Production: Area Harvested, Yield, and Long-Term Projections. *International Food and Agribusiness Management Review* 12 (4): 145-164.

Mills T.C. 1990. *Time Series Techniques for Economists*. Cambridge Univ. Press.

Ortega, D.L., H. Holly Wang and J. Eales. 2009. Meat Demand in China. *China Agricultural Economics Review* 1(4): 410-419.

Putnam, J.J. and J.E. Allshouse. 1996. Food Consumption, Prices, and Expenditures, 1970-95. *Statistical Bulletin 939.* Washington, D.C.: USDA.

Putnam, J.J. and J.E. Allshouse. 1999. Food Consumption, Prices, and Expenditures, 1970-97. *Statistical Bulletin 965.* Washington, D.C.: USDA.

Stata, 2011. www.stata.com.

Sebben, D. 2010. *Harvest and Post-Harvest Loss in Mato Grosso*. Presentation to the ADM Institute for the Prevention of Post-Harvest Loss. University of Illinois. August.

Stein, H.H., L.L Berger, J.K. Drackley, G.C Fahey, Jr., D.C Hernot, and C.M. Parsons. 2008. Nutritional Properties and Feeding Values of Soybeans and Their Co-Products (Ch. 18). In *Soybeans: Chemistry, Production, Processing and Utilization*, edited by L.A. Johnson, P.J. White, and R. Galloway, 613-660. Urbana-Champaign, IL: AOCS Press.

Stock, J.H. 1987. Asymptotic Properties of Least Squares Estimators of Cointegrating Vectors. *Econometrica* 55 (5): 1035-1056.

Stock, J.H., Watson, M.W., 1988. Testing for Common Trends. *Journal of American Statistical Association* 83 (404): 1097-1107.

Waldroup, P.W., 2010. Soybean Meal Demand. Soybean Meal Information Center Fact Sheet. http://www.soymeal.org/FactSheets/soymealdemand.pdf. (accessed December 2010).

Wang, J.M., Z.Y. Zhou, and R.J. Cox. 2005. Animal Product Consumption Trends in China. *Australasian Agribusiness Review* 13: Paper 2.

Wang, J.M., Z.Y. Zhou, and J. Yang. 2004. How Much Animal Product do the Chinese Consume? Empirical Evidence from Household Surveys. *Australasian Agribusiness Review* 12: Paper 4.

Xin, X.A., Z.H. Yang, and Z.Y. Zhou. 2005. China's Feedgrain: Production and Consumption (Ch. 7). In *Grains in China: Foodgrain, Feedgrain and World Trade*, edited by Zhou, Z.Y. and W.M. Tian. Ashgate Publishing.

Xing, L. 2009. *Estimating the Non-Commercial-Commercial Feed Gap in China and Its Impact on Future World Demand for Soybeans*. Master's Thesis, Department of Agricultural and Consumer Economics, University of Illinois.

Xing, L. and P.D. Goldsmith. 2012. Estimating the Non-Commercial – Commercial Feed Gap in China. *Chinese Journal of Agricultural Economics*. Under Review. June.

Zhou, Z.Y., W.M. Tian, X.A. Liu, and G.H. Wan. 2003. Research Methodological Issues in Projecting China's Feedgrains Demand and Supply. *Zhongguo Nongye Jingji Pinglun (China Agricultural Economic Review)* 1(1): 54-74.

Zhou, Z.Y., W.M. Tian, and B. Malcolm. 2008. Supply and Demand Estimates for Feed Grains in China. *Agricultural Economics* 39(1): 111-122.

Appendix 1.

Table 4. Comparison of China's Meat and Egg Production/Consumption Balances: FAOSTAT and SSB1 Adjusted by Wang et al. (2005)

Appendix Table 4. Comparison of China's Meat & Egg Production/Consumption Balances: FAOSTAT and SSB Adjusted Wang et al. (2005)

1999-2001 year average	Meat Total		Pigmeat/Pork		Poultry Meat		Bovine Meat/Beef		Mutton & Goat Meat		Other Meat
(million metric tons)	FAOSTAT	SSB Adj.	FAOSTAT	SSB Adj.	FAOSTAT	SSB Adj.	FAOSTAT	SSB Adj.	FAOSTAT	SSB Adj.	FAOSTAT
Production/Output	61.7	60.2	40.8	40.4	12.3	11.8	5.1	5.3	2.6	2.7	0.9
Net Import	1.0	-0.6	0.2	-0.1	0.6	-0.4	0.1	0.0	0.0	0.0	0.0
Domestic Supply	62.7	59.6	41.0	40.2	12.9	11.3	5.2	5.3	2.7	2.7	0.8
Food Manufacture	0.0	-	0.0	-	0.0	-	0.0	-	-	-	0.0
Food Consumption	62.6	-	41.0	-	12.9	-	5.2	-	2.7	-	0.8
Other Utility	0.0	-	0.0	-	0.0	-	0.0	-	-	-	0.0
Food Cons. (kg/capita/yr)	49.0	47.0	32.1	31.8	10.1	9.0	4.1	4.2	2.1	2.2	0.7
-- w/loss rate (kg/capita/yr)	-	37.7	-	24.2	-	8.5	-	3.1	-	1.9	-

1999-2001 year average	Eggs	
(million metric tons)	FAOSTAT	SSB Adj.
Production/Output	22.1	22.4
Net Import	0.0	0.0
Domestic Supply	22.2	22.3
Seed	0.5	-
Waste	1.1	-
Food Consumption	20.1	-
Other Utility	0.4	-
Food Cons. (kg/capita/yr)	15.8	17.6
-- w/loss rate (kg/capita/yr)	-	16.8

Notes. 1. Wang et al. (2005) adjusted the Official Statistics by the State Statistical Bureau, People's Republic of China. 2. Based on Putnam and Allshouse (1996). According to Putnam and Allshouse (1999), the revised version, the carcass retail weight loss parameters are for the U.S. food consumption.
Sources. FAOSTAT, Wang et al. (2005), and authors' calculation.

Appendix 2.

Estimation Results of Damped Trend Exponential Smoothing

Following the equations (8) and (9), the damped parameter was set as 0.98 then the level (α) and trend (γ) parameters were grid-searched and determined to the minimize forecasting mean square error (see Table 8). With the estimated parameters, equation (12) computed the forecasts for 2009-30.

Table 8. Estimation Summary: Meat and Egg Production Quantities in China

Univariate time series	α (level)	γ (trend)	φ (damped)	Forecasting MSE	# of obs.
Pig Meat	0.60	0.20	0.98	1.512E+12	48
Poultry Meat	0.80	0.30	0.98	1.121E+11	48
Beef & Buffalo Meat	0.80	0.30	0.98	2.903E+10	48
Sheep & Goat Meat	0.90	0.30	0.98	4.462E+09	48
Other Meat	0.90	0.15	0.98	2.999E+09	48
Eggs	0.90	0.30	0.98	3.682E+11	48

Notes. 1. The observation period is 1961-2008. 2. Meat Total = Pork + Poultry + Beef and Buffalo meat + Sheep and Goat meat + other meat.

International Food and Agribusiness Management Review
Volume 15, Issue 3, 2012

Improving Smallholder Livelihoods Through Local Value Chain Development: A Case Study of Goat Milk Yogurt in Tanzania

Helene Lie[Φa], Karl M. Rich[b], Lusato R. Kurwijila[c], and Anne M. Jervell[d]

[a]*PHD Research Fellow, Department of International Environment and Development Studies, and UMB School of Economics and Business, Norwegian University of Life Sciences, P.O. Box 5003, 1432 Ås, Norway*

[b]*Research Professor, Department of International Economics, Norwegian Institute of International Affairs, and Agricultural Economist, International Livestock Research Institute, P.O. Box 8159, Dep. 0033, Oslo, Norway*

[c]*Professor, Department of Animal Science and Production, Sokoine University of Agriculture P. O. Box 3004, Morogoro, Tanzania*

[d]*Researcher, UMB School of Economics and Business,Norwegian University of Life Sciences P. O. Box 5003, 1432 Ås, Norway*

Abstract

Smallholder farmers have difficulties entering established value chains with value-added products. In this paper, we look at smallholders' capability to establish and sustainably manage a competitive and economically viable local dairy value chain through the case of Twawose, a small dairy goat co-operative in Tanzania. The analysis uses a value chain approach as a framework to identify the possibilities for upgrading and the determinants of competitiveness in value chains in which smallholder farmers can participate. Results highlight the benefits Twawose participants receive, but caution that a multitude of constraints could impede scaling-up in the future.

Keywords: goat, yogurt, value chain, smallholder farmers, Tanzania.

[Φ]Corresponding author: Tel: +47.9945.9122
Email: helene.lie@umb.no K. M. Rich: kr@nupi.no
L. R. Kurwijila: kurwijila@suanet.ac.tz A. M. Jervell: anne.jervell@umb.no

+The IFAMR is a non-profit publication. The additional support provided from this issue advertisers, Novus International and GlobalGap help keep us open access and dedicated to serving management, scholars, and policy makers worldwide.

Introduction

Establishing a new value chain or entering an existing value chain are both challenging endeavors for smallholder farmers in developing countries. If a market opportunity is recognized, smallholders still require entrepreneurship, business skills, education, and a range of other assets to start an enterprise. Business and entrepreneurship skills are usually not provided by schools in the rural sector, if school has been attended at all. There is often a high degree of illiteracy that increases the difficulties faced by smallholders in starting up a value-adding enterprise (Vermeulen and Cotula 2010; Vorley, Lundy, and MacGregor 2009; World Bank 2007).

For years, the focus among donor organizations has been to increase the participation of smallholder farmers in high-value global value chains. A particular emphasis has been on the promotion of exports, often of organic and fair trade products, with support from either the private sector or public sector, and facilitated through NGO's and other international development agencies. However, in such high-value agrifood value chains, smallholders have limited control. Power is often concentrated among one or a few chain participants that coordinate market activity. As the modern agrifood sector is based on consumer assurance, high standards for food quality and safety, low prices, and reliability of supply, lead actors in retail or export often coordinate the value chain. The ability of smallholder farmers to take the lead is limited, as is their ability to maximize economies of scale. The market is also constantly changing, requiring rural farms and firms to respond and innovate by, for example, switching market channels, changing how they are organized, or investing in equipment. Such value chains may thus be less appropriate for many smallholder actors, who may lack the ability to handle dynamic markets and comply with their increasing amount of regulations and standards.

By contrast, local value chains that meet growing local demand might be more within the reach of smallholders. Local markets may also be characterized by new consumer demands due to changing lifestyles and increased knowledge of the benefits of a more diversified diet (World Bank 2007). In Europe and the United States, local value chain development has been advocated by environmentally conscious consumers demanding local farm products that they perceive as being of higher quality, leading to a rise in the number of specialty and local markets. Many producers have taken advantage of this trend by selling their produce at the growing number of local farmers' markets and/or directly to customers, thus creating local food value chains (see Gilg and Battershill 1998; Verhaegen and Van Huylenbroeck 2002). While Herr (2007) has further identified the potential of local value chain development in the developing world, an in-depth analysis of successful smallholder initiatives in local value chains could give valuable insights on how to develop value chains based on local resources and context.

In Tanzania, local goat production represents an opportunity for local value chain development. Goats already play a significant role in supporting smallholder farmers in improving their livelihoods. Goats are tolerant to limited food and water access, their herds can recover quickly due to fast reproduction cycles, and, because of their small size, are easy to transport (Peacock 2007). In addition, the presence of goats assures farming families of a continuous flow of income, which is difficult to attain from seasonal vegetable sales. Owning goats also represents an investment in capital and can increase the likelihood of obtaining a micro-loan to augment livestock-related or other farm activities (Omore et al. 2004).

Dairy goats are a particularly attractive investment, as the additional milk they generate is sizable compared to indigenous goats that provide much less milk. Small-scale dairy production is an important source of cash income for subsistence farmers, especially in the East African highlands (Omore et al. 2004). It is estimated that 70% (1.6 million tons) of the total national milk production in Tanzania is produced by smallholder dairy farmers. Goats are the most commonly owned type of small ruminant in Tanzania, with dairy goats gaining increased popularity as a source of milk, particularly for the poor (Njombe and Msanga 2009). While Tanzanians consume less milk compared to their East African neighbors, partly due to views that it is a drink for children, the formal market has nonetheless expanded rapidly during the last decade after the dairy processing industry was privatized. In urban areas, the supply of milk and milk products has consistently not met demand. For example, the local processing capacity in Tanzania only met about 33% of the demand during the 1990s (RLDC 2010). The remainder of the milk is imported. The demand for milk and dairy products is also growing in rural areas, creating an opportunity to develop new products and new value chains that connect local supply with local demand.

In this paper, we give an in-depth analysis of Twawose, a dairy goat co-operative in Tanzania, which has attempted to improve smallholder livelihoods through the commercialization of goat milk yogurt. Our research questions explore (i) whether local dairy value chains are beneficial for smallholder farmers, and (ii) whether smallholder farmers are capable of developing and maintaining a newly established dairy value chain. The analysis makes use of a value chain approach that provides a framework to analyze the nature and determinants of competitiveness in value chains in which smallholder farmers can participate. A particular contribution of this study is to highlight the role of farm-specific assets within a value chain analysis as an important means to contextualize the governance relationships within the chain and the ability of smallholders to successfully upgrade production. Our approach further allows us to assess the strategies open to Twawose, both to overcome the barriers currently faced and to sustain and improve market participation.

Overview of the Case

Mgeta division is located on the western slopes of the Uluguru Mountains between 1100 and 1750 meters above sea level. It is about 40 km from the nearest city of Morogoro (see Figure 1). The climate in Mgeta is fairly temperate, with temperatures ranging between 11 and 23°C. The dry seasons in Mgeta lasts for approximately four months, usually from June to September. The population consists primarily of smallholder farmers, with about 84% of residents engaged in agriculture and animal husbandry. Arable land is intensively used in Mgeta and there is little or no opportunity for expansion, which is a considerable constraint to improving livelihoods in the area. Vegetable production is the most important farming system and focused on cabbage, tomatoes, green peas, beans, cauliflower, and carrots (UMADEP 2001).

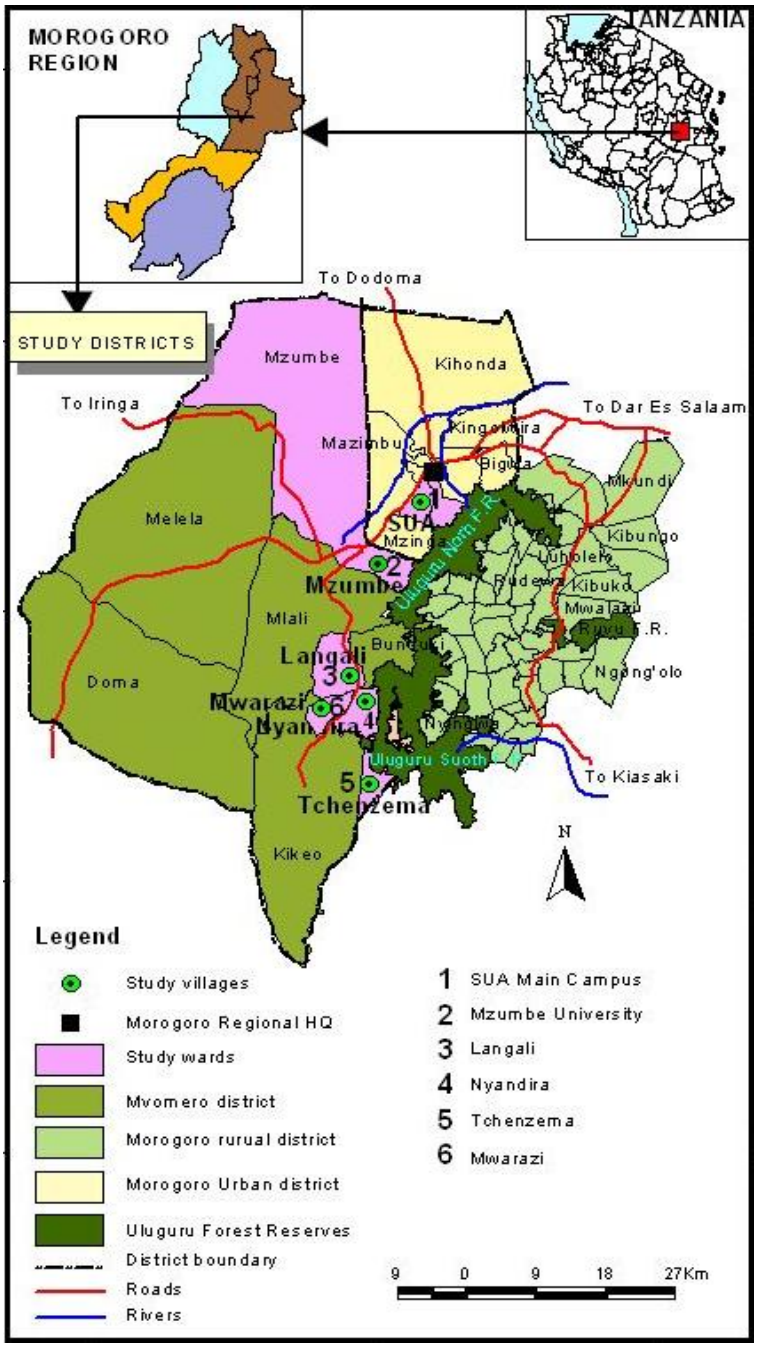

Figure 1. Map of Mgeta.
Source. Developed by Sokoine University of Agriculture, Tanzania

The farmers in the district struggle with inconsistent incomes due to climatic variations that generate variable yields from farming and a lack of alternative income sources. Given their small plots and limited access to new lands, most farmers sustain a subsistence lifestyle complemented by small amounts of revenue from cash crops. Household food security is a major concern for many low-income countries such as Tanzania where 22% and 38% of the population lives below the food poverty and basic poverty lines, respectively (Eik et al. 2008). Additionally, many fami-

lies in Mgeta cannot afford to send their children to school. There are also a number of infrastructural challenges in the area. For instance, access to electricity is limited or unavailable, while roads are often in poor repair and impassible during the rainy season (UMADEP 2001).

In 1988, Norwegian dairy goats were introduced in three villages: Nyandira, Tchenzema, and Mwarazi in Mgeta Divison, Morogoro. Their introduction was led by the Department of Animal Science and Production (DASP) of Sokoine University of Agriculture (SUA) (UMADEP 2001). It was implemented in collaboration with the Norwegian University of Life Sciences (UMB). The aim of the project was to improve the livelihoods of smallholder farmers and more specifically to improve household nutrition, especially among children. Previously, there was no access to milk in the area because of the difficulty of keeping cows in a mountainous area (Krogh 2007).

SUA was in charge of distributing the dairy goats to the chosen farmers in Mgeta and providing the accompanying training in goat management. In parallel, a local dairy goat association was established in 1993 by these dairy goat owners. The name of the group is Twawose, which means, "let us come together" in the local Luguri language. The association's role was to create a network of farmers owning Norwegian dairy goats. They organized training and advisory services, facilitated the sales of goats, and implemented other actions agreed upon by the association. The introduction of dairy goats was followed up through various research projects and collaboration with local NGO's and extension officers.

A natural scaling out of dairy goats in Mgeta started in 1990 and increased rapidly from 2000, leading to a rise in the number of farmers keeping Norwegian goats in the area. By 1999, the initial number of 10 goat keepers had grown to 50, and by 2009, there were approximately 380 farmers in the three villages maintaining 1538 dairy goats (Krogh 2007).

In the 1990s, a number of studies concluded that the dairy goat project was a success, as the introduction of dairy goats met the project goals of improved nutrition, food security, and increased income for smallholder farmers in Mgeta. Dairy goats were recognized as a path to alleviate poverty among dairy goat keepers, as they enabled farmers to realize more consistent sources of income. This was important, as the sale of vegetables is subject to seasonal variation. Also, household nutritional standards increased, especially among children, through the availability of goat milk (Eik et al. 2008; Safari et al. 2005; UMADEP 2001).

The initial success of introducing dairy goats in Mgeta led to further interest from the dairy goat keepers to expand the project. The idea of starting a milk collection and production center (MCPC), and adding value to the goat milk by producing goat milk yogurt, materialized in 2007 by the farmers themselves with support UMB and SUA (Krogh 2007). The idea was triggered by a perception that there was surplus milk available, but that it required collective effort to market. A feasibility study conducted by professors from SUA during a PANTIL (Programme for Agricultural and Natural Resources Transformation for Improved Livelihoods) baseline survey suggested that both goat milk producers and consumers were in favor of establishing such a center. It was believed that a MCPC would boost milk production and assist in the marketing of milk (Kifaro et al. 2007).

There are several reasons for choosing yogurt over other dairy products as a means to add value to surplus milk. In tropical environments characterized by high temperatures, milk deteriorates rapidly, and requires processing to prolong its shelf-life and reach more distant markets. Once processed into fermented milk products like yogurt or cultured sour milk, its shelf life may be extended up to one week (or more) depending on quality, packaging, and storage temperature. Fermented milk is also considered easier to digest and healthier than fresh milk (Bille et al. 2000). Cheese was not considered as an option because there is no tradition of consuming cheese in Tanzania, especially not in poor rural areas like Mgeta. A small market research study on the potential of yogurt production was implemented in Nyandira and met with positive feedback, motivating Twawose to start production (Krogh 2010).

On request from the dairy goat keepers, two selected members of Twawose were trained in ensuring the quality of goat milk and producing yogurt by SUA. By November 2008, pilot production commenced. When this pilot confirmed the potential of selling goat milk yogurt locally, the registration of a co-operative as a business unit began in 2009 and was finalized in January 2010. The production started in January 2010, and by May approximately 20 liters of yogurt was produced twice a week and sold successfully on local market days (Mondays and Thursdays). During these days, farmers from neighboring villages and the nearest town, Morogoro, come to Nyandira, where the processing is located.

Twawose now functions both as a dairy goat farmers association, with 68 members, and a yogurt producing co-operative. While Twawose has successfully taken advantage of one of the many value-adding opportunities in the Tanzanian dairy sector, a multitude of challenges remain to sustain and scale-out such opportunities. In the next sections, we take a value chain perspective to couch the context arising from the opportunities and challenges faced by Twawose as it expands into new markets.

Methodology

A value chain is the full range of activities that are required to create and add value to a finished product or service (Kaplinsky and Morris 2001). This refers to the different phases of production from raw material, processing, distribution, and marketing until the product or service reaches the consumer and is disposed of after use. A value chain analysis (VCA) examines all the actors involved in the chain, the linkages between them, and the activities within each link. It also takes into account market demand, buyer requirements, quality standards, and local, regional, national and global influences on the chain (Kaplinsky and Morris 2001, ; 14). In doing so, the value chain approach goes beyond firm- or activity-specific analysis as it looks at all the actors and institutions that play a part of a product or service's life cycle, rather than single enterprises (Gereffi, Humphrey, and Sturgeon 2005; Kaplinsky and Morris 2001; M4P 2008).

Significant literature exists on how global value chains interface with smallholder farmers' participation (Dolan and Humphrey 2000; Ponte 2008). However, *local* value chains have received little attention in the context of developing countries. Development agencies also tend to focus on supporting farmers in developing countries by identifying profitable markets overseas rather than domestically (Shepherd 2007). According to Altenburg (2006), much less work has focused on local value chains that might provide viable market opportunities, especially for smallholder

farmers. This is supported by Shepherd (2007) who notes: "[The] development of export markets is expensive and complex, particularly where small farmers are involved" (Shepherd 2007, 14).

In this study, the VCA framework of Kaplinsky and Morris' (2001) was applied in the context of local value chains. Their methodology has four main components. First, it maps the activities in the chain and characterizes the actors participating in it. The purpose of mapping the value chain is to give a visual presentation of the actors in the chains and connections between them. Second, VCA assesses governance structures in the value chain to understand the relationships and coordination mechanisms that exist between actors in the chain and how these may need to be restructured to improve the chain. Governance includes, among other factors, power asymmetry, rule-making, sanctions, and degree of trust and dependence between the different parties (Kaplinsky and Morris 2001). In some cases, governance is simply referred to as coordination between actors in the same position or different positions in the chain, where the aim is to make different actors within the same value chain act in a way that leads towards a common goal, including efforts that prevent actions based on a different agenda (Riisgaard et al. 2008).

The governance context in this case is a co-operative. Farmer-led co-operatives are democratic associations of voluntary members that work collectively to meet a common goal of mutual benefits. In African countries, co-operatives have a relatively long and sordid history which contrasts with the more successful co-operative experience for farmers in the US or Europe that focuses on local markets (Birchall 2003; Holloway et al. 2000). There are several reasons for the mixed experience of co-operatives in African countries, including poor management, inappropriate cooperative structures, lack of democracy, corruption, lack of working capital, and weak supporting institutions.

Third, VCA highlights upgrading strategies based on constraints and opportunities in the chain. There are numerous ways of upgrading a value chain, with four types being referred to in the value chain literature: process, product, functional, and chain upgrading. Process upgrading focuses on increasing the efficiency of the production both within links and/or between links in the value chain. Product upgrading refers to enhancing the quality and specification of the product, whether by creating entirely new products or by improving old products. Changing the scope of activities carried out within the firm as a means of adding value is referred to as functional upgrading. Finally, upgrading can involve a move into a new value chain altogether by using the skills gained from participating in an existing value chain (chain upgrading). In value chain literature, case studies indicate that product and process upgrading are most common, while functional upgrading is difficult to achieve (Kaplinsky and Morris 2001; Mitchell, Keane, and Coles 2009). Lastly, VCA evaluates who benefits from participation in the chain, and assesses how the distribution of benefits will be influenced by restructuring the chain through different upgrading strategies (Kaplinsky and Morris 2001; Rich et al. 2011).

For the purpose of this study, we modify Kaplinsky and Morris's framework to include a new area of analysis - review of assets. This is to take account of the fact that rural smallholders are poor, and that assets and resources are crucial in entrepreneurial efforts to build new ventures (Boughton et al. 2007; Shepherd and Wiklund 2005). The asset approach is well-known in the community-based development literature (Green and Haines 2008). How and whether an actor can capture value depends on how assets are generated and maintained, and whether the value

chain achieves a competitive advantage (Barney and Clark 2007; Shepherd and Wiklund 2005). Assets or resources are key elements when creating and implementing strategies for developing the value chain. In this sense, we view assets as closely related to the resource-based perspective in which firms internal strengths are assumed as a source of competitiveness (Barney and Clark 2007). Access to resources, or the asset base, is important when trying to understand why some smallholders perform better than others and how they can create and sustain a competitive value chain. This thus gives a necessary, contextual background to suggest more specific upgrading strategies and to assess the case's capability to implement the strategies.

Assets can be defined in various ways, and may include skills and capacities of individuals, associations, and institutions. In our study, five groups of assets have been chosen to give the necessary overview of Twawose's capabilities to take advantage of opportunities and cope with challenges facing their cooperative when developing their value chain. These asset classes include physical assets, environmental assets, institutional assets, financial assets, and social and human assets. A discussion of each is given in the next section.

Data collection for this study was conducted during two field visits in 2010 and 2011, involving 107 interviews with 120 Twawose members and management, experts, customers, and other dairy goat farmers in the region. In-depth, semi-structured, and group interviews were conducted by the first author, with use of translation, to obtain a clearer picture of the case. Interviews were complemented by secondary data from previous research from the same area, financial reports, and records of milk and herd demographics. During the field work, emphasis was put on cross-cultural differences to ensure that information was understood correctly. More details can be found in Lie (2011).

Results

Overview of Twawose's Value Chain

Before commencing goat milk yogurt production, Twawose's value chain was informal and consisted of farmers selling their surplus goat milk to neighbors and small local restaurants. Twawose supplied its dairy goat farmers with medicines provided through their input supply shop. Other local suppliers provide farmers with complementary feed. In 2007, when dairy goat farmers started complaining about rising milk surpluses and limited market outlets for this surplus, the process of goat milk yogurt production was initiated, as portrayed in the case study introduction.

In January 2010, the MCPC building was renovated to meet milk processing standards, a process guided and sponsored by SUA professors. Fifteen of the 68 Twawose members have been trained in yogurt processing. This ensures constant production even when illness, or when there are other reasons for the absence of workers.

Twawose's upgraded value chain is mapped in Figure 2 (green squares show the development of the chain). Local retailers supply the MCPC with sugar, firewood, used water bottles, and ancillary equipment like cooking pots. The changes to Twawose's value chain have resulted in a tran-

sition from an informal chain to a semi-formal value chain, in which yogurt production is organized through a formally registered cooperative, but still sold informally at the local market.

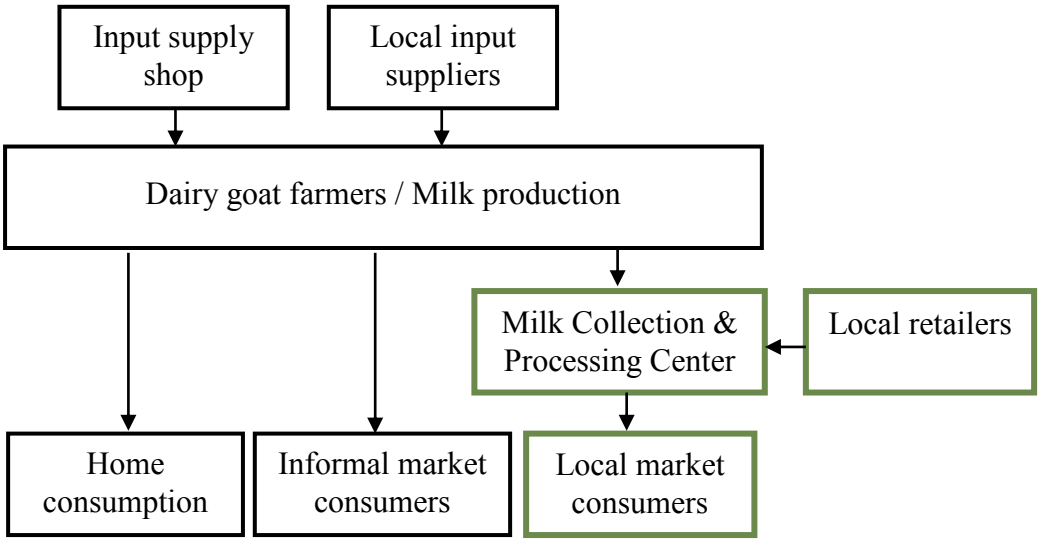

Figure 2. Twawose's semi-formal value chain.
Source. Developed by Authors

Twawose's upgraded value chain has resulted in new actors and activities in the chain. The main actors in Twawose's new value chain are goat owners that supply milk and the farmers working at the MCPC. See Figure 3 for an overview of activities and corresponding costs present in Twawose's value chain. Dairy goat owners that produce goat milk consume milk at home, sell it at the informal market, or sell it to the MCPC; they also sometimes engage in a combination of these activities. Findings from interviews with dairy goat owners reveal that the majority of farmers keep approximately one liter of milk for home consumption. The rest of the milk, about 2-5 liters, is then sold to the MCPC if the farmer is one of those who have been allowed to deliver milk two days a week to the MCPC. Because only a restricted amount of milk is processed, due to the limited local market, supply restrictions have been implemented by the MCPC. The selection of farmers is not controlled very well and mostly based on which farmers are most actively involved in Twawose and produce the largest amount of milk at the time. In theory, farmers delivering milk to the MCPC are supposed to be Twawose members, but in practice there have been occasions when this was not followed. The suppliers that are not members of Twawose have stated their intention to become members, but due to relatively high entrance costs and little pressure from Twawose, this has not yet happened.

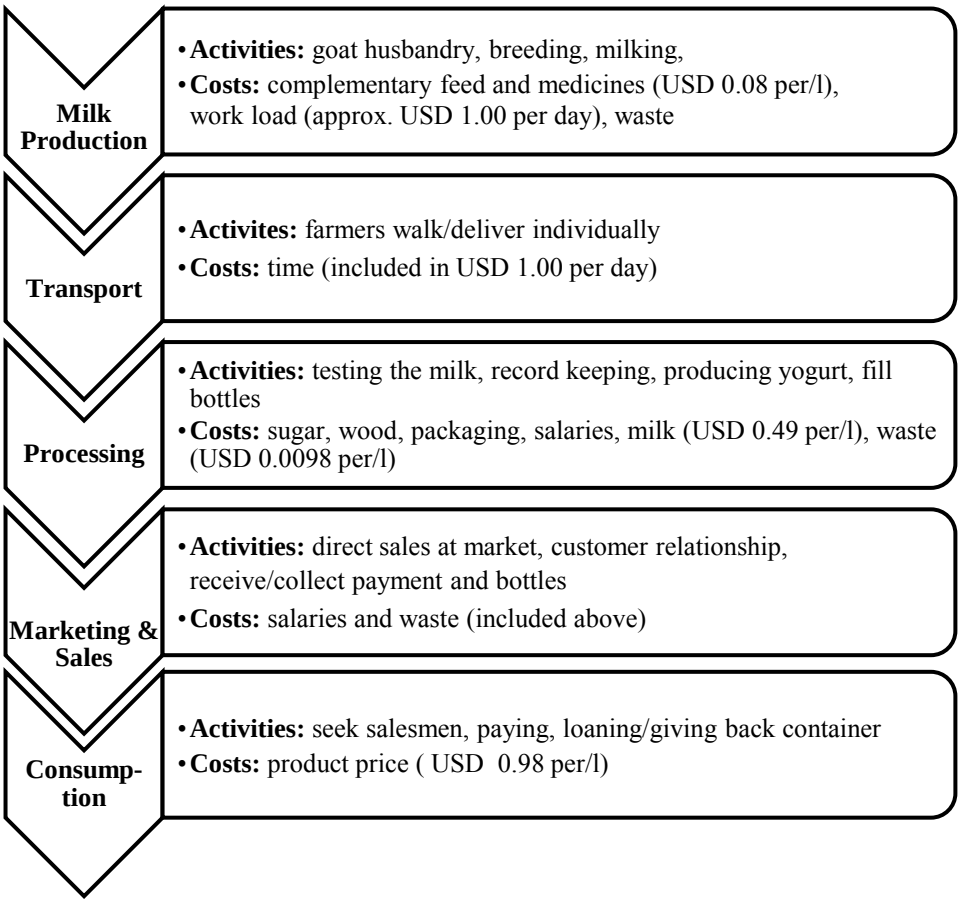

Figure 3. Twawose's value chain including activities and cost in each link.
Source. Developed by Authors

The farmers usually milk the goats twice a day, once in the morning and in the afternoon, and walk up to one hour and a half to reach the MCPC. At the MCPC, the milk is quality controlled and recorded for payment (0.49 USD[1] per/liter) through the local branch of the Savings and Credit Cooperative Societies' (SACCOS). Based on calculations for optimal supplementary feeding and medicine use[2], we estimate that producing one liter of milk costs farmers approximately 0.08 USD. If we assume that the opportunity cost of own (family) labor is approximately USD 1.00 per day and that a full day of labor is required for trekking milk to the MCPC, milking, and grazing, a household selling 2.5 liters of milk would cover both variable and implicit costs of production.[3] Increasing the scale of production would be more profitable for participating households, as household costs for trekking and farming are fixed costs and independent of herd size (i.e., the household cost of trekking one goat or twenty would be the same), while the marginal cost of extra milking (less than one hour per liter) is much less than the added milk rev-

[1] Currency converted per USD: TZS exchange rate prevailing on 8 November 2011.
[2] The calculation is based on one kg supplementary feed per goat per day consisting of 83.22 % maize, 16.65 % sunflower and 0.12 % minerals. In addition comes deworming approx. three times a year, external insecticide approx. every 14 days and penicillin approx. once a year.
[3] Later in the text, we note that the urban minimum wage is USD 50/month, and that rural wages are lower than those prevailing in urban areas. We assume one person would be tasked with this activity.

enue. At the same time, households on average generate less surplus milk than the breakeven quantity computed here (1.48 liters/day, see Table 3 later in the text). While this suggests that current benefits go primarily to larger farmers, with greater certainty in market conditions and more local demand, there would be higher incentives for smaller farmers to produce more milk for the market and improve their own profitability.

The two processors are responsible for producing the yogurt using traditional methods, which leads to a milk-yogurt conversion ratio of 98 %. On average only 2% of the milk evaporates or is spilled during processing into yogurt. Based on Twawose's financial records from 2010 (Table 1), annual profits were 180 USD, of which the suppliers were supposed to receive 50%, an agreement that was made when the cooperative was founded. Twawose's financial records indicate that it has a profit margin of 0.08 USD per liter of yogurt when producing an average of 21 liters of yogurt. This is based on purchasing milk for 0.49 USD per liter and includes fixed costs such as allowances and firewood, and the variable costs of procuring sugar, packaging materials, and marketing services. The processors are also in charge of selling the 20-25 liters of yogurt that is produced, using direct marketing and sales strategies. First, they make one round selling the milk. During the second round, they collect bottles (if bottles are not returned the consumer has to pay an extra 0.06 USD) and money. At the end of their work day, the bottles are cleaned to be reused, and the cycle starts over again two days later.

Table 1. Twawose 2010 Financial Accounts

	Costs USD	**% of Costs**
Income	1993.5	
Raw material	1204.7	66.46 %
Gross profit	788.8	
Allowances	523.9	28.91 %
Equipment	28.5	1.58 %
Marketing	0.94	0.05 %
Other	54.3	3.00 %
Total costs	1811.7	100 %
Net profit	180.7	

Source. Developed by Authors

Twawose's Assets

In this section, we describe the assets in Twawose's value chain, focusing on strengths and weaknesses in the chain and related to Twawose as the chain leader. The assets we consider are environmental, physical, institutional, financial, and social and human assets, respectively. Of particular interest here is how these assets both influence the governance of the chain and the upgrading strategies available to Twawose.

The strongest and most critical asset of Twawose, is their collective organization. Strong ties and mutual trust among many of the members has been built through a relatively long history and active membership. Its external network is also a critical asset. This network has provided knowledge and support without taking control of the development or management of the organization. Lack of assets such as proper roads, electricity, and access to information and finance are

threats for future expansion. Twawose's assets are summarized in Figure 4 and briefly discussed below. In the figure, the available resources to Twawose are shown above the line and the missing assets below the line.

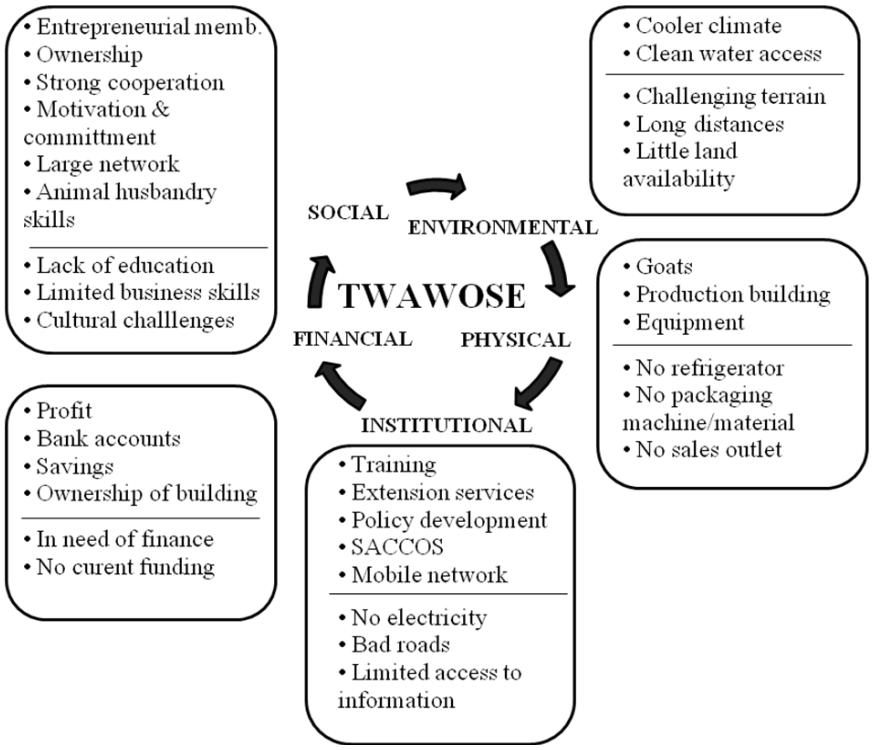

Figure 4. Overview of Twawose's assets.
Source. Developed by Authors

Environmental Assets

Environmental assets such as land and water are determined by the location of the place and its characteristics and climate (Green and Haines 2008). The location of the three villages in the Uluguru Mountains, provides a cooler climate than the average in Tanzania. Norwegian goats thrive better here than in other warmer locations. Moreover, the relatively cooler climate also allows Twawose to temporarily store its yogurt overnight using only cold water, partially mitigating the constraint of limited access to electricity. There is good access to water most of the year.

At the same time, the area is characterized by a difficult terrain and long distances between villages, which negatively impacts both the delivery of milk to the collection center and the distribution of the yogurt. There is pressure on the land available for farming and adequate pasture for grazing. This influences herd sizes, potentially restricting the ability of farmers to increase animal stocks. A no-grazing production system can be implemented by Twawose and its network in cooperation with the farmers, but would result higher feeding costs. Milk production may still be an attractive option, since the lack of available land is a bigger challenge if solely pursuing crop farming. Overall, the environment in Mgeta provides relatively favorable conditions for processing goat milk, in light of the opportunity costs present on other resources.

Physical Assets

Physical assets include roads, buildings, and other goods such as animals and equipment that require an investment and where a return on investment is expected (Green and Haines 2008). Twawose's members all own goats, as this is a prerequisite for joining the group. The introduction of dairy goats has been promoted and subsidized through a network effort by SUA, UMB, and Uluguru Mountains Agricultural Development Project (UMADEP). The MCPC has access to rising volumes of milk from Twawose members, as well as non-members that are at times allowed to sell to the MCPC. The large number of dairy goats in the area before the MCPC was established is an important success factor for the cooperative. Other assets available to Twawose include a building that was first used to store input supplies, and has since been renovated for processing activities, a crucial physical asset to establish the MCPC. Currently, Twawose owns enough equipment to process a maximum of 60 liters of milk a day, which means that if they want to process more they will need additional equipment. In the building, there is no sales outlet or shop from which to sell the yogurt.

While Twawose maintains a basic level of physical assets to sustain current levels of production, there is lack of physical assets to further develop and scale-up the chain. A packaging machine, including proper packaging material, will be necessary if larger production volumes are to be sold in new and possibly more distant markets. The yogurt is currently sold in old water bottles, which is not an adequate way of packaging if selling to markets outside the local market. Indeed, even local market customers raise concerns from the use of old cleaned water bottles in interviews. A better cooling system than today's use of cold water would require electricity

The infrastructure in the area is rather poor, and infrastructure is an essential element of forming and developing value chains. There is no electricity available in the village, except from a few generators. This is typical in Tanzania, as only 40% of communities in the country are electrified (Kinda and Loening 2008). That is a major drawback for expanded dairy production because it is important to store the products in a cool place before distribution. The problem is further aggravated by poor roads that are sometimes impassible during the rainy season. This impacts the cooperative's ability to deliver yogurt on time and cost-effectively to customers.

Institutional Assets

Institutional assets include the norms, laws, regulations, policies, trade agreements, services, and public infrastructure that facilitate the transactions or movement of a product or a service along a value chain. The institutional environment comprises of the state, non-governmental agencies, or other supporting instances (Green and Haines 2008).

Institutionally, Twawose is negatively impacted by the lack of an appropriate enabling environment for dairy production in Tanzania in general. One of the smallholder milk producers associations, the Tanzania Milk Producers Association (TAMPRODA), was not in operation as of 2011, while the government seems unwilling to invest sufficiently in infrastructure and farmer empowerment. On the other hand, there are other institutions, like the Tanzania Dairy Board (TDB), Tanzania Milk Processors Association (TAMPA), and the Smallholder Dairy Development Program (SDDP) (Mpagalile, Ishengoma, and Gillah 2008) that can be tasked with providing neces-

sary assistance to Twawose. However, for small cooperatives, like Twawose, institutions like these are located far from Mgeta and can be challenging to connect with because of limited knowledge about the institution.

An important institutional constraint faced by Twawose is its limited access to information on issues that can benefit their business development. This includes everything from clean milk production; to processing equipment, transportation and storage of milk; to potential markets, product price, business strategies and advisory services; and other possibilities and solutions. This is despite relatively good mobile phone coverage and the presence of extension officers in the village. However, extension officers' knowledge on value-added products is relatively limited. SUA and the farmer association attempt to fill in the information gaps, with both acting as important sources for Twawose to overcome these informational challenges.

Financial Assets

Financial assets are economic resources. These are tangible or intangible assets that can be used to create value and include access to financial capital from external sources (Green and Haines 2008). Twawose's MCPC is already generating a profit, which was nearly a total of 180 USD at the end of 2010. Fifty percent of the profit is obliged to be reinvested into development of the value chain, with the remainder distributed to its milk suppliers. Early profitability of the enterprise is important both as a positive feedback on their operating routines and a means to increase the motivation for members to develop the business further.

Twawose has access to savings accounts through the local SACCOS (also an institutional asset), where the money is safely stored until the members collectively decide on the use of the cooperative's funds. In theory, the cooperative has the opportunity to borrow from SACCOS to invest in needed physical assets, using as collateral its production building and equipment. Normally, however, the loans provided from SACCOS are meant for farmers to buy seeds and other necessary farm inputs and not for 'larger-scale' business development like the MCPC. Moreover, the needed amount in loans to scale up production is greater than what can be provided by SACCOS.

External investment is currently not available. However, Twawose's network could in theory provide the necessary capital through research projects, directly from the university, or through individual or NGO support. In any case, accessing finance is not considered the biggest barrier to operations for Twawose.

Social and Human Assets

Social and human assets include human capital, which takes the form of skills and experiences such as leadership abilities, experience, education, labour skills, agricultural knowledge, and mindset. It also comprises of networks, capability, and norms that facilitate collective action and the ability to mobilize resources. Social and human capital can be considered assets that contribute to the development of other forms of capital (Green and Haines 2008).

Twawose is comprised of a group of 68 entrepreneurial minded members. The board mainly focuses on opportunities and solutions, and not barriers and problems. These, and the motivation

the organization has to succeed, are important reasons as to why yogurt production was realized in the first place. These characteristics are also important to overcome constraints and barriers in developing Twawose's value chain. This high motivation to succeed stems from the ownership the Twawose members have of the MCPC, and would probably not be the same if it was introduced and/or run by an external source. The fact that the foundation for the cooperative is the dairy goat farmers' association that was founded in 1988 has built a strong sense of community and cooperation. It has given them experience, both organizational and developmental, that has resulted in an ability to solve disputes and to move forward collectively. This reflects a strong base of social capital.

Twawose members do not have higher education. The highest education of any of the members is secondary school, but several members have received training on various relevant practices. Training has been given on goat husbandry, yogurt production, and an introductory seminar on cooperative structures, providing the organization with members who are knowledgeable in these subjects. At the same time, observations during market research and several interviews with the Twawose leadership revealed a lack of business skills such as marketing, cost and price setting, and other business development skills. Training in these subjects is needed, particularly in making strategic decisions concerning future investments.

Twawose has, as previously mentioned, a large network and collaboration with actors such as SUA, MVIWATA, extension officers, local NGOs like SACCOs, and UMADEP. According to an expert working closely with Twawose and other farmers groups, the large network outside the village is somewhat unusual and differentiates this cooperative from others in the region. A large network is highly valuable in making up for and/or enabling access to missing critical assets or resources (Casson and Wadeson 2007). Nevertheless, being dependent on others that have limited time and resources can be discouraging. This is apparent in Twawose's case. Currently, they are in need of information about new markets and new equipment, but their network has not provided them with such information. If Twawose is going to develop and expand the dairy value chain further, they must use their network more deliberately and actively if desired changes are to be realized, rather than use it in a more passive manner as at present.

Culture and norms can also be considered social assets but can also complicate the development of new products. Interestingly, this value chain has overcome the cultural inertia against drinking goat milk. The villagers in Mgeta have developed a taste for goat milk despite the stronger and more characteristic smell compared to cow milk. However, other areas of Tanzania do not have a tradition of drinking goat milk, and this is especially true for towns that have limited access to goat milk. The lack of familiarity with and traditions for consuming goat milk may be a major drawback when introducing goat yogurt to new markets. Moreover, goat yogurt will compete with yogurt from cow milk that is now widely available in urban areas. This aspect will consequently be important to keep in mind when choosing new markets and corresponding marketing strategies.

Governance

Twawose is unique in the sense that it comprises a producer-driven chain (Kaplinsky and Morris 2001). Chains where producers drive coordination activities downstream to processors and re-

tailers are relatively uncommon in developing country agriculture. In Twawose's case, a cooperative structure facilitated this form of governance. The reason for choosing a cooperative form of organization was to facilitate participation of all the Twawose members in the value chain. According to Holloway et al. (2000) producer marketing cooperatives can effectively reduce transaction costs and thereby enhance market and value chain participation for farmers. Transaction costs in this context can be defined as "the pecuniary and non-pecuniary costs associated with arranging and carrying out an exchange of goods or services" (Holloway et al. 2000, 280). Examples of such costs can be searching for parties with whom to exchange goods and services, taking into account their trustworthiness and bargaining to reach an agreement, transferring the product (transportation, processing, packaging), and finally monitoring the agreement. Since raw milk is highly perishable, especially in tropical environments, there are increased risks when there are long distances to markets, implying higher transaction costs. The means by which the milk reaches consumers or is processed into less perishable forms influences how high these transaction costs might be (Delgado 1999; Staal, Delgado, and Nicholson 1996).

A dairy cooperative can reduce transaction costs facing individual producers by lowering unit collection costs through the pooling of goods, provision of inputs, and enhancement of bargaining power. Cooperatives are also beneficial from a processor perspective by making milk supplies more reliable. Buyers of dairy products can also experience lower transaction costs because cooperatives reduce the need for information about widely dispersed and small-scale sellers of milk (Staal, Delgado, and Nicholson 1996). To lower transaction costs, it is important to develop strong bonds among the actors of the chain through trust, reputation, and mutual dependence.

Twawose has the advantage of being organized as an association since 1988, which has created strong bonds and a history of working together towards a common goal. This has resulted in the opening of a pharmacy focusing on goat medicines, training and advice on goat husbandry among the members, and milk collection and yogurt production activities. Trust, reputation, and mutual dependence among the members have been built through the annual election of leadership posts. A fairly strong leadership with support from the members has further made it possible to develop the activities of the cooperative and attract new members every year.

While Twawose's cooperative structure has some important advantages in its value chain, a number of limitations mitigate the full potential of this model. In particular, challenges remain on both the supply and demand sides. First, Twawose sometimes accepts milk from producers that are not presently members of the cooperative on occasions when members cannot meet their production quotas or simply when such milk is available from producers outside the cooperative. To date, non-members are allowed to deliver milk if they intend to join Twawose, but demands for formal membership intention have not always been followed up. Second, agreements over revenue-sharing modalities have not been fully addressed. When founding the cooperative, the profit from the MCPC was agreed to be split evenly, with 50 % to the members supplying milk and 50 % to reinvestment in the MCPC. However, this was not implemented at the end of 2010. It is unclear why this was not implemented, but one reason could be that it was imposed by external experts and not fully understood or agreed upon among the cooperative members. By not following up on set cooperative agreements, such as profit sharing, the potential exists to discourage suppliers of milk and weaken the cooperative structure.

Third, despite the cooperative structure, an important finding of this research is that there are important differences in the perspectives of different actors in the cooperative concerning marketing behavior. In particular, farmers tend to have a more short-term focus regarding the sales of their milk whereas the MCPC considers longer-term sustainability issues, including reliability and the quality of milk supply. This dissonance in incentives often leads to higher transactions costs between suppliers and the MCPC and constrains expansion. For instance, some farmers tend to add water to the milk to increase their revenue, in contrast to the high quality standards set by the MCPC. In addition, farmers are sometimes induced to direct supplies to informal markets rather than to Twawose where average prices are 0.13 USD higher per liter than those offered by the MCPC. However, selling to the informal market also has its limitations. A farmer can never be sure whether he can sell all his milk due to lack of purchasing power among the farmers in Mgeta that are potential consumers. Moreover, informal sales are often made on credit, unlike sales made to the MCPC. This highlights how the cooperative structure of Twawose serves to ensure quality and steady marketed supplies.

The analysis suggests that an important need in the Twawose case is to better align incentives among stakeholders in the chain to better create and distribute added value in the milk chain. Given the types of assets present among Twawose participants, we reflect on the types of strategies that could be undertaken in the next section.

Upgrading Strategies

Based on the above findings and discussion about the assets and governance structures in Twawose's value chain, constraints and opportunities have been identified. Three types of improvements in upgrading are considered in this section: production and milk supply, processing, and marketing. We note that these types of strategies are not mutually exclusive, as there is an important dependence on strategies to simultaneously improve both the efficiency and quality of supply with greater stability and growth in demand.

Upgrading in Production and Milk Supply

Table 2 summarizes many of the key constraints and opportunities related to upgrading in production. Important constraints revolve around issues of seasonality, instability in production and demand, and limited incentives for production. In response to this, Twawose members are subject to supply restrictions, limited to produce up to a total of 25 liters combined to the MCPC each collection day. The restriction is imposed due to limited local market demand. Goat milk yogurt is only sold two days a week during market days.

Table 2. Constraints and Opportunities in the Production Node

	Key Constraints	**Opportunities**
Production (Collection/ Transporting)	Milk production low due to poor complementary feed	Annual increase in dairy goats and farmers keeping dairy goats
	High demand for dairy goats	Underutilized supply of milk
	Natural high seasonality in production	Pooling of collection and transportation of milk
	Unstable supply of milk	
	Limited motivation to supply MCPC	Increasing the scale of yogurt production
	High percentage of milk sales to the informal market	

Source. Developed by Authors

Many Twawose members noted during interviews that the most important change that could be implemented in Twawose's value chain was to increase the number of days that goat milk is accepted at the MCPC. All respondents, from dairy goat owners to Twawose leaders and experts, were certain that the potential supply of milk available is much higher than the 25 liters that is allowed to be sold today. To address this, the total potential volume of goat milk present in the three villages (Nyandira, Tchenzema and Mwarazi) was calculated based on expert consultation with staff at SUA. These results are summarized in Table 3. We estimate that the available goat milk in the three villages is approximately 567 liters per day. If only current Twawose members supply the MCPC, the current available supply is still approximately 93 liters/day. This is a conservative estimate and does not take into account that five farmers alone currently supply the MCPC with 20 liters. This implies, in line with findings from the field interviews, that Twawose members maintain higher goat stocks with better management, resulting in higher milk yields than the average farmer.

Table 3. Estimation of Available Supply of Goat Milk in Mgeta

Assumptions	
Number of goats in the 3 villages	1538 goats
Number of female goats in the 3 villages	1186 goats
Farmers keeping dairy goats	382 farmers
Members of Twawose	63 farmers
Average number of goats per farmer	4.0 goats
Average female goats per farmer	3.10 goats
50 % are mature females	1.55 goats
80 % have milk	1.24 goats
Average of 2 liters milk per goat	2.48 liters/day
1 liter for home consumption	1.48 liters/day
Average daily milk surplus per farmer	1.48 liters/day
Supply of milk from Twawose members	93 liters/day
Total supply of milk in the 3 villages	566.8 Liters/day

Source. Developed by authors

The larger question is developing ways of bridging the gap between potential and realized supply, and then to link this to and exploit greater demand for goat milk. According to Riisgaard (2008), upgrading a value chain controlled by smallholders often requires stronger forms of coordination between all the links in the chain. Based on the examination of the governance structures in Twawose value chain, improved coordination is necessary. To increase the coordination between the suppliers and the MCPC to increase the supply of milk, there are several strategies than can be used:

Increased number of Twawose members: more Twawose members could be recruited to increase the number of farmers that can supply to the MCPC to deal with seasonal variations and to increase milk supplies if new markets are explored. It is preferable that these suppliers are members of the cooperative to ensure the quality of dairy goats and the milk generated from them. It is also an important means of developing trust between new members and the MCPC.

Further training in goat husbandry: This is important so that new members of Twawose, who have not received this training, can learn how to build sturdy goat houses, feed the goats optimal-

ly, treat them appropriately with medicines, and understand the importance of a clean milking environment. Training and coordination of impregnating the goats to deal with the seasonal variety in milk supply would be beneficial.

Formal contracting: Although it is difficult to legally bind farmers in contracts, contracts can be used to improve the communication between milk suppliers and the MCPC. A contract can express more formally the intentions of the MCPC to raise the volumes of the milk it accepts. Transaction costs will be lowered if producers have an assured market for their sales, reducing the incentives for farmers to sell to informal markets. This process can be enhanced further if the profit-sharing scheme between producers and the MCPC can be successfully established.

Increased price of milk: The current price of milk delivered to the MCPC is 0.49 USD, which is less than the local informal market price of 0.62 USD. Several dairy goat owners repeatedly expressed that this was the main reason for not supplying the MCPC. The Twawose leadership stated that the MCPC price was decided upon together with all members of Twawose during the annual meeting at the beginning of 2010. At that time, however, the idea had been to implement the profit-sharing program, which was not realized in 2010 (without cost savings). In order to raise the price of milk to levels closer to those prevailing in the informal market, Twawose would need to attract more milk suppliers and rely on the economies of scale generated by greater numbers of producers.

Increased number of production days for yogurt: This would result in a more secure market for goat milk suppliers and would lower transaction costs.

Establishment of small collection centers: The long distances between farmers and the MCPC still keep transaction costs high. The pooling of milk collection by starting up a mini collection centers and organize transport activities has the potential to mitigate transaction costs for farmers by reducing time spent on sales due to long distances to market and limited access to information regarding demand and prices. During interviews, both suppliers and the Twawose leadership expressed a desire to establish small collection centers in Tchenzema and Mwarazi, something that was supported by experts, such as Kurwijila (2011). This would lower the delivery time for farmers since only one dairy goat owner would deliver the bulked milk. Small collection centers would also lower the chance of farmers selling the milk to informal channels instead of complying with the agreement of supplying the MCPC. To realize the establishment of a small collection center, one would require a place to collect the milk, a quality assurance manager, and a delivery system for the bulked milk. Reactions to this prospect were mixed, however. In Mwarazi, for instance, dairy goat owners do not trust each other when it comes to the quality of the milk. Testing for quality in each village requires that a farmer might have to refuse milk from their neighbors. An independent third-party, possibly from SUA or a trained extension agent, may be required to facilitate this option.

While it is clear that the supply base for larger volumes of goat milk exist, other parts of the value chain need to be considered in parallel. We next focus on ways to improve processing and link the potential supply with activities that will expand consumer demand too.

Upgrading in Processing

Table 4 provides an overview of constraints and opportunities related to upgrading in processing. The main challenges relate to available technology and infrastructure, though opportunities exist to increase both the amount of milk processed and number of days processing takes place. In 2010, the total amount of milk processed by the MCPC was 2128 liters of goat milk. The goal for 2011, according to the Twawose leadership, was to collect and process 3000 liters of goat milk, an increase of 29%. This intended increase is modest given the potential supply in the market, implying a daily increase of 10 liters per day (from an average of 20 liters per day to 30 liters per day). Technically, Twawose would need to increase its processing capacity utilization by 200-300 liters, which would be easily possible given its capacity utilization of just 22% in 2011.

Table 4. Constraints and Opportunities in the Processing Node

	Key Constraints	Opportunities
Processing	Variable yogurt quality	Increase processed milk volumes
	Limited access to new yogurt culture	Increase processing days
	Lack of satisfactory packaging	Utilization of large network to overcome constraints
	No electricity	
	No cooling mechanisms	
	Limited investment	

Source. Developed by Authors

The most cost-effective approach to this would likely be through the bulking of milk, meaning that they should increase the amount processed at any given time, but continue to process only two days a week. Expert consultation and the Twawose management remarked that approximately 30 additional liters of milk can be processed per day before considerable investments in new equipment are needed. This means that farmers could deliver every day to the mini collection center, once in operation, or directly to the MCPC. On the days when the milk is not processed, it would be kept cool for production the next day since production will only take place every other day or even two times a week. This would require expert management to ensure links between suppliers and buyers were adequately established and to ensure that the milk quality is maintained.

Further expansion will require additional investments on the supply side. A strict focus on quality is crucial when entering new competitive markets. One important factor is to secure access to new culture that is needed to produce yogurt from milk. At present, the MCPC uses the previous day's yogurt as the culture, but this is risky, as if one batch is contaminated, culture for the following day would be unavailable. Access to new culture can be secured through their network, for example through the milk processing plant at SUA.

Improved cooling systems are essential to keep a high quality product, particularly if Twawose embarks on strategies to sell to more distant markets or to bulk milk for processing the following day. An established cold chain increases the shelf life of yogurt from two days to 5-7 days, which would make new markets possible. A cold chain would require the acquisition of either a refrigerator or freezer, both of which would be a fairly large investment and depend on access to electricity which is problematic. The two means of accessing electricity are generators or solar power. While a few smallholders and small businesses use generators in Mgeta, the use of gener-

ators is expensive and would increase the price of yogurt considerably. The generator used by the guest house near the MCPC, for example, uses 2 liters of fuel per hour, and one liter of fuel costs approximately 1.25 USD. Running a generator all day long to keep a refrigerator cold would be prohibitively expensive for the MCPC. On the other hand, solar power can be a good option considering it already exists in the village and can potentially be acquired through Twawose's network.

Another major bottleneck in further developing Twawose's value chain is the poor packaging used at present. Today, Twawose uses old water bottles when selling the yogurt and collects them for reuse the same day unless the customer pays for the bottle (0.06 USD). Interviews in May 2010 revealed that Twawose leaders did not know the availability of plastic sachets, their cost, or that a packaging machine needed to seal the sachets requires electricity. While plastic sachets would increase the price per liter of yogurt by approximately 0.06 USD[4] to 1.05 USD/liter, they represent a better option than other forms of packaging. Their use would require overcoming obstacles concerning electricity and infrastructure, however.

A final challenge concerns transportation. In Tanzania, transportation is expensive and might drive the price of yogurt to uncompetitive levels, especially if we considered the cost of improved packaging as well. One transportation option is to use the public dala dalas (the local privately-operated bus service). This option would add about 3.69 USD to the costs per time milk is transported and 45 liters would have to be transported at a time to breakeven at today's supply and selling price, which would necessitate a relatively large increase in production relative to current levels. Another option is to organize transport independently. Because of the distance and that the area is mountainous, a bicycle is not feasible, requiring the use of either a motorbike or car. Either option is too costly at present considering the small amount of yogurt produced. The third transportation or distribution option is inspired by the Danone Grameen joint venture in Bangladesh. In this case, yogurt is produced locally and predominantly uses door-to-door distribution by local women that are trained in sales and delivery of a nutritional message. The women buy the yogurt using micro-credit and receive a commission for each packet of yogurt they sell (Yunus, Moingeon, and Lehmann-Ortega 2010). This option would not influence the price substantially because a middle-man, either in form of a retailer, mobile trader, or a salary to a Twawose member, would be used as well if using other modes of transportation and distribution. A 0.06 USD commission per liter is reasonable according to interviewed respondents. The breakeven for this scenario is 17 liters sold, which is less than current production, but would benefit from greater scale of production over time. Whether it is best to use public transportation or Twawose members to sell the yogurt on commission depends on the nature of the additional market that is targeted.

Upgrading in Marketing

Table 5 summarizes Twawose's various market options and many of the constraints and opportunities related to each market. We distinguish between local and urban markets, where numerous new venues exist, but limited market information constrains expansion at present.

[4] Electricity is not included in the calculation.

Table 5. Constraints and Opportunities in the Market Node

Markets	Opportunities	Key Constraints
Local market (Mgeta)		
Current local market	Sales outlet at MCPC Two "bigger" restaurants Increase marketing	Limited local purchasing power Limited marketing skills Increase in price due to added profit margin
Neighboring villages	Sales by members of cooperative Sales on commission Local restaurants	Lack of adequate packaging Lack of cold chain Increase in price due to added profit margin Limited local purchasing power Limiting marketing skills Unknown market demand
Institutions	School milk program Orphanage Make use of network to acquire financial support	Lack of existing school milk program Need for external financial support Challenging to meet constant and larger supply demand
Urban market (Morogoro)		
Restaurants	University cafeterias Local restaurants Demand for local dairy products	Long distance to market Lack of cold chain Little experience in producing specific and larger amount at constant high quality Competition from other dairy products
Mobile traders	Town market and surrounding areas Differentiation strategy Premium price	Long distance to market Lack of adequate packaging Limited marketing skills Limited ability to meet large demands Competition from other dairy products Unknown market demand
Institutions	School milk programs Orphanages High demand Networking to acquire financial support	Long distance to market Lack of cold chain In need of external financial support Little experience in producing specific and larger amount at constant high quality
Supermarket	Two supermarkets Differentiation strategy Premium price	Long distance to market Lack of cold chain No adequate packaging Little experience in producing specific and larger amount at constant high quality Competition from other dairy products Unknown market demand
Milk bar	Morogoro town Differentiation strategy Premium price	Long distance to market Lack of cold chain Financial investment needed High rent Limited ability to produce and meet large demands Limited marketing skills Competition from other dairy products Unknown market demand

Source. Developed by Authors

The market research revealed that there is potential to sell more goat milk yogurt (approximately 10 liters) if the yogurt is marketed more intensively during the market days. Some yogurt can also be sold on other days during the week directly from the processing building to people living

in Nyandira. Several current customers expressed that they would buy goat milk yogurt every day if it was available at the current price. Increasing the price in the local market is not an option due to limited purchasing power. The local restaurant market has not been exploited yet, and introducing yogurt as a new product in these locations may be an option because of the limited choices of food and drinks locally. Brief interviews were conducted with the owners of the larger restaurants in Nyandira village, and there was positive feedback about this prospect. A second option is to serve milk or yogurt to school children, but that would depend on external funding since Tanzania has no official school milk program. Serving children in Grade 1-3 at the nearby primary school would require 80 liters of yogurt per day, or about 25 liters over three days, which is achievable. Seasonal supply of milk and unsteady supply of yogurt remains a challenge if entering this market. But local markets might be more understandable if orders are not met compared to more formal urban markets.

A small amount of yogurt can be transported back to Tchenzema and sold to, among others, the dairy goat owners that supply the milk. Another possibility is to introduce the yogurt (approximately 35 liters) in nearby local villages that are not part of the cooperative, such as Langali and Mlali (recall Figure 1). Selling directly to consumers at these markets requires packaging and preferably plastic sachets. Selling to local restaurants would save both packaging and the time spent selling in local markets. By using cool boxes, it would be possible to transport the yogurt to nearby villages, but it would have to be sold on the same or the following day to avoid poor quality. In Nyandira, and neighboring villages, the main source of income is agriculture, resulting in a highly seasonable purchasing power. An interesting finding during the field visits is that people preferred to drink milk and yogurt when the weather is hot as refreshment. To avoid the high level of seasonality of consumption in Mgeta, one solution would be to introduce the yogurt in the nearest town, Morogoro. This would also bring economic value from outside Nyandira and will allow money to be circulated beyond the local market.

In Morogoro, goat milk yogurt could be sold to cafeterias at the two local universities, SUA and Mzumbe, at smaller local restaurants, and/or to the two supermarkets. Selling to the supermarkets would require improved packaging, but when selling to cafeterias, packaging is not necessarily required because they can sell by the glass. Several restaurants visited during the informal market research followed this practice. Twawose can sell yogurt in larger 3-5 liter plastic cans if selling to such markets. However, cooling the yogurt before transporting it to Morogoro is necessary to ensure quality. Also, the seasonal supply of milk and unsteady supply of yoghurt will make entering this market a challenge. On the other hand, Twawose could use the seasonality of production to its advantage by marketing its product as a seasonal or "limited time" product, generating a buzz about specific times when "best" to consume yogurt.

Other market possibilities are schools and orphanages, and to open a milk bar in Morogoro (a shop that sells 'home-made' dairy products). In the latter case, it should be noted that there has been an upsurge in the number of milk bars in urban areas in Tanzania (Ashimogo and Greenhalgh 2007). The market research in this study only revealed two milk bars in Morogoro and none of them sold goat milk. A milk bar usually only sells home-made dairy products, but could also supplement their sales with other products that a customer would find convenient to buy at the same time. A milk bar would make the distribution channels easier because the supplier (Twawose) would not have to deal with different buyers that are dependent on getting the milk

and yogurt at specific times. Additionally, targeting milk bars would minimize new packaging costs because it is common for milk bars to sell yogurt by the glass. Still, offering packaged yogurt in addition to selling by the glass would be a good diversification strategy for sales to consumers purchasing for home consumption. Twawose intended to run a milk bar in Morogoro and started the process in 2010, but stopped such plans when they realized the expense and difficulties in obtaining packaging materials. However, as throughput increases, this could be an option to examine in the future if a consistent supply of milk and yoghurt can be achieved.

A major challenge in the urban market is competition that the cooperative does not face locally. Urban consumers are not used to drinking goat milk, and cow milk is widely available at cheaper prices. Cow yogurt is not widely available and prices are higher. At the same time, some consumers might choose goat milk products over cow's milk products. Many people believe that goat milk is easier on digestion than cow's milk, and some of those in urban areas have a fondness for goat milk from their childhood in rural areas. Some studies indicate that goat milk can be tolerated by those that are lactose intolerant, especially children, but no comprehensive studies have been conducted yet (Haenlein 2004). This can create a competitive advantage for goat milk products, especially if additional research focusing on African countries is conducted. Due to this advantage and limited supplies, a higher price of goat milk products could be justified in the urban market. Many challenges would need to be overcome to enter the urban Morogoro market, such as coordinating milk and yogurt supply, creating a cold chain, and improved packaging. A good marketing strategy is also necessary.

Scaling Up: Upgrading and/or Replication of Value Chain

The analysis has revealed that there is potential for significantly increasing the supply of goat milk and identified possible strategies for utilizing this potential. If farmers can supply the MCPC nearly every day, the amount of milk processed would increase, allowing more farmers to supply milk and other actors (such as vendors) to profitably enter the value chain. These strategies are incumbent upon new markets for yogurt. Due to a lack of electricity and limited experience with meeting non-local demand, it is advisable to focus on the local market initially. When a more stable yogurt production chain is established, and obstacles concerning electricity and packaging are better managed, the urban market can be targeted. This should be preceded by more thorough market research and marketing strategies that educate consumers on the nutritional advantages of goat milk.

As noted earlier, the different upgrading strategies suggested here are not mutually exclusive, and necessitate some degree of integration. The expansion of supply from Twawose necessitates an integrated package of interventions that raise production and processing throughput, while simultaneously expanding the market for goat yogurt products. Focusing purely on production without looking at interventions downstream will not be successful. While our research highlights the portfolio of potential options, we have not thoroughly addressed which basket of options would be the most cost-effective. Further quantitative techniques, such as those proposed by Rich et al. (2011), would be a worthwhile exercise to examine these issues in the future. Many of the strategies discussed require large resources, both in terms of capital and knowledge. Twawose has limited access to both these resources and upgrading the chain might prove to be a challenge that is difficult to overcome.

Replicating the existing value chain in other areas is also an option for development. This can be achieved by franchising the Twawose value chain or by establishing independent new value chains in other areas of Tanzania. Franchising would benefit from Twawose's experience, knowledge, and up-in-coming brand, as well as training from the farmers in yogurt production. This would require a large amount of resources, and for a small cooperative like Twawose this is unlikely to occur in the short-run. It would also create an internal competition in a limited market. Replicating the value chain elsewhere in its current or a modified form could be possible with support from SUA, or non-governmental organizations for instance. This requires a large amount of dairy goats in close proximity and would also be relatively capital intensive. But if facilitated by an external institution, it would increase the number of smallholder farmers that can benefit from this new type of local dairy value chain. Already, the value chain has been replicated in the Hanang district in Northern Tanzania, where the research base for the SUA goat project is located. In this area, one larger farm processes yogurt and sells it to the children's department and cantina at the local Haydom Lutheran Hospital.

Distributional Benefits of Twawose's Value Chain

Goat milk increases by about 50% in value when processed into yogurt. The value is distributed along the chain. In 2010 about 42 %[5] of the value of yogurt went to the milk suppliers and 37 % remains in the processing link, when including costs of production. The remaining 21% are used for purchased inputs (Lie 2011).

Suppliers of goat milk in Twawose's value chain are supposed to receive additional income when profit is distributed at the end of the year. However, during interviews with board members and several suppliers, it was clear that this profit sharing arrangement was not implemented at the end of 2010. Based on the profit from 2010, 180 USD, and the intention that 50% of the profit will be distributed to the farmers, we estimate that a farm supplying Twawose with five liters of milk two times a week would receive an end-of-the-year bonus of 10.6 USD. This can be a motivational factor for supplying to the MCPC instead of the local informal market -indeed, if the profit bonus is included, the farmer would have received only 0.02 USD less per liter compared to the informal market.

Twawose further provides employment benefits within its value chain. Twenty-nine percent of the Twawose's 2010 financial costs are paid as an allowance to MCPC workers and to board members when they have official meetings. Those Twawose members that serve as a processor for a three-month period also receive a combined monthly allowance of 31 USD. This is a good salary for working four short days a week (two processing days and two sales days), considering that 17.5 USD[6] is the mean monthly income per capita across all household members in rural Tanzania, and that rural wages are considerably lower than the urban minimum wage of about 50 USD (HBS 2007).

Many farmers in Mgeta are subsistence farmers. To these households, a constant source of petty cash income is very important, especially since the small amount of farming products they are able to sell are seasonal. Interviewed dairy goat owners stated that their goat milk earnings

[5] The calculation has not included workload.

[6] The mean monthly income per household in rural Tanzania is 74.6 USD (HBS 2007).

enabled them to pay for their children's school fees, substantiating past studies conducted by UMADEP (2001) that found that 80% of dairy goat keepers in Mgeta use their earnings from dairy goats to pay school fees for their children. One dairy goat owner noted that he was even able to send his children to a better school in the city. In addition, some were able to improve their houses.

The MCPC also benefits other actors in the value chain besides dairy goat farmers. The MCPC depends on local purchases of sugar, old water bottles, plastic cups, pots, and other small equipment. This represents valuable income for local retailers. Literature suggests that each dollar of additional value added in agriculture in Africa generates $0.3-$0.5 of additional rural non-farm income (Omore et al. 2004).

A third way of looking at value creation is in a non-monetary way. Knowledge of yogurt processing and quality control provides smallholders with an increased skill base. Milk contributes to reducing food insecurity and improving the household nutritional value according to studies conducted by Eik et al. (2008). The presence of an MCPC can increase the motivation of farmers to produce milk and may result in more dairy goats in surrounding areas, and more people having access to the nutritional benefits of milk. If a replication model is chosen, additional communities will enjoy the benefits of this local dairy value chain.

Conclusions

In this paper, we assessed the potential of local dairy value chains as an approach for smallholder farmers to improve their livelihood. The Twawose's semi-formal dairy value is based on the successful introduction of Norwegian dairy goats in Mgeta, Tanzania. The most important questions in the Twawose case study is whether the establishment of Twawose's local dairy value chain has contributed to and has the potential to further improve smallholder livelihoods. To answer these questions, we have studied how Twawose's value chain was established, how it is maintained, what challenges are faced in the continued development of the chain, as well as possible upgrading strategies. The major challenges to further develop Twawose's value chain include the following:

- Unstable milk supply;
- Limited local market demand;
- The lack of adequate quality assurance and packaging;
- Limited access to cooling systems, given sporadic to no access to electricity;
- Limited access to information, particularly on new marketing opportunities.

By producing yogurt, considerable value is added to goat milk. In a locally controlled value-chain such as Twawose, the value accrues to farmers since the chain is controlled by the farmers themselves through a cooperative. The production of goat milk yogurt has increased the market for dairy goat milk in general, but currently the marketed volumes are not large enough to involve all dairy goat owners in Mgeta or all Twawose members. There is therefore the potential to generate benefits for even more dairy goat owners, and other actors indirectly involved in the chain, by scaling up production.

Our research tentatively suggests an initial focus on the local market, with more aggressive marketing of the product in local villages. This would require an expansion of milk and yogurt production, establishment of a mini collection center, and development of new distribution channels. A good strategy would be targeting the local primary schools with external financial support to start up a school yogurt program. This will provide a constant market, and provide valuable experience in processing a fixed amount of high quality yogurt at set delivery times, without large infrastructural challenges and the need to incur high costs in new or expensive technology. It also leads to improved nutrition for children in the local community.

Increased production of goat milk yogurt would result in additional income for a number of dairy goat owners, but will depend on its marketability too. Based on the prospects of supplying more goat milk to the MCPC, more farmers in Mgeta might decide to acquire dairy goats. This is of value in itself, because new households will have easier access to nutritional goat milk for their own families and have the potential to realize increased income through local sales of goat milk. Additional supplies of goat milk for processing into yogurt will also result in increased processing throughput, which would lower unit costs and improve the competitiveness of goat milk products. Increased yogurt production might also lead to the hiring of a MCPC manager, which is another valuable local job created. The ancillary services created by value chain expansion could create a host of downstream opportunities in input supply, packaging, and transport as well. This case demonstrates the broader, village-level benefits of increased knowledge in goat husbandry, increased milk processing, marketing, and business knowledge skills in a range of activities and services within the value chain.

The focus of this case study has been to reveal what factors have been crucial in creating and maintaining this value chain. The existing asset base that has been built over the past several years has been important for Twawose. The participatory farmer-led cooperative mode of organization and the cooperative governance structure in the value chain is crucial for the distribution of value and local development of the chain. All profit that is generated throughout the chain accrues the farmers themselves. At the same time, constraints such as poor infrastructure and limited access to information and services that are common in rural areas are present in this case study.

The Twawose case shows that by pooling the resources of individual farmers and with support from a network of universities, organizations and extension officers, it is possible for smallholders themselves to establish and run a semi-formal local dairy value chain. The nearby university, SUA, played an important role in enhancing farmer assets by introducing dairy goats and creating new opportunities for adding value to goat milk. Public-private coordination like this is crucial for developing a new and fairly simple value chain for smallholders, but its sustainability depends on long-term commitment. In this case, the focus of Twawose has been on supply-side interventions, with less attention paid to marketing strategies necessary to expand markets. Developing integrated interventions that simultaneously improve producer incentives for supply while opening up potential markets and marketing channels, will be critical for this case to be sustained in the future.

References

Altenburg, T. 2006. *Donor Approaches to Supporting Pro-Poor Value Chains*. Germany: German Development Institute.

Ashimogo, G., and P. Greenhalgh. 2007. Tanzania-Trends in Growth of Modern Retail and Wholesale Chains and Related Agribusiness. http://www.regoverningmarkets.org/en/filemanager/active?fid=439.

Barney, J, and D Clark. 2007. *Resource-Based Theory. Creating and Sustaining Competitive Advantage*. Oxford: University Press.

Bille, P.G., M.N. Vovor, J. Goreseb, and E.L. Keya. 2000. Evaluating the feasibility of adding value to goat's milk by producing yoghurt using low cost technology method for rural Namibia. *Journal of Food Technology in Africa* 5 (4):139-144.

Birchall, J. 2003. Rediscovering the cooperative advantage. Poverty reduction through self-help. Geneva: ILO.

Boughton, D., D. Mather, C.B. Barrett, R. Benfica, D. Abdula, D. Tschirley, and B. Cunguara. 2007. Market participation by rural households in a low-income country: An asset-based approach applied to Mozambique. *Faith and Economics* 50 (1):64–101.

Casson, M., and N. Wadeson. 2007. The discovery of opportunities: Extending the economic theory of the entrepreneur. *Small Business Economics* 28 (4):285-300.

Delgado, C. L. 1999. Sources of growth in smallholder agriculture integration of smallholders with processors in Sub-Saharan Africa: The role of vertical integration and marketers of high value-added items. *Agrekon* 38 (1):165-189.

Dolan, C., and J. Humphrey. 2000. Governance and trade in fresh vegetables: the impact of UK supermarkets on the African horticulture industry. *Journal of Development Studies* 37 (2):147-176.

Eik, L.O., G.C. Kifaro, S.M. Kiango, Ø.M. Nordhagen, J. Safari, and L.A. Mtenga. 2008. Productivity of goats and their contribution to household food security in high potential areas of East Africa: A case of Mgeta, Tanzania. *African Journal of Food, Agriculture, Nutrition and Development*. 8 (3):278.

Gereffi, G., J. Humphrey, and T. Sturgeon. 2005. The governance of global value chains. *Review of International Political Economy* 12 (1):78-104.

Gilg, A.W., and M. Battershill. 1998. Quality farm food in Europe: a possible alternative to the industrialised food market and to current agri-environmental policies: lessons from France. *Food Policy* 23 (1):25-40.

Green, G.P., and A. Haines. 2008. *Asset building and community development*. 2nd ed: Sage Publications, Inc.

Haenlein, GFW. 2004. Goat milk in human nutrition. *Small Ruminant Research* 51 (2):155-163.

HBS. 2007. National Household Budget Survey - Tanzania Tanzania National Bureau of Statistics.

Holloway, G., C. Nicholson, C. Delgado, S. Staal, and S. Ehui. 2000. Agroindustrialization through institutional innovation Transaction costs, cooperatives and milk market development in the east-African highlands. *Agricultural Economics* 23 (3):279-288.

Kaplinsky, R, and M Morris. 2001. A handbook for value chain research. IDRC.

Kifaro, G. C., L. A. Mtenga, J. Safari, and D. E. Mushi. 2007. Feasability study on the potential of establishing a center for milk collection in Mgeta, October 2007. Morogoro: SUA.

Kinda, T., and J.L. Loening. 2008. Small enterprise growth and the rural investment climate: evidence from Tanzania. In *Policy Research Working Paper 4675*. Washington: The World Bank.

Krogh, E. 2007. Dairy Goats in Mgeta – Improvements of Livelihood. In Proceedings of the Second Annual PANTIL Research Workshop. October. Morogoro, Tanzania: PANTIL SUA.

Krogh, E. 2010. Personal Communication. Ås, 14.12.2010.

Kurwijila, L. R. 2011. Personal Communication. Morogoro, 28.04.2010, 05.01.2011, and 19.01.2011.

Lie, Helene. 2011. Making better use of goats in tanzania - improving smallholder livelihoods through local value chains for goat milk yoghurt: a case study. M.Sc. Thesis., UMB School of Economic and Business, Norwegian University of Life Sciences (UMB), Ås.

M4P. 2008. Making value chains work better for the poor: a toolbook for practitioners of value chain analysis. Agricultural Development International. Phnom Penh, Cambodia.

Mitchell, J., J. Keane, and C. Coles. 2009. *Trading up: How a value chain approach can benefit the rural poor*. London: Overseas development institute (ODI).

Mpagalile, J.J., R. Ishengoma, and P. Gillah. 2008. Agribusiness Innovation in Six African Countries. The Tanzanian Experience. Morogoro, Tanzania: World Bank Institute.

Njombe, A. P. , and Y. N. Msanga. 2009. Livestock and Dairy Industry Development in Tanzania. Department of Livestock production and Marketing Infrastructure Development, Ministry of Livestock Development: 17.

Omore, A.O., S. M. Cheng'ole Mulindo, Fakhrul Islam, G. Nurah, M. I. Khan, and J. S. Staal. 2004. "Employment generation through small-scale dairy marketing and processing: experiences from Kenya, Bangladesh and Ghana: a joint study by the ILRI Market-oriented Smallholder Dairy Project and the FAO Animal Production and Health Division." In. Rome FAO. http://www.fao.org/docrep/007/y4860e/y4860e00.htm.

Peacock, C. 2007. The goats model. A proven approach to reducing poverty among smallholder farmers in Africa by developing profitable goat enterprises and sustainable support services. In *Working Papers*: Farm-Africa.

Ponte, S. 2008. Developing a'vertical'dimension to chronic poverty research: Some lessons from global value chain analysis. In *Working paper*: Chronic poverty research centre (CPRC).

Rich, K.M., R.B. Ross, A.D. Baker, and A. Negassa. 2011. Quantifying Value Chain Analysis in the Context of Livestock Systems in Developing Countries. *Food Policy* 36:214-222.

Riisgaard, R., S. Bolwig, F. Matose, S. Ponte, A. du Toit, and N. Halberg. 2008. A Strategic Framework and Toolbox for Action Research with Small Producers in Value Chains. In *DIIS Working Paper*.

RLDC. 2010. Survey on Dairy Products Market in Tanzania. Dar Es Salaam: Rural Livelihood Development Company.

Safari, J, F Sundstøl, LA Mtenga, LO Eik, and FH Johnsen. 2005. "Analysis of three goat production systems and their contribution to food security in the semi-arid areas of Tanzania." In *The role of biotechnology in animal agriculture to address poverty in Africa: Opportunities and challenges*, edited by J.E.O. Rege, A.M. Nyamu and D. Sendalo, 423. Arusha, Tanzania: AASAP/TSAP.

Shepherd, A. 2007. *Approaches to linking producers to markets, a review of experiences to date*. Rome: FAO.

Shepherd, A., and J Wiklund. 2005. *Entrepreneurial Small Businesses: A Resource-Based Perspective*: Elgar Publishing Incorporated.

Staal, S., C.L. Delgado, and C.F. Nicholson. 1996. Smallholder dairying under transactions costs in East Africa. In *MSSD Discussion Paper*. Washington DC: International Food Policy Research Institute.

UMADEP. 2001. UMADEP Agricultural Report Morogoro: SUA.

Verhaegen, I., and G. Van Huylenbroeck. 2002. *Hybrid governance structures for quality farm products: A transaction cost perspective*. Aachen: Shaker verlag.

Vermeulen, S., and L. Cotula. 2010. Making the most of agricultural investment: A survey of business models that provide opportunities for smallholders. London, Rome, Bern: IIED/FAO/IFAD/SDC.

Vorley, B., M. Lundy, and J. MacGregor. 2009. Business models that are inclusive of small farmers. In *Agro-industries for development*, edited by C.A. Da Silva, A.D. Baker, A. Shepherd, C. Jenane and S. Miranda-da-Cruz, 186-222. FAO, UNIDO and CABI Publishing.

World Bank. 2007. World development report 2008, Agriculture for development. Washington DC: The World Bank

Yunus, M., B. Moingeon, and L. Lehmann-Ortega. 2010. Building social business models: Lessons from the Grameen experience. *Long Range Planning* 43 (2-3):308-325.

International Food and Agribusiness Management Review
Volume 15, Issue 3, 2012

How to Treat Farmers Fairly? Results of a Farmer Survey

Anneke Hellberg-Bahr[Φa] and Achim Spiller[b]

[a]*Research Assistant, Department of Agricultural Economics and Rural Development, Georg-August-University Goettingen, Platz der Göttinger Sieben 5, 37073 Göttingen, Germany*

[b]*Chair, Marketing for Food and Agricultural Products, Department of Agricultural Economics and Rural Development, Georg-August-University Goettingen, Platz der Göttinger Sieben 5, 37073 Göttingen, Germany*

Abstract

With growing price volatilities on agricultural markets, the question of fair prices for agricultural products is becoming increasingly important. One major aspect of this is fair treatment of farmers by supply chain partners. Fairness has been discussed in studies in the literature for some time now, but there is little evidence concerning farmers' perceptions of fairness. This paper addresses this gap, using empirical data from a farm survey and regression analysis of farmer attitudes. The results clearly reveal that besides the overall price satisfaction, the reliability of the supply chain partners and solidarity between farmers influence perceived fairness.

Keywords: fairness, solidarity, agricultural supply chain, price volatilities, multiple regression analysis

ΦCorresponding author: Tel: +49 551 39 22399
Email: abahr@gwdg.de
A. Spiller: a.spiller@agr.uni-goettingen.de

+The IFAMR is a non-profit publication. The additional support provided from this issue advertisers, Novus International and GlobalGap help keep us open access and dedicated to serving management, scholars, and policy makers worldwide.

Introduction

With the increasing liberalization of the EU Common Agricultural Policy and growing dependency on global agricultural commodity markets, farmers face greater price volatility leading to a number of frictions in agri-food supply chains. For example, the increasing volatility and the imminent abolition of milk quotas led to a growing dissatisfaction among dairy farmers, which inter alia resulted in the "milk strike" in Germany and some other European countries in 2008. This initiated a discussion about fair prices in agricultural supply chains. The strike and the increasing complaints by German farmers led agricultural organizations and politicians to the conclusion that farmers felt unfairly treated, due to dissatisfaction with agricultural product prices. In the context of this discussion, the question arose of what fair prices are and what fairness in agricultural supply chains actually means.

Fairness concepts are widely discussed in the marketing literature from a consumer point of view (Toler et al. 2009; Chang and Lusk 2009; Diller 2000). Economists research the question of why people behave fairly, and not like "Homo economicus" (Kahneman et al. 1986; Charness and Rabin 2000; Fehr and Schmidt 1999; Fischbacher et al. 2009). Sociologists research the question of what fair wages are (Jasso 1978; Liebig et al. 2009). However, this issue has not yet been approached from the suppliers' – in our case the farmers' – point of view. The main research question of this paper is to examine what farmers perceive as fair, given that the existence of fairness improves strong supplier relationships (Kahneman et al. 1986; Kumar et al. 1995; Wagner et al. 2011). Our objective is thus to determine relevant factors that might affect the perceived fairness of farmers concerning the below-mentioned hypotheses. Moreover, we give suggestions for successful supplier relationship management based on the results. To answer this question we proceed as follows. After a short overview of the relevance of fairness in supply chains and of different fairness definitions, we use a survey of 533 German farmers to examine their perceptions of fairness. By means of exploratory factor analysis and multiple regression analysis, we show different influences on fair treatment in agricultural supply chains. The results can be used to enhance fairness between trade partners in agricultural supply chains.

Fairness in Supply Chains

For supply chain researchers, the most important question is whether and how fairness influences relationships. A strong influence of the perceived fairness on long-term relationships has indeed been found (Lind 2001; Kumar et al. 1995; Gu and Wang 2011; Wagner et al. 2011). However, the argument that actors in a supply chain collaborate in order to realize economic benefits and that these benefits positively influence the relationship (Williamson 1983) cannot be universally accepted (Kahneman et al. 1986). In most cases, it is impossible to determine the outcome of a transaction beforehand. Hence, other aspects should be taken into account when discussing motivational aspects for cooperation (Wagner et al. 2011; Gu and Wang 2011). Kahneman et al. (1986) introduced the role of perceived fairness for the willingness to collaborate in their research. Furthermore, perceptions of fair treatment in relationships differ according to the degree of uncertainty of fairness (van den Bos and Lind 2002; van den Bos 2001) and to individual fairness perceptions (Lind et al. 1993) but have substantial effects on attitudes towards and behavior in these relationships (Lind 2001).

Kumar et al. (1995) highlighted the importance of supplier fairness in buyer-seller relationships. They state that there is a difference between fairness of the outcomes and fairness in supply chain processes. Hence, it may also be assumed that there is a difference for farmers. The overall assumption that a high price satisfaction may lead the farmers to feel treated fairly could be supplemented by attitudes of the farmer towards supply chain processes which deal with trade in a supply chain. Whilst fairness in supply chains is one important factor for functioning relationships, most research has focused on fairness in organizations. However, there is a difference between fairness in organizations (Kumar et al. 1995; van Knippenberg et al. 2007) and fairness between supply chain partners. To the best of our knowledge, there has as yet been no research on farmers' evaluation and view of important aspects of fairness in agricultural supply chains. This study tries to fill this research gap and sheds light on how farmers can be treated fairly.

Fairness in Research and Hypotheses

The question of fair treatment has been discussed for some time by both economists (Kahneman et al. 1986) and sociologists (Jasso 1978), and has also been adapted to price psychology in marketing (Diller 2000) on which we will focus in this context as well. We will give a short introduction to fairness research in sociology, experimental economics and price psychology to describe how fairness can be evaluated and perceived by people. Additionally, we will provide a link to the assumed influences of interactions between business partners on farmers' perception of fairness.

Before starting, we will focus on the actual evaluation of fairness by European farmers. As we have mentioned above, it can be assumed that perceived fairness has been reduced as a result of market liberalization. Liberalized markets, so the hope, will increase efficiency in the agricultural sector. Many researchers have focused on the question whether efficiency in agriculture and fairness are mutually exclusive (Colman 1994). They come to the conclusion that the degrees of effectiveness and fairness have to be weighed up to allocate an optimal trade-off (Colman 1994; Weise 2002; Suchanek 2002). Thus, our first research question focuses on how high the perceived fairness is.

Sociological approaches often discuss fairness in the context of justice of payments (Jasso 1978) or the justice of political forces (Breyer 2008). Justice of payments can be differentiated into basic human needs and the needs for luxury goods which one actor can fulfill with his/her own work. In addition, a just compensation of performance is discussed (Liebig et al. 2009). In supply chains this may mean that a just compensation of performance is needed to think that one is treated fairly. If farmers' revenues do not cover their production costs they will not be satisfied with their product prices. This will reduce their perceived fair treatment. From this, we hypothesize that a high price satisfaction will increase farmers' perception of fairness (H1).

Sociologists also talk about the recognition of work (Liebig et al. 2009; Schoefer 2005). For farmers, this can be in terms of monetary value, but also in social recognition. If the work of the farmer is not recognized by the buyer or by the consumers, this may lead to a perception of unfairness. For German consumers prices are very important, due to the fact that discounters have a high market share (Spiller et al. 2010). Thus we hypothesize that their high price-consciousness will lead farmers to feel treated unfairly (H2).

In experimental economics, fair and just actions of human beings have been evaluated using game theory with experimental research designs. The most common models discussed in this context are those of Fehr and Schmidt (1999) and Bolton and Ockenfels (2000), which addressed the question why people behave fairly and altruistically and do not act like "Homo economicus" (Fischbacher et al. 2009). In these models, the actors draw conclusions about whether each other's actions were fair (consequence). Fehr and Schmidt (1999) and Bolton and Ockenfels (2000) argued that people's aversion to inequality leads them to behave fairly. Other researchers state that people consider whether they will be treated fairly (intention-based approach) (Rabin 1993; Charness and Rabin 2000). Thus, experimental economics concludes that people's perception of fairness is contingent on individual social preferences for fairness. These preferences refer to people's reciprocity, aversion to inequality and pure altruism (Fehr and Fischbacher 2002). Nevertheless, Bauernschuster et al. (2010) found that competition reduces reciprocity. Hence, a competitive market environment reduces the perception of fairness. In our research, we use this assumption to investigate the question of solidarity between farmers. An increase in competition, as assumed with higher market liberalization, may result in a loss in solidarity between farmers, which may have a negative influence on perceived fair treatment. We hypothesize that there is an influence of solidarity between farmers on farmers' perception of fairness (H3), meaning that farmers who perceive solidarity as important are less satisfied with fairness in the increasingly competitive agribusiness environment.

In psychological disciplines, price fairness is important. Aspects of price fairness for the consumer include transparency, honesty, reliability, influence and a say in decisions, consideration, respectfulness and consistent behavior (Diller 2000). For actors in supply chains (farmers, in this context) these aspects could be important too. For example, if the price for agricultural products is clear and transparent to the farmer, he may feel treated fairly. Diller (2000) argued that reliability plays an important role in fairness. If the farmer relies on his supply chain partner and trusts him, he will feel treated fairly. Hence we hypothesize that a high reliability of supply chain partners will positively influence the farmer's perceived fairness (H4).

Data and Empirical Methods

A standardized questionnaire was developed. Questions were mainly answered in 5-point Likert scales (-2= I fully disagree, 0= partly, +2= I fully agree). The questionnaire can be divided into three different topics; we refer to the second and last one in this context. The questionnaire begins with questions referring to the current political situation and attitudes towards market processes. Additionally, one part refers to values like solidarity between farmers. The second part of the survey asked the farmers about attitudes towards fair treatment and prices in supply chains, which we will deal with in this context. At the end, farmers were asked about their sociodemographic and business organisational situation. Some items were taken from the literature, and some were newly developed if no earlier studies and scales could be found or an adaption did not seem to be appropriate for farmers. The questionnaire was pre-tested online with a software tool for comments by research assistants and students. Thereafter students asked farmers to answer the online questionnaire (snowball sampling). In addition, we promoted the survey online on the website of an agricultural magazine.

The online sample consists of 533 farmers and was conducted between December 2010 and January 2011. The respondents were mainly located in the North-West of Germany and were on average 41 years of age. Respondents were mainly well educated (master, university or college education in 62 % of cases; German average = 10 % (DBV 2011)), male (92.7 %) and managers of professional farms (89.8 %). The farms cultivate 198 (sd=266) hectares on average (German average = 56.5 hectares (DBV 2011)), with different concentrations: 38.6 % were mainly engaged in arable farming, 33.1 % produced milk, 22.8 % produced pork, 2 % fruit and vegetables, and 3.5 % bioenergy. Although the sample is not representative of German farmers, this study can give indications for further research. Moreover it is interesting for agribusiness because the sample is based on future-oriented farmers. However, it is not universally valid.

Data analysis is divided into three parts. First we present results of descriptive analyses followed by an exploratory factor analysis, which extracted four reliable factors. We then investigate the impact of the extracted factors on fair treatment perception of farmers by means of multiple regression analyses. Principal component analysis with orthogonal rotation (varimax) was used to reduce the number of attitudinal items in the data set (Table 1). The Kaiser-Meyer-Olkin value (0.777) verifies the adequacy of the sampling for this analysis. Additionally the Bartlett´s test of sphericity x^2 (91) = 1926.23, p<0.001 indicates high correlations between the used items in the analysis. According to the Scree-Plot and Eigenvalue criteria, four factors with Eigenvalues higher than one were extracted and explained 60.53 % of the variance. The reliability of each factor was measured with the Cronbachs´ Alpha value, where values higher than 0.6 (for scales used for the first time) / 0.7 (for scales used for a second or multiple times) indicate a reliable factor (Field 2009; Nunally 1978).

In the next step, a multiple regression analysis was used to predict the perceived fair treatment of farmers. The overall model quality criteria - the adjusted R^2 - displayed with 57.3 % and F-Value of 179.44*** a good fit of the model (Field 2009). The appropriateness of the individual predictors for farmers` perceived fairness is shown in the table below for each factor (Table 2).

Results

The farmers agree to some extent with the statement “I feel treated fairly by my buyer” (mean: 0.56, sd: 0.838). 61 % of the respondents agree with this statement, whereas 10 % feel treated unfairly and 29 % have indifferent feelings about their actual treatment of the buyer. These results generally agree with the assumption of Suchanek (2002) and Weise (2002). Nevertheless, we do not examine the reasons of actual fairness perceptions, but question how fairness can be accomplished in agricultural supply chains. Taking into account that nearly 40 % of farmers feel unfairly treated or have indifferent feelings towards their supply chain partners, it is an essential goal to investigate how farmers can be treated fairly. For this our results show the opportunities for increasing the farmers’ perceptions of fairness.

Four factors displaying different aspects of possible fairness patterns were examined by means of an exploratory factor analysis (Table 1). The first factor refers to the price satisfaction of farmers. The mean values display indifferent attitudes towards price satisfaction. Additionally, this factor includes items concerning just compensation for the effort of the farmer. The second factor comprises the reliability and the relationship quality in the supply chain. The respondents generally confirm that they can rely on their buyer and nearly all have good relationships with

them. The statements representing the solidarity factor were answered positively, except price differences between small and large scale farmers which was given a cautiously positive evaluation. For this statement, the respondents have very different attitudes indicated by a high standard deviation. The fourth factor displays the perceived price-consciousness of consumers. Overall, farmers evaluate the willingness of consumers to pay enough money for their produced goods negatively. The relatively large standard deviations of the used items suggest that in several cases it can be assumed that the farmers in our sample differ in their attitudes towards the relational factors. In the next step we use regression analysis with "I feel treated fairly by my buyer" as dependent variable to investigate influences on the fairness perception of farmers.

Table 1. Results and Items of Factor Analysis

Factor and Items	Mean (sd)	Factor Loading
Factor 1: Price satisfaction, CA: 0.773, % of variance: 19.43		
In general I am satisfied with the product prices.	0.08 (0.848)	0.786
My product prices correspond to my effort.	-0.18 (0.858)	0.774
Most products I sell do not generate enough profit.	0.08 (0.860)	-0.711
I am satisfied with the product prices my supplier has paid me in the last ten years.	-0.04 (0.871)	0.652
I am satisfied with the current product prices.	0.49 (1.081)	0.639
Factor 2: Reliability and relationship quality, CA: 0.775, % of variance: 17.41		
With my buyer you have to be careful not to be short-changed.	-0.64 (0.899)	-0.840
My buyer changes product prices too frequently.	-0.75 (0.822)	-0.778
I can trust my buyer.	0.48 (0.817)	0.777
I feel committed to my buyer.	0.30 (0.926)	0.647
Factor 3: Solidarity, CA: 0.644, % of variance: 13.12		
Solidarity in agricultural farming is important.	0.85 (0.840)	0.849
Farmers should help each other.	1.10 (0.683)	0.735
Product price differences between small-scale and large-scale farmers should not be too big.	0.33 (1.064)	0.690
Factor 4: Price-conscious consumers, CA: 0.625, % of variance: 10.57		
In our society, food is not supposed to be expensive.	1.03 (0.944)	0.848
German consumers are only concerned with prices when buying food.	0.77 (0.930)	0.847

Source. authors' calculation, sd = standard deviation, CA = Cronbach´s Alpha

As can be seen in Table 2, the most important aspects for fairness in the food supply chain are relational subjects such as price satisfaction, reliability and relationship quality. This corresponds to the results of Liebig et al. (2009) and Diller (2000) who evaluate these relational factors as important for the perception of fair treatment. A high stated price satisfaction increases the perceived fairness of the farmer. Therefore the sociological point of view that a just compensation of the farmers' work is important for fair treatment in supply chains is confirmed, and we accept H1. Concerning the social recognition of farmers in a supply chain, the results show that a perceived high price-consciousness of consumers does not improve the perceived fairness. Thus H2 is rejected.

Table 2. Regression Analysis of Fairness

Independent Variables	Regression Beta	Standardized Beta	t
Constant	0.559		23.577 ***
Price satisfaction	0.224	0.291	10.274 ***
Reliability / relationship quality	0.581	0.694	24.489 ***
Solidarity	-0.078	-0.093	-3.270 **
Price-conscious consumers	0.032	0.038	1.337 $^{n.s.}$

Source. Authors' calculation, *** $p \leq 0.001$, ** $p \leq 0.01$, $^{n.s.}$ = not significant, dependent variable="I feel treated fairly by my buyer"

The solidarity factor between farmers leads to a negative influence on farmers' feelings of fair treatment. This corresponds to the results of Bauernschuster et al. (2010). The higher farmers value solidarity with their colleagues, the more unfairly treated they feel, thus H3 can be accepted.

The more positive the farmers' relationship with their buyer and the more they can rely on them, the greater the feeling of fairness. Concerning the results of Chang and Lusk (2009) and Diller (2000) this was expected, and gives an indication of further relationship assumptions. From this we accept H4.

Additionally we examined the evaluation of price differences between small-scale and large-scale farmers into consideration, i.e., if the size of the farm has an influence on the feeling of being fairly treated. Large-scale farmers may feel treated more fairly if they get better product prices. Nevertheless, there was no influence of this business related item on the perceived fairness. We also tested other sociodemographic factors, but did not measure any influences on the fair treatment of farmers.

Discussion and Conclusions

Fairness in food supply chains is one important aspect for functioning relationships and has been discussed from different points of view. With the increasing liberalization of the CAP, fairness patterns in agricultural supply chains have been moved into the spotlight. First of all, the actual perceived fairness between farmer and buyer leads us to the conclusion that buyers have to work to achieve fairer relationships. If farmers have good relationships with producers the likelihood of switching the buyer is low (Schulze et al. 2006). Nearly 40 % of our respondents did not feel treated fairly. Further, our study has shown that key success factors for fair treatment in supply chains are relational factors, such as reliability and relationship quality between the partners and

additionally the overall price satisfaction. So the main assumption that fairness in supply chains can be reached with a high price satisfaction can partly be confirmed. For consumers Chang and Lusk (2009), Toler et al. (2009) and Diller (2000) suggest several aspects that may be important in supply chains as well from a price fairness point of view. For example, this implies that buyers should not change prices frequently, and maintain prices which have been agreed upon. Price fairness is, however, not the most important variable, other aspects have to be taken into account as well.

Concerning sociological aspects, our conclusions are somewhat divergent. The monetary part of price satisfaction and just compensation of work improves the perceived fairness, whereas perceived price-consciousness of consumers does not play a role. Taking into account that the respondents are more indifferent to the actual stated price than satisfied with it, buyers have a point of reference for further action. This includes a good communication of prices and an acceptance and commitment to the farmer's work. First of all the relational aspect relationship quality and reliability is more important than the monetary aspect price satisfaction. Second, consumers do not deal directly with farmers. Farmers mostly sell their products to a processor, and contact to end-consumers is rare. This may be one reason why these items have no influence on the perceived fairness. Further research should take this into account by measuring the mutual respect between direct market partners. Additionally it could be useful to investigate the different marketing channels for agricultural products. Farmers who sell their products to processors do not deal with consumers whereas farmers who sell their products via direct marketing may have different fairness perceptions.

Our results lead us to the conclusion that farmers who place a great importance on values such as solidarity are not easily satisfied concerning fair treatment. The attitude of all respondents towards overall solidarity between farmers is surprising. Therefore, a reliable communication of solidarity patterns may be a useful tool for agribusiness companies to increase perceived fairness. From a financial point of view, solidarity is valued more or less indifferently with high standard deviations. So not all farmers judge the same product prices for all as a "must have" of solidarity. Quantity premiums for large-scale farms will not necessarily decrease the perceived fairness and vice versa. Buyers should take this into account.

Concerning the results of reliability and relationship quality, we have seen that these are the most important aspects for fair treatment in supply chains. Surprisingly it is not price satisfaction that is exclusively responsible for fairness perceptions. Therefore, factors for improving the relationship quality are crucial (Schulze et al. 2006). Schulze et al. (2006) and Weibler and Feldmann (2012) emphasized the importance of trustful communication between farmers and buyers. This may improve the farmers' feeling of being treated fairly even if the prices are low for short periods.

Limitations and Further Research

The study focused on farmers in one country. It is not representative, but nevertheless provides indications for fair treatment of farmers and a basis for further research. The R2 of 57.3 % indicates that there are more aspects of fairness that were not fully explored in this research. Further research should, e.g., consider more aspects from price psychology (Diller 2000). It should also

be taken into account that some sectors have specific organizational structures (e.g., cooperatives). Therefore research in only one production sector is advised. Here we have considered the fairness relevance for the agribusiness in general, but particularly for questions of solidarity and fair treatment, differences between sectors could be important as well. Further studies could also take the whole supply chain into account as it can be assumed that not all parts of the supply chain have the same fairness perceptions. For fairness in the whole supply chain an investigation of the status quo and possible impacts for fairness concepts is necessary. Nevertheless, the goal is to cope with heterogeneous preferences of fairness between farmers and in the supply chain as well.

Additionally the discussion about fairness in supply chains has shown that beyond fair treatment it could be interesting to investigate what could be meant by fair prices. Liberalization will lead to agricultural prices which reflect market conditions. Hence, the question is whether liberalized and highly volatile prices are perceived as unfair in general or if other aspects should be taken into account when evaluating the fairness of prices in agricultural markets.

Acknowledgements

The authors would like to extend their thanks to the Wilhelm Schaumann Stiftung, as well as the Organic Farming Program of the Federal Ministry of Food, Agriculture and Consumer Protection for financial support of this research.

References

Bauernschuster, S., O. Falck and N.D. Grosse. 2010. Can Competition Spoil Reciprocity? A Laboratory Experiment. *Working Paper 2923*. CES ifo, Munich, Germany. http://www.cesifo-group.de/portal/pls/portal/docs/1/1185796.PDF (accessed November 15, 2011).

Bolton, G. E. and A. Ockenfels. 2000. ERC: A Theory of Equity, Reciprocity, and Competition. *The American Economic Review*. 90 (1): 166–193.

Breyer, F. 2008. Die Chancen der Sozialen Marktwirtschaft und die Rolle der Ökonomen. *Perspektiven der Wirtschaftspolitik*. 9 (2): 125–138.

Chang, J. B. and J. L. Lusk. 2009. Fairness and food choice. *Food Policy*. 34 (6): 483–491.

Charness, G. and M. Rabin. 2000. Social Preferences: Some Simple Tests and a New Model. Department of Economics, University of Berkeley. http://www.escholarship.org/uc/item/46j0d6hb (accessed January 6, 2012).

Colman, D. 1994. Ethics and Externalities: Agricultural Stewardship and other Behaviour: Presidential Address. *Journal of Agricultural Economics* 45 (3): 299–311.

DBV. 2011. Situationsbericht 2011/2012. edited by Deutscher Bauernverband, Berlin, Germany.

Diller, H. 2000. Preispolitik. 3rd edition Stuttgart: Kohlhammer.

Fehr, E. and K. M. Schmidt. 1999. A Theory of Fairness, Competition, and Cooperation. *The Quarterly Journal of Economics.* 114(3): 817–868.

Fehr, E. and U. Fischbacher. 2002. Why Social Preferences Matter — The Impact of Non-Selfish Motives on Competition, Cooperation and Incentives. *Economic Journal* 112(478): C1-C33.

Field, A. 2009. Discovering statistics using SPSS (and sex and drugs and rock 'n' roll). 3rd edition. Los Angeles, CA: Sage.

Fischbacher, U., C. M. Fong and E. Fehr. 2009. Fairness, errors and the power of competition. *Journal of Economic Behavior and Organization* 72(1): 527–545.

Gu, F. F. and D. T. Wang. 2011. The role of program fairness in asymmetrical channel relationships. *Industrial Marketing Management* 40(8): 1368–1376.

Jasso, G. 1978. On the Justice of Earnings: A New Specification of the Justice Evaluation Function. *American Journal of Sociology* 83(6): 1398–1419.

Kahneman, D., J. L. Knetsch and R. H. Thaler. 1986. Fairness and the Assumptions of Economics. *The Journal of Business* 59(4): 285-300.

Kumar, N., L. K. Scheer and J.-B. E. M. Steenkamp. 1995. The Effects of Supplier Fairness on Vulnerable Resellers. *Journal of Marketing Research* 32(1): 54–65.

Liebig, S., C. Sauer and J. Schupp. 2009. The Justice of Earnings in Dual-Earner Households. *SOEP Papers* (216). http://www.diw.de/documents/publikationen/73/diw_01.c.338496.de/diw_sp0216.pdf (accessed November 3, 2011).

Lind, E. A. 2001. Fairness Heuristic Theory: Justice Judgements as Pivotal Cognitions in Organizational Relations. *Advances in organizational justice,* edited by J. Greenberg, J. and R. Cropanzano, 56–88. Stanford, CA: Stanford University Press.

Lind, E. A., C. T. Kulik, M. Ambrose and M.V.V. de Park. 1993. Individual and Corporate Dispute Resolution: Using Procedural Fairness as a Decision Heuristic. *Administrative Science Quarterly* 38(2): 224–251.

Nunally, J. C. 1978. Psychometric theory. 2nd edition. New York: McGraw-Hill.

Rabin, M. 1993. Incorporating Fairness into Game Theory and Economics. *The American Economic Review* 83(5): 1281–1302.

Schoefer, M. 2005. Ökonomik - experimentelle Wirtschaftsforschung - Wirtschaftsethik. Dissertation Universität Münster, Münster.

Schulze, B., C. Wocken and A. Spiller. 2006. Relationship quality in agri-food chains: Supplier management in the German pork and dairy sector. *Journal on Chain and Network Science* 6 (1): 55–68.

Spiller, A., J. Böhm and C. von Cossel. 2010. Die (neue) Lust am Discount? - Einkaufsmotive und Kaufbarrieren. *Ernährungsumschau* 11/10: 598-604.

Suchanek, A. 2002. Das Verhältnis von Effizienz und Gerechtigkeit aus vertragstheoretischer Sicht. In *Gerechtigkeit als Voraussetzung für effizientes Wirtschaften*, edited by M. Held, G. Kubon-Gilke and R. Sturn,134–150. Marburg: Metropolis.

Toler, S., B. C. Briggeman, J. L. Lusk, and D. C. Adams. 2009. Fairness, Farmers Markets, and Local Production. *American Journal of Agricultural Economics* 91(5): 1272–1278.

van den Bos, K. 2001. Uncertainty management: The influence of uncertainty salience on reactions to perceived procedural fairness. *Journal of Personality and Social Psychology*, 80(6): 931–941.

van den Bos, K. and E. Lind. 2002. Uncertainty management by means of fairness judgments. *Advances in Experimental Social Psychology* 34: 1–60.

van Knippenberg, D., D. de Cremer and B. van Knippenberg. 2007. Leadership and fairness: The state of the art. *European Journal of Work and Organizational Psychology* 16(2): 113–140.

Wagner, S. M., L. S. Coley and E. Lindemann. 2011. Effects of suppliers´ reputation on the future of buyer-supplier relationships: the mediating roles of outcome fairness and trust. *Journal of Supply Chain Management* 47(2): 29–48.

Weibler, J. and M. Feldmann. 2012. Gerechtigkeit und Arbeitskontext – Zur Bedeutung situativer Merkmale für die Gerechtigkeitswahrnehmung von Führungskräften. *Zeitschrift für Betriebswirtschaft* 82(1): 75–94.

Weise, P. 2002. Effizienz versus Gerechtigkeit: Tragweite und Folgen der Annahme eines Tradeoffs. In *Gerechtigkeit als Voraussetzung für effizientes Wirtschaften*, edited by M. Held, G. Kubon-Gilke and R. Sturn, 51-70. Marburg: Metropolis.

Williamson, O. E. 1983. Credible Commitments: Using Hostages to Support Exchange. *The American Economic Review* 73(4): 519–540.

International Food and Agribusiness Management Review
Volume 15, Issue 3, 2012

To Make or to Buy: Is this the Question?

Testing making or buying decisions to explain innovation sourcing strategies in the food sector

Stefano Pascucci[Φa], Annie Royer[b] and Jos Bijman[c]

[a]*Assistant Professor, Management Studies Group, Wageningen University, Hollandseweg 1, 6700EW, The Netherlands*

[b]*Assistant Professor, Département d'économie agroalimentaire et des sciences de la consummation, Université Laval, Pavillon Paul-Comtois, local 4401, 2425 rue de l'Agriculture, Quebec City, Quebec, G1V 0A6, Canada*

[c]*Assistant Professor, Management Studies Group, Wageningen University, Hollandseweg 1, 6700EW, The Netherlands*

Abstract

This paper analyses the decision of food companies to realize innovations through in-house activities, outsourcing and suing collaborations. The paper uses information from a dataset of 389 Italian food companies collected by Unicredit group in 2007. We develop a set of hypotheses from three theoretical perspectives: transaction cost economics, strategic management and resource-based view. This paper aims at highlighting what firm's features are related to the make, buy and mixed innovation-sourcing decisions. We found that these strategies are positively interlinked which is challenging current theories. We conclude the paper by discussing these results and bringing some interesting outcomes to discuss managerial implications and/or policy interventions in this highly strategic domain.

Keywords: Making or buying decisions, innovation sourcing strategy, innovation, food industry.

ΦCorresponding author: Tel: + 31.0317482572
Email: stefano.pascucci@wur.nl
A.Royer: annie.royer@eac.ulaval.ca J. Bijman: jos.bijman@wur.nl

+The IFAMR is a non-profit publication. The additional support provided from this issue advertisers, Novus International and GlobalGap help keep us open access and dedicated to serving management, scholars, and policy makers worldwide.

Introduction

Managers and practitioners evolving in the food industry know that innovation is a key-issue for their company success (Rama 2008). Innovations keep consumers aware of product attributes, create market segmentation and quality-premium opportunities, and increase knowledge and capabilities within the organization (Traill and Meulenberg 2002; Omta and Folstar 2005; Pascucci et al. 2011). However only a minority of food companies dare to innovate, and if they do, prefer to combine in-house and outsourced projects, for example through collaboration with other companies or knowledge institutions and simultaneously buying technology on the market. Why? A reason frequently mentioned is that in the food industry, innovation processes are becoming more and more complex, maybe even more than other sectors (Rama 2008; Capitanio et al. 2010; Enzing et al. 2011). This is explained by the so-called uniqueness of food innovation processes: companies dealing with innovative projects are squeezed by technology-push and demand-pull forces simultaneously (Grunert et al. 1997; Rama 2008). On the one hand, an almost continuous technological development (i.e. in the ICT domain) compels food companies to continuously adopt new technologies, restructuring and updating their activities and related capabilities. On the other hand, retailers impose strict quality standards and requirements on food companies, with low returns and high risks. On top of that, raw materials (agricultural products) are becoming increasingly expensive, or complex to source worldwide. Therefore food companies' decisions on whether and how to innovate are gaining more and more importance over time.

Despite the recognized relevance of this topic, the literature on innovation sourcing strategy has not yet been very prolific in the food sector (Pascucci et al. 2011). One of the main persistent issue in food innovation is that new food products generally have a relatively low success rates (Stewart-Knox and Mitchell 2003; Enzing et al. 2011). Notwithstanding this phenomenon, it is still unclear why so many European food companies do not show significant efforts in innovative investments and R&D activities (Rama 2008).

However, if factors affecting the decisions of food companies to innovate and how to innovate could be better understood, more effective policy actions and managerial strategies could then be undertaken. In this paper, we propose a first step to address this issue, and to cover this gap.

Looking back at the literature on the organization and management of innovation processes, decisions to innovate "in-house", to "collaborate" or to "outsource" are considered as an important aspect of companies' strategies (Becheikh et al. 2006; Cassiman and Veugelers 2006). Previous studies investigating the decisions of manufacturing companies to make or buy innovations have been mainly supportive of both the transaction costs theory (Williamson 2000; 2002) and the property rights approach developed by Grossman, Hart and Moore (Grossman and Hart 1986; Hart and Moore 1990; Klein 2005). In these studies making or buying decisions are often seen as substitute rather than complement.

However, other works from different theoretical perspectives have brought new elements relevant to these analyses. These elements relate to strategic management (Ahuja and Katila 2001) knowledge, capabilities and resource-based elements, and the contextual environment (Becheikh et al. 2006; Noteboom 2004). They suggest more complementarity between making and buying decisions.

Although better known, the mechanisms leading to outsourcing versus realizing in-house innovative investments and\or R&D activities are still far from completely understood. For instance, the literature looking at the role of dynamic capabilities such as absorptive capacity and learning processes within company networks, suggests that a strict dichotomy of "making or buying" no longer holds (Zahra and George 2002; Nooteboom 2004). A company innovates in-house if it is able to develop internal competences, for example through R&D investments, but at the same time might well develop and maintain external ties for example with research organizations, while organizing and investing in collaborative networks. Therefore, instead of conceptualizing the "make or buy" decisions as opposite alternatives, scholars should better look at them as potentially complement. Moreover, "mixed" decisions can be undertaken such as investing in collaborative networks based on R&D and learning activities, which imply both making and buying. We can conceptualize this type of organizations as hybrid forms of innovation.

This paper is concerned with this specific issue. It analyses the determinants of the make, buy and collaborative (hybrid) decisions in the food industry using a database collected by Unicredit group in 2007 that relates to 389 companies operating in the Italian food industry (fruits, vegetables, vegetal oil, wine and dairy). Following a previous approach developed in Pascucci et al. (2011), we have organized the analysis in two steps: in the first one, we formulate hypotheses on the relationship between food companies and their innovation sourcing strategies. In the second step, we use a multi-variate probit model (MVP) to test the correlation between "making", "buying" and "collaborative" decisions, and we highlight the main driving factors of innovation sourcing strategies in the Italian food sector. Our results show that in-house, outsourcing and using hybrid forms of innovative collaboration are correlated and interlinked decisions, while a clear-cut behaviour between food companies that make and the ones that buy innovations cannot be draw based on our empirical evidence.

This paper proceeds as follows. In section 2, we introduce the concept of innovation as used in this paper and we elaborate on the theoretical elements used to develop our hypotheses. In section 3, we present our empirical analysis with a first glance at some descriptive statistics before introducing our empirical model. Section 4 shows the results while in section 5 we discuss and conclude with policy and managerial implications.

Theoretical Framework

Innovation in the Food Sector

Though similar to other manufacturing sectors, innovation processes in the food sector are conditioned by a relatively higher degree of uncertainty. This is due to the key role played by bio-based products. Bio-based products have a greater fluctuating quality than manufactured products, due to the perishable nature of agricultural products and the unpredictable weather conditions affecting the quantity and quality of products (Pascucci et al. 2011). Food companies have often to deal with very heterogeneous farmers/suppliers. These features of the food sector add to the existing uncertainty of the innovative activities (Pascucci et al. 2011). Moreover, new food products have generally a relatively low success rates (Grunert et al. 1997; Enzing et al. 2011). Finally, innovation outsourcing has a greater importance within the food industry, where R&D intensity could be a non-exhaustive indicator to catch the innovativeness (Galizzi and Venturini 2008).

The decision to outsource innovative activities or R&D has to take into account a number of peculiarities that lie in the distinctive nature of innovation compared to other goods or activities (Howells et al. 2008). Howells et al. (2008: 206) have made an exhaustive inventory of these peculiarities. First, the outcome of the outsourced innovation is highly uncertain and risky compared to other activities (Doctor et al. 2001). As mentioned by Veugelers and Cassiman (1999), given their uncertain returns and short life cycles, investments in risky sunk R&D expenditures have taken an overriding importance in the survival of companies. Second, the firm outsourcing cannot evaluate the quality of the knowledge that is transferred to them by the supplier (Howells et al. 2008). Third, the fact that the supplier of an innovation often does not know the quality of the knowledge it sells, because it does not know the future outcomes of its innovation, may lead to contractual incompleteness problem related to intellectual property exchange (Howells et al. 2008). Fourth, both partners, the firm and the customer, are involved in a co-joint production of new knowledge which may lead to intellectual property rights rent-sharing issues (Howells et al. 2008). Fifth, innovation outsourcing may lead to a whole set of moral hazard problems such as the use of the knowledge transferred to the supplier for other customers (Howells et al. 2008). Sixth, if outsourcing goes wrong, the future of the firm can be threatened given the importance of R&D and innovation as core competences and capabilities of companies (Howells et al. 2008). Seventh, outsourcing decisions have an irreversible effect on R&D or technical capacity of the firm (Howells et al. 2008). Eighth, the exchange of information during the outsourcing process is a unique event, which limits the capacity of companies to learn from experience (Howells et al. 2008). Ninth, tacit nature of the know-how exchanged when outsourcing makes it difficult to monitor contracts (Howells et al. 2008). These characteristics are not unique to innovation *per se*, other outsourced activities also show these features, but their combination surely is.

Determinants of the Make or Buy Decision

The make or buy decision applied to a company innovation sourcing strategy is receiving increasing attention in the literature. Outsourcing innovation allows companies to tap into advanced knowledge and technology, as well as to obtain a cost advantage (Ulset 1996; Gooroochurn and Hanley 2007). The downside of these advantages, especially when outsourcing innovation, is that control loss, maladaptation, technology leakages and hold-up[1] situations may incur costs. Many works looking at the make or buy issue have been performed in the last fifteen years in various industries: Ulset (1996) on Norwegian information technology industry; Veugelers and Cassiman (1999) on the Belgium manufacturing industry; Love and Roper (2001); Roper and Love (2002) on UK manufacturing plants; Love and Roper (2005); Howells et al. (2008) on UK pharmaceuticals; Gooroochurn and Hanley (2007) on UK companies. Although the transaction cost theory has proved to be quite successful in explaining the decision of companies to make in-house or to outsource activities, the relevance of this theoretical framework seems to be limited when it comes to explain innovation sourcing strategies.

A number of authors have argued that companies faced with the decision to innovate in-house or to outsource are more motivated by strategies (Gooroochurn and Hanley 2007; Howells et al. 2008) or resources (Conner and Prahalad 1996; Love and Roper 2005; Nooteboom 2004) rather

[1] A hold-up is a term used to describe a situation in which one of the partner to a transaction uses its bargaining power opportunistically to extract rents from another partner 's specific investments.

than transaction costs considerations. When investigating the determinants of the make or buy decision applied to innovation outsourcing, transaction costs but also competence/resource-based approaches and strategic reasons must be taken into account. Based on these considerations, we decided to rely on the three theoretical approaches aforementioned (transaction cost economics, strategic management and resource-based view). In this section, we review the literature on the make or buy innovation determinants drawn from these three perspectives and develop hypothesis to be tested.

Transaction Cost Economics

Transaction costs economics makes the assumption that efficient production requires specific investments that will enable companies to reduce production costs, innovate and meet customers' requirements. However, these specific investments create a bilateral dependency that may lead to hold-up hazards. As a matter of fact, because these specific investments have a lower value in alternative uses, partners to an exchange with such investments may act opportunistically to appropriate the quasi-rent created by them through post-contractual bargaining or threats of termination, creating transaction costs. In order to minimise transaction costs, contractual partners will either seek to develop safeguards such as stronger administrative control rights and more exclusive property rights, or to internalise the transaction, that is to make in-house. Transaction costs economics thus argues that companies incurring heavy sunk costs in R&D expenditures will want to protect these investments from opportunistic behaviour by innovating in-house (Gooroochurn and Hanley 2007). Thus, the following hypothesis is formulated.

Hypothesis 1. Companies having high investment costs in R&D will more likely undertake in-house innovation sourcing.

Another factor that can influence a firm to outsource innovation activities is related to the nature of the other contracting activities of the firm, such as network relations (Becheikh et al. 2006). These include the linkages between the food firm and other agents of the food chains (agriculture, distribution operators, etc.) and deal with the attitude to enter in formal and/or relational networks (consortia, production-based association, manufacturing joint-ventures, informal contracts, etc.). These linkages allow companies to share information and "know-how", reduce contractual uncertainty and have access to group resource (Teece 1996). According to transaction costs economics, companies involved in a network experience lower transaction costs. Since our database contains data on being part of a holding/group and participating in a consortium, we make the following hypothesis.

Hypothesis 2. Companies that are part of a holding/group or a consortium are more likely to outsource and/or use hybrids.

Strategic Management

As mentioned previously, outsourcing innovation is particular compared to other activity outsourcing since there is a potentiality for R&D findings to be disclosed by the research partner or subcontractor (Becheikh et al. 2006). Rents from investments in innovation might then be dissipated. In this section, we draw three hypotheses that take into account companies' strategic concerns when deciding to make or buy innovation.

One of the strategic factors cited in the literature that might influence the make or buy decision concerns the market structure. In order to protect their market positions, companies in concentrated markets will have an incentive to innovate in-house so as to reduce the risk of disclosure and to prevent or delay rivals' imitations (Love and Roper 2001; Smolny 2003). In a study on the Dutch manufacturing sector, Hertog and Thurik (1993, 283) mention "Internal R&D may give a firm a valuable lead time over its rivals in a concentrated market." Their empirical results show that a high level of market concentration in a sector is correlated with a relatively low incidence of R&D outsourcing. Given these evidences, we pose the following hypothesis.

Hypothesis 3. Companies evolving in high market concentration will be more inclined to make innovation in-house.

The role of company size, the capacity to allocate financial resources to internal R&D is another relevant factor considered in the literature (Beneito. 2003; Greve. 2003; Becheikh et al. 2006). In this sense, large companies with strong market power show higher investments in innovation activities than the small ones, for example due to larger cash flow generated by monopolistic power, and to a better access to capital market (Arundel and Kabla 1998; Acs and Audretsch 1998; Bougrain and Haudeville 2002; Beneito 2003). However, other authors deeply contested this point of view, according to the idea that small and medium companies (SMEs) are more adaptable to the market conditions, more open to "innovation joint-venture" and "contracting strategies" ("buying" innovation activities) (Omta 2002; 2004) and less constrained by the transaction costs of bureaucratic and managerial structures (Teece 1996; Teece at al. 1997; Becheikh et al. 2006). Moreover, SMEs show a higher internal flexibility (related to the organization of the production and to decision making processes), a better flow of internal communication, greater specialisation possibilities, as well as a higher informal and strategic control (Galende and de la Fuente 2003). Since the relationship between size and sourcing strategy is ambiguous, we derived this general hypothesis.

Hypothesis 4. Large companies are more likely to adopt an in-house innovation strategy.

Veugelers and Cassiman (1999) have noticed that process and generic product innovations are more likely to be outsourced than product and specialized innovations. Since product innovation is considered as a firm-specific input, leakage through outsourcing has more important strategic implications than for generic process innovations. The supplier firm cannot use leakage over generic R&D innovations opportunistically since most companies are contracting these innovations. Therefore, similar to Gooroochurn and Hanley (2007), we make the following hypothesis.

Hypothesis 5. Process innovation is more likely to be outsourced, or realized through hybrids than product innovation.

Resource-Based View

Approaches based on resources claim that we need to incorporate capabilities and competences in governance analysis since they have an impact on the efficiency of alternative governance structures (Teece 2007; 2009; Nooteboom 2004). There are two complementary competence explanations for innovation sourcing choice. One assumes opportunism as a basic characteristic of human behaviour. As innovation involves activities that are often difficult to measure, it provides options for opportunistic behaviour. The choice of a governance structure has thus to be made so as to reduce the risk of opportunism. The second perspective focuses on the problem of limited cognition. It is often impossible to transfer (tacit) knowledge to other persons. By bringing the different persons working on an innovation within the boundaries of the firm, knowledge sharing is facilitated. Mason and Wagner (1994) have stressed the importance of highly skilled employees for innovation but the effect of these capabilities on the make or buy strategy is far from being unanimous. Some scholars argue that high internal competences may be an incentive for companies to innovate in-house with available resources and thus benefit from scale of operation (Veugelers and Cassiman 1999; Romijn and Albaladejo 2002). Others mention that in-house and external activities are complementary, in the sense that in-house capabilities allow companies to absorb external knowledge effectively (Cohen and Levinthal 1990; Cohen 1995). Aurora and Gambardella (1994) have argued that internal knowledge resources support using foreign know-how more effectively in the firm, which would stimulate external innovation sourcing. Since the effect of internal capabilities on innovation sourcing decision is not unanimous in the literature, we pose the following hypothesis using the percentage of employees dedicated to R&D activities as a proxy for internal resources in innovation.

Hypothesis 6. Companies with a high percentage of employees dedicated to R&D activities are more likely to innovate in-house.

The level of human quality also influences the innovation sourcing strategy of companies (Becheikh et al. 2006). The way the firm acts in order to facilitate the cumulative learning can be assessed by the rate of economic and financial resources dedicated and oriented to the professional formation and its organisation inside the firm (Romijn and Albaladejo 2002).

Hypothesis 7. Companies with a higher concentration of skilled workers are more likely to innovate in-house and/or using hybrids.

Control Variables

Contracting activities can be analysed in an indirect way, looking at the results of their influence on the firm strategies on the markets, such as internationalisation and export-orientation (Romijn and Albaladejo 2002), the degree of specialization (Hitt and Hoskisson 1988; Beneito 2003; Galende and de la Fuente 2003). The empirical literature shows a positive relationship between export orientation and innovations (Kumar and Saqib 1996; Roper and Love 2002; Beneito 2003; Galende and de la Fuente 2003), while the way product-diversification or specialisation affect firm innovation is not clearly recognized and remain still controversial (Chen 1996; Beneito 2003; Galende and de la Fuente 2003). Since export activities might have an important effect on the decision to innovate, we use it as a control variable in our model.

The age of the firm and type of ownership (for example being a cooperative or an investor-owned firm) can be used as another possible measure of its organisational complexity, potentially representing the experience and the knowledge accumulated throughout its history and the "learning" process of the firm (Galende and de la Fuente 2003; Pascucci et al. 2011). Some articles showed the higher inclination to innovate by "old" companies (Kuemmerle 1998; Freel 2003), while some other considered "young" enterprises as more active in the direction of innovation (Molero and Buesa 1996). In this sense, the age remains a controversial factor of innovation.

Other factors which might be relevant for sourcing decisions refer to the level of modernization of the company, for example, considering ICT investments, and ownership structure (i.e. being a cooperative or an investor-owned company) (Becheikh et al. 2006). Moreover, sourcing decisions are influenced by the context in which the firm operates. In other words, the geographical location and local networking of food companies are key factors behind different attitudes to innovativeness (Omta et al. 2001; Nielsen 2008). The specific location of a firm is important to understand the opportunities to use local social capital and the institutional environment as a source of knowledge and innovativeness (Becheikh et al. 2006; Capitanio et al. 2009; 2010).

Testing the Hypotheses for "Making-Buying" Decisions

Data and Descriptive Analysis

The database used in this paper comes from the 10th survey on Italian manufacturing companies carried out by Unicredit Group in 2007. It includes a sample of 389 food companies with information related to the period 2004-2006. Data include financial and economic characteristics, organization, investments, internationalization and innovation processes. The dataset distinguishes between internal, external sourcing and use of networks of collaboration and joint ventures for carrying out innovation activities. The set allows us to define the three dependent variables of our analysis as follow:

(1) "*in-house innovation*" refers to the presence of R&D activities carried out within the company, due to the presence of a specific department or division. We also take into account the presence of training activities for the employees of the company with the specific purpose of increasing the firm innovation capacities.
(2) "*out-sourcing innovation*" is whenever the company indicates that it acquired technologies, industrial equipment, machineries, patents and/or know-how from other companies with the specific purpose of introducing new processes and/or products
(3) *"hybrids"* relates to R&D activities carried out together with external entities through networks of collaboration, strategic alliances or joint ventures, for example with knowledge institutes, universities and research centres, or other companies.

One quarter of the sampled companies indicated being involved in innovative projects, 20% mentioned using both in-house and outsourcing, and 5% indicated realizing only in-house or only outsourcing innovations (Table 1).

Table 1. In-house, outsourcing and hybrid forms of innovation in the Italian food companies

		Hybrids	Outsourcing (buy)		Total
			No	Yes	
In-house	No	No	265	15	280
		Yes	0	2	2
	Yes	No	21	31	52
		Yes	8	47	55
Total			294	95	389

Source. Author's elaboration on Unicredit 2007

To empirically test our theoretical hypotheses, we use a set of variables presented in Table 2.

Table 2. Explanatory Variables and Descriptive Statistics.

Theoretical Background	Hypothesis	Variable		Statistics	
				Mean	S.D.
Transaction Cost Economics	H1	Total amount of R&D expenses 2004-2006 (000 euro) (a)	rd_tot	98.24	197.89
	H2	Being part of a holding/group (a)	holding	0.19	0.46
		Participating in a consortium (a)	consort	0.07	0.25
Strategic Management	H3	Index of market concentration (% Turn-over first 4 companies in the same sector of specialization) (b)	c4	34.00	24.40
	H4	Size (number of employees) (a)	tot_employ	54.17	92.30
	H5	Presence of product innovation (a)	in_prod	0.43	0.50
		Presence of process innovation (a)	in_proc	0.19	0.39
Resource-Based View	H6	Percentage of employees dedicated to R&D activities (a)	per_empl_rd	5.53	17.35
	H7	Number of skilled workers (a)	skilled_work	29.77	69.67
Control		Age of the firm (year) (a)	age	31.47	25.86
		Amount of investment in ICT (2006) (000 euro) (a)	inv_ict	0.54	0.58
		Being a cooperative (a)	coop	0.09	0.29
		Presence of export activities (a)	export	0.63	0.61
		Capacity of capital accumulation in the region of location (index) (c)	cap_stock	21.72	2.27
		Innovation capacity in the region of location (index) (c)	in_capac	1.10	0.34
		Percentage of public R&D expenses in the region of location (c)	pub_r_d	0.52	0.22
		Percentage of private R&D expenses in the region of location (c)	priv_r_d	0.54	0.31

Source. Author's elaboration on a. Unicredit, 2007; b. ISMEA, 2009; c. ISTAT, 2010

The Empirical Model

A widely used approach to estimate the probabilities of choosing between alternative strategies is to implement a discrete-choice model (Masten and Saussier 2002). In this case, the observed innovation strategy (i.e. in-house, outsourcing or hybrid form) is considered as an expression of a continuous latent variable reflecting the propensity to choose a specific option among different alternatives. The generic empirical model related to the company *j* to choose an innovation strategy *s* can be written as follow:

$$(1) \qquad Y_{sj}^{*} = X_{j}^{'}\beta_s + \varepsilon_{sj} \qquad \forall s \in S$$

$$(2) \qquad \begin{array}{ll} Y_{sj} = 1 & \textit{if} \quad Y_{sj}^{*} > 0 \\ Y_{sj} = 0 & \textit{otherwise} \end{array} \qquad \forall s \in S$$

where Y_{sj}^{*} is the unobservable value of the strategy *s* for company *j* (latent variable), Y_{sj} is the observable strategy choice, for s = 1 in case of in-house strategy, s = 2 in case of outsourcing and s=3 in case of hybrid form strategy. $X_{j}^{'}$ is the vector of explanatory variables for company *j*, β_s a vector of coefficients for strategy *s* and ε_{sj} a vector of unobservable characteristics related to company *j* and strategy *s* (Masten and Saussier 2002). We can derive the probability that strategy *s* is chosen by company *j* (γ_{sj}) as a function of the potential explanatory variables (Masten and Saussier, 2002):

$$(3) \qquad \gamma_{sj} = P(Y_{sj} = 1) = P(Y_{sj}^{*} > 0) = P(X_{j}^{'}\beta_s + \varepsilon_{sj} > 0) = P(\varepsilon_{sj} > -X_{j}^{'}\beta_s) = F(X_{j}^{'}\beta_s)$$

where *F* denotes the distribution function of the unobservable characteristics ε_{sj}. Different econometric strategies can be implemented accordingly to the nature of the strategic choice analysed and the distributional form assumed for *F* (Verbeek, 2008). In this case, the decision setting is about (1) innovating in-house (*making*), (2) outsourcing (*buying*) and (3) using a hybrid form. This would lead to a system of (three) equations. The implicit assumption is that the probability of making is independent from the probability of buying. But there is a high probability that the company likelihood to operate in-house is conditional to the decision whether or not to outsource, and/or use a hybrid form. In other words, these decisions are likely to be interrelated. The usual alternative would be to estimate a multivariate probit model (see also Pascucci et al. 2011). For each choice (in-house, outsourcing and hybrid form), a probit model is estimated and it is assumed that the error terms for the two equations are correlated.

As presented in Pascucci and colleagues (2011), the multivariate probit model is suitable to define company decisions to choose more than one strategies simultaneously (Greene 2008). Since the outcomes are treated as binary variables any combination of strategies is possible. The strategies can be complements rather than substitutes only. The three equations model (one for s = 1, one for s = 2, and the other for s = 3) is featured by correlated disturbances, which (due to identi-

fication reasons) are assumed to follow a normal distribution (variance is normalized to unity). That is for each j^{th} company:

$$(4) \quad \begin{aligned} &E[\varepsilon_{1j}] = E[\varepsilon_{2j}] = E[\varepsilon_{3j}] = 0 \\ &\text{cov}[\varepsilon_{1j}, \varepsilon_{2j}, \varepsilon_{3j}] = \rho = \{\rho_{123}\} \\ &\text{var}[\varepsilon_{1j}] = \text{var}[\varepsilon_{2j}] = \text{var}[\varepsilon_{3j}] = 1 \end{aligned}$$

where ρ is a vector of correlation parameters denoting the extent to which the error terms co-vary. Should this be the case, we would need to estimate the two equations jointly, following a bivariate normal distribution: $\{\varepsilon_1, \varepsilon_2, \varepsilon_3\} = \phi_3(0,0,0,1,1,1,\rho)$. Because in this model we are interested in simultaneous strategic decisions we have to define the joint probability. For example, the probability of firm j of choosing making and buying strategies at the same time $(Y_{1j} = Y_{2j} = Y_{3j} = 1)$ would be:

$$(5) \quad \begin{aligned} \gamma_{sj} &= P(Y_{1j} = 1, Y_{2j} = 1, Y_{3j} = 1) = \int_{-\infty}^{\varepsilon_{1j}} \int_{-\infty}^{\varepsilon_{2j}} \int_{-\infty}^{\varepsilon_{3j}} \phi_3(X'_{1j}\beta_1, X'_{2j}\beta_2, X'_{3j}\beta_3, \rho) d\varepsilon_{1j} d\varepsilon_{2j} d\varepsilon_{3j} \\ &= \Phi_3(X_{1j}'\beta_1, X_{2j}'\beta_2, \beta_3 X'_{3j}) \end{aligned}$$

In this model the log-likelihood is then a sum across the four possible strategies variables (that is, four possible combinations of innovate $(Y_{1j} = Y_{2j} = Y_{3j} = 1)$ and non-innovate $(Y_{1j} = Y_{2j} = Y_{3j} = 0)$ times their associated probabilities (Greene, 2003). These probabilities may be drawn from (5) as well. The most relevant coefficients estimated in the model are $\beta_1, \beta_2, \beta_3$ and $\rho(\rho_{123})$. The latter, if significantly different from zero, will evaluate to which extent each pair of decisions are interrelated.

Results

The multivariate probit model results indicate whether the theoretical hypotheses are verified by empirical evidence (Table 3, see Appendix). The correlation between in-house, out-sourcing and hybrid forms has been confirmed by the results. They indicate that the likelihood that a company will jointly consider using in-house, out-sourcing and hybrid forms simultaneously as sourcing strategies is positive and relatively high. This result is indeed intriguing from a theoretical perspective where often making-buying decisions are seen as alternative rather than complementary strategies (see also results from Pascucci et al. 2011). Of course, results refer to joint decisions on innovation strategies, which involve different types of innovative projects with different features. Therefore, it would be necessary to analyse in more detail the type of innovative projects implemented in-house versus out-sourced.

In hypothesis 1 *"companies having high investments costs in R&D will favour in-house innovation sourcing*". Results indicate a positive effect of R&D investments not only on in-house strategy, but also on outsourcing and hybrid forms. Therefore, according to these results, the nature of R&D investments should not be seen as leading to an increase of asset specificity of the com-

pany but, more in line with assumption of the dynamic capabilities literature, as a flexible form of assets. The companies can make use of the improved R&D capabilities (i.e. due to the financial resources allocate for their implementation) also to better look at how to outsource innovation or set up a collaborative joint venture with an external research centre.

In the hypothesis 2, we indicated "*companies that are part of a holding/group or a consortium are more likely to outsource and/or use hybrids"*. The variables used to test this hypothesis were both not significantly correlated to our dependent variables. Therefore *H2* doesn't hold according to our empirical results. Results indicate that in the food industry participation in networks, partnerships or alliances targeted to financial activities (holding) or quality and market-participation control (consortium) do not necessarily lead to the sharing of innovative projects with those partners. An explanation for these results is linked to the degree of complexity of food innovation processes, which requires targeted partners to be implemented in a collaborative form or to allow effective outsourcing.

In hypothesis 3, we indicated "*companies evolving in high market concentration will be more inclined to make innovation in-house*". This is substantially rejected by our results, which indicate a strong negative effect on the likelihood of the firm to implement in-house projects. At the same time, results do not indicate any impacts on both outsourcing and hybrid form strategies. Therefore, it seems that concentration is discouraging companies to undertake investments in internal R&D activities in the food industry.

The variable on the size of the company could not be verified either. Therefore, hypothesis 4, which states "*the size of the firm has a positive effect on in-house innovation strategy*", doesn't apply to food companies. Our results indicate that SMEs and large corporations do not differ in terms of likelihood of innovate in-house, outsource or use hybrid forms.

In hypothesis 5, we indicated that "*process innovation is more likely to be outsourced or realized through hybrids than product*". Our results partially confirm this hypothesis. While we can highlight that more process related innovations are more likely to be outsourced, it also applies to product innovations. Moreover, it seems that in-house and hybrid form strategies are used in both product and process innovation, therefore indicating that a clear-cut relationship doesn't exist.

Hypothesis 6 states that "*companies with a high percentage of employees dedicated to R&D activities are more likely to innovate in-house"*. Results indicate (*per_empl_rd*) that this hypothesis partially holds and that food companies with higher application of human capital in R&D activities are less likely to implement outsourcing innovative projects. However, a direct positive effect on in-house strategies has not been found.

Finally, looking at hypothesis 7, "*companies with a higher concentration of skilled workers are more likely to innovate in-house and/or using hybrids"*, our results don't confirm this statement while indicating a negative correlation between the concentration of skilled employees and in-house innovation decisions.

In our analysis, we also used a set of control variables, in order to better explain making and buying decisions of food companies. First, we considered the age of the company. Results indicate

that more experienced food companies showed a higher likelihood to innovate through outsourcing activities. Our interpretation is that while older food companies have more accumulated knowledge and tacit internal know-how, they are also potentially suffering from routines and internal procedures which might reduce their likelihood to innovate internally or through collaborative networking. However, longer experience in the operating sector and cumulative knowledge create capabilities to use outsourcing strategies that younger food companies might not have.

Another result found that companies that invested in information and communication technology (ICT) are more likely to both make and out-source innovation. Investments in ICT are basically linked to hardware and software technology, which is used in processing food products, manage in-bound and out-bound activities, and communicating with other chain partners. ICT technology is developed outside the food sector and intensively patenting. Therefore, food companies develop networks of collaboration where ICT-companies are less strategically involved. In contrast, ICT technology is more likely to be acquired from the market and internally adapted to company-specific problems.

Our results show that being an exporter-oriented company is positively affecting in-house strategies. Adaptation to foreign costumers' requirements and preferences is the main issue for food exporting companies. This requires a highly targeted innovative process, which may lead to internalize R&D activities more than making use of collaboration or buying technologies on the market.

Among the control variables we used to test the role of location and local interactions, only the index of the capacity of capital accumulation in the region of location has showed a significant correlation. Food companies located in area with higher intensity of investments are less likely to make innovation in-house but this situation does not necessary lead to more outsourcing strategies. It means that food companies do not fully benefit from a better environment for implementing innovative strategies. It also indicates that internal factors seem to be more relevant than external ones.

Discussion and Conclusions

Starting from empirical findings in Pascucci and colleagues (2011), and in line with previous researches on innovation in the food sector, this paper investigates the strategies used by food companies to innovate. Namely it analyses whether using in-house, out-sourcing or hybrid forms of innovation strategies are interrelated, and which driving factors can explain them. We identify a set of research hypotheses and use the empirical data to test them. However, empirical results highlight that only some of the theoretical statements can be confirmed.

The main finding of this paper is the idea that companies do innovate using interrelated strategies. In-house activities, out-sourcing, and usage of collaborative networks and\or joint ventures are part of a more general innovative attitude (capability) of food companies. However, identifying specific factors affecting those decisions remain puzzling, as already highlighted in previous papers dealing with the same topic (see for example Pascucci et al. 2011). The general picture that emerges from this analysis is that the behaviour of food companies in terms of internaliza-

tion and externalization of innovation is less differentiated than theories could predict. Another important aspect is that the control variables related to the external environment in which the company operates were less significant than expected. In the first case, we can highlight the relevance of a synergistic relationship between internalization, pure and mixed outsourcing strategies. In the second case, it could be argued that the context is less relevant than expected *a priori*.

The set of results indicates that it is complex to conceive and implement strategic actions and policies to stimulate and foster innovation processes in the Italian agro-food sector. In any case, our results indicate the need to establish a theoretical analysis more grounded on empirical findings. In particular, the results indicate the need to further test the validity of some theoretical elements such as the ability of companies to learn from other partners (absorptive capacity) and their ability to adapt to different socio-economic and institutional contexts (adaptive capacity).

Food managers and practitioners are aware that, although innovation is a key-element for successful businesses, it might also be extremely uncertain and complex to organize, especially in the food sector. This leads to the conclusion that food managers might have a risk-averse attitude, and therefore opting for "black or grey" as opposite to "black or white" options. Many food companies cannot cope with the high stakes imposed by innovative behaviour. They prefer "black" options, therefore staying out of innovative strategies and acting as laggards, or late followers. When they go for an innovative strategy, they have the tendency to combine in-house and external activities (grey options), no matter if they are large corporations or SMEs, cooperatives or investor-owned companies, belonging to a holding or a consortium of companies.

The results indicate that a clearer understanding of this decision-making process can be achieved either through the analysis of the specific innovative projects, therefore moving from a company to a project level, or from an active engagement of managers in experiments and longitudinal studies. On the one hand, project-level research can reveal whether in-house decisions are linked to more risky projects, or to incremental rather than radical innovations. Moreover, it can indicate whether collaborations are linked to open or closed innovation processes and whether they imply complementarities or similarities among partners. On the other hand, experimental settings and longitudinal studies can allow researchers to test for risk-aversion behaviour. We believe this is a solid ground for building further research on this topic.

References

Acs, Z.J. and D.B. Audretsch. 1998. Innovation in large and small companies: an empirical analysis. *American Economic Review* 78(4):678-690.

Ahuja, G. and R. Katila. 2001. Technological acquisitions and the innovation performance of acquiring companies: a longitudinal study. *Strategic Management Journal* 22(3):197–220.

Arundel, W.J. and I. Kabla. 1998. What percentage of innovations are patented? Empirical estimates for European companies. *Research Policy* 27:127-141.

Aurora, A. and A. Gambardella. 1994. Evaluating technological information and utilizing it: scientific knowledge, technological capability and external linkages in biotechnology. *Journal of Economic Behavior and Organisation* 24: 91-114.

Becheikh, N., R. Landry and N. Amara. 2006. Lessons from innovation empirical studies in the manufacturing sector: A systematic review of the literature from 1993–2003. *Technovation* 26:644–664.

Beneito, P. 2003. Choosing among alternative technological strategies: an empirical analysis of formal sources of innovation. *Research Policy* 32:693–713.

Bougrain, F. and B. Haudeville. 2002. Innovation, collaboration and SMEs internal research capacities. *Research Policy* 31:735-747.

Capitanio, F., A. Coppola and S. Pascucci. 2009. Indications for drivers of innovation in the food sector. *British Food Journal* 111(8):820-838.

Capitanio, F., A. Coppola and S. Pascucci. 2010. Product and process innovation in the Italian food industry. *Agribusiness: an International Journal* 26:503-518.

Cassiman, B. and R. Veugelers. 2006. In Search of Complementarity in Innovation Strategy: Internal R&D and External Knowledge Acquisition. *Management Science* 52 (1):68-82.

Chen, R. 1996. Technological expansion: the interaction between diversification strategy and organisational capability. *Journal of Management Strategy* 33:649-666.

Cohen, W. 1995. Empirical studies of innovative activity. In *Handbook of the Economics of Innovation and Technological Change*, edited by P. Stoneman, 182-264. Oxford: Blackwell.

Cohen, W. and D.A. Levinthal. 1989. Innovation and learning: the two faces of R&D. *The Economic Journal* 99 (9):569-596.

Conner, K.R. and C.K. Prahalad. 1996. A Resource-based Theory of the Firm: Knowledge versus Opportunism. *Organization Science* 7(5):477-501.

Enzing, C.M., S. Pascucci, F.H.A Janszen, and S.W.F. Omta. 2011. Role of open innovation in the new product short and long-term market success: evidence from the Dutch food and beverages industry. *Journal of Chain and Network Science* 11(3):235-250.

Freel M.S. 2003. Sectoral patterns of small firm innovation, networking and proximity. *Research Policy* 32:751-770.

Freel M.S. and R.T. Harrison. 2006. Innovation and cooperation in the small firm sector: evidence from "Northern Britain". *Regional Studies* 40(4):289-305.

Galende, J. and J.M de la Fuente. 2003. Internal factors determining a companies' innovative behaviour. *Research Policy* 32:715-736.

Galizzi G. and L. Venturini, 2008. Nature and Determinants of Product Innovation in a Competitive Environment of Changing Vertical Relationships. In *Handbook of Innovation in the Food and Drink Industry,* edited by R. Rama, 51-80. New York and London: The Haworth Press.

Gooroochurn, N. and A. Hanley. 2007. A tale of two literature: Transaction costs and property rights in innovation outsourcing. *Research Policy* 36:1483-1495.

Greene, W.H. 2008. *Econometric analysis*. Upper Saddle River: Prentice-Hall.

Grossman, S. and O. Hart. 1986. The Costs and Benefits of Ownership: A Theory of Vertical and Lateral Integration. *Journal of Political Economy* 94:691-719.

Grunert, K., H. Hermsen, M. Meulenberg, E. Kuiper, T. Ottowitz, F. Declerck, B. Traill, and G. Göransson. 1997. A framework for analysing innovation in the food sector. In *Product and Process Innovation in the Food Industry*, edited by B. Traill, and K. Grunert,1-37. London: Blackie Academic and Professional.

Hart, O. and J. Moore. 1990. Property Rights and the Nature of the Firm. *Journal of Political Economy* 98(4):1119-1158.

Hertog, R.G.J den and A.R. Thurik. 1993. Determinants of Internal and External R&D: Some Dutch Evidence. *De Economist* 141:279-289.

Hitt, M. and R. Hoskisson. 1991. Strategic competitiveness. In *Advanced in Applied Business Strategy*, edited by L.W. Foster, 1-36. Greenwich: JAI Press.

Howells, J., D. Gagliardi and K. Malik. 2008. The Growth and Management of R&D Outsourcing: Evidence from UK Pharmaceuticals. *R&D Management* 38(2):205-219.

Kuemmerle, W. 1998. Optimal scale for research and development in foreign environments: an investigation into size and performance of research and development laboratories abroad. *Research Policy* 27:111-126.

Kumar, N., and M. Saqib. 1996. Firm size, opportunities for adaptation and in-house R&D activity in developing countries: the case of Indian manufacturing. *Research Policy* 25:713-722.

Ismea. 2009. *Indicatori del sitema agroalimentare italiano (Indicators for the Italian agri-food system)*. Rome, Italy.

Istat. 2010. *Indicatori di contesto chiave e variabili di rottura (Key-contextual indicators and breakdown variables)*. Rome, Italy.

Love, H.J. and S. Roper. 2001. Outsourcing in the innovation process. Locational and strategic determinants. *Regional Science* 80(3):317-336.

Love, H.J. and S. Roper. 2005. Economists' perceptions versus managers' decisions: an experiment in transaction-cost analysis. *Cambridge Journal of Economics* 29:19-36.

Mason, G. and K. Wagner. 1994. Innovation and the Skill Mix: Chemicals and Engineering in Britain and Germany. *National Institute Economic Review* 148(1):61–72.

Masten, S.E. and S. Saussier. 2002. Econometric of contracts: An assessment of developments in the empirical literature on contracting. In *The economics of contracts: Theories and applications*, edited by E. Brousseau and. J.M. Glachant , 273–292. Cambridge: Cambridge University Press.

Molero, J. and M. Buesa. 1996. Patterns of technological change among Spanish innovative companies: the case of Madrid region. *Research Policy* 25:647-663.

Nooteboom, B. 2004. Governance and competence: how can they be combined?. *Cambridge Journal of Economics* 28(4):505-525.

Omta, O., J. Trienekens and G. Beers. 2001. The knowledge domain of chain and network science. *Journal on Chain and Network Science* 1(2):77-85.

Omta, O. 2002. Innovation in chains and networks. *Journal on Chain and Network Science* 2(2):3-80.

Omta, O. 2004. Increasing the innovative potential in chains and networks. *Journal on Chain and Network Science* 4(2):75-81.

Omta, O. and P. Folstar. 2005. Integration of innovation in the corporate strategy of agri-food companies. In *Innovation in agri-food systems. Product quality and consumer acceptance*, edited by W.M.F Jongen and M. Meulenberg, 221-230. Wageningen: Wageningen Academic Publishers.

Pascucci, S., A. Royer and J. Bijman. 2011. Should I Make or Should I Buy? Innovation Strategies and Governance Structures in the Italian Food Sector. *International Journal on Food System Dynamics* 2(2):167-180.

Rama R. (ed.). 2008. *Handbook of innovation in the food and drink industry,* 428. New York and London: The Haworth Press.

Romijn, H. and M. Albaladejo. 2002. Determinants of innovation capability in small electronics and software companies in southeast England. *Research Policy* 31:1053–1067.

Roper, S. and J.H. Love. 2002. Innovation and export performance: evidence from the UK and German manufacturing plants. *Research Policy* 31(7):1087-1102.

Smolny, W. 2003. Determinants of innovation behaviour and investment estimates for West-German manufacturing companies. *Economics of Innovation and New Technology* 12 (5):449–463.

Stewart-Knox, B and P. Mitchell. 2003. What separates the winners from the losers in new food product development?. *Trends in Food Science and Technology* 14 (1-2): 58-64.

Teece, D.J. 1996. Firm organization, industrial structure, and technological innovation. *Journal of Economic Behavior and Organization* 31:193-224.

Teece, D.J., G. Pisano and A. Shuen. 1997. Dynamic capabilities and strategic management. *Strategic Management Journal* 18:509-533.

Teece, D. J. 2007. Explicating dynamic capabilities: the nature and microfoundations of (sustainable) enterprise performance. *Strategic Management Journal* 28:1319–1350.

Teece, D.J. 2009. Dynamic Capabilities and Strategic Management: Organizing for Innovation and Growth. Oxford: Oxford University Press:.

Traill, B. and M. Meulenberg. 2002. Innovation in the Food Industry. *Agribusiness: an International Journal* 18(1):1-21.

Ulset, S. 1996. R&D outsourcing and contractual governance: An empirical study of commercial R&D projects. *Journal of Economic Behavior and Organisation* 30: 63-82.

Unicredit. 2007. *Decima indagine sulle imprese manifatturiere* (10th Survey on manifacturing companies). Rome, Italy.

Verbeek, M. 2008. *A Guide to Modern Econometrics*, 488. Chichester: John Wiley & Sons.

Veugelers, R. and B. Cassiman. 1999. Make and Buy in innovation strategies: evidence from Belgian manufacturing companies. *Research Policy* 28:63-80.

Williamson, O.E. 2000. The New Institutional Economics: Taking Stock, Looking Ahead. *Journal of Economic Literature* 38 (September):595-613.

Williamson, O.E. 2002. The Theory of the Firm as Governance Structure: From Choice to Contract. *Journal of Economic Perspective* 16 (3):171-195.

Zahra, S.A. and G. George. 2002. Absorptive Capacity: A Review, Reconceptualization, and Extension. *Academy of Management Review* 27(2):185-203.

Appendix

Table 3. Results of the multivariate probit model (MVP)

Theoretical Background	Hypothesis	Variable		In-House	Out-Sourcing	Hybrids
Transaction Cost Economics	H1	Total amount of R&D expenses 2004-2006	rd_tot	0.0041***	0.0040***	0.0037***
				(0.0006)	(0.0006)	(0.0005)
	H2	Being part of a holding	holding	-0.0485	0.114	0.4609
				(0.2410)	(0.2494)	(0.3130)
		Participating in a consortium	consort	-0.1314	-0.0655	0.1675
				(0.3923)	(0.4148)	(0.4497)
Strategic Management	H3	Index of market concentration±	c4	-0.0087**	0.0007	-0.0064
				(0.0044)	(0.0040)	(0.0051)
	H4	Size (number of employees)	tot_employ	-0.002	-0.0031	0.0021
				(0.0044)	(0.0052)	(0.0044)
	H5	Presence of product innovation	in_prod	0.7289***	0.4730*	0.5748**
				(0.2042)	(0.2012	(0.2573)
		Presence of process innovation	in_proc	0.4646*	0.8048***	0.6059**
				(0.2476)	(0.2422)	(0.2787)
Resource Base- view	H6	% of employees dedicated to R&D activities	per_empl_rd	-0.0056	-0.0163**	-0.0058
				(0.0056)	(0.0067)	(0.0079)
	H7	Number of skilled workers	skilledwork	-0.0117*	-0.0112	-0.0101
				(0.0066)	(0.0072)	(0.0076)
Control		Age of the company	age	-0.0006	0.0082**	0.0053
				(0.0040)	(0.0033)	(0.0044)
		Amount of investment in ICT (2006)	inv_ict	0.0036***	0.0019*	-0.0002
				(0.0009)	(0.0011)	(0.0011)
		Cooperative	coop	-0.0886	-0.5428	-0.4849
				(0.3743)	(0.4200)	(0.4785)
		Presence of export activities	export	0.2709*	0.0437	0.3001
				(0.1541)	(0.1672)	(0.1881)
		Capacity of capital accumulation in the region of location	cap_stock	-0.1573***	-0.0346	-0.1696**
				(0.0597)	(0.0545)	(0.0840)
		Innovation capacity in the region of location	in_capac	-2.6928	-0.4669	-4.0125
				(2.0688)	(2.0462)	(2.8471)
		% of public R&D investment in the region of location	pub_r_d	1.9568	0.5637	3.2669
				(1.9711)	(1.9425)	(2.6643)
		% of private R&D investment in the region of location	priv_r_d	2.5461	0.51682	3.0088
				(2.2036)	(2.1771)	(2.9022)

Table 3. *Continued*

Constant	cons	2.4085 (1.500)	-1.1897 (1.4130)	2.1778 (2.1131)
Correlation between in-house and out-sourcing	r12	0.8135*** (0.0785)		
Correlation between in-house and hybrids	r13	0.8070*** (0.0813)		
Correlation between out-sourcing and hybrids	r23	0.6717*** (0.0945)		
McFadden R2 = 0.4743	Number of obs. = 347			
Wald chi2(42) = 128.28	Log likelihood = -233.11711	Prob > chi2 = 0.0000		
Likelihood ratio test = 0: chi2(1) = 83.4562	Prob > chi2 = 0.0000			

Note. ±% turn over first 4 companies in the same sector of specialization

*** significant at 1%; ** significant at 5%; * significant at 10% level

International Food and Agribusiness Management Review
Volume 15, Issue 3, 2012

Creating Sustainable Businesses by Reducing Food Waste: A Value Chain Framework for Eliminating Inefficiencies

Gerry Kouwenhoven[Φ][a],Vijayender Reddy Nalla[b] and Ton Lossonczy von Losoncz[c]

[a] *Researcher, Project Manager, Inholland University of Applied Sciences, Unit Agriculture, Rotterdamseweg 141, Delft, Zuid Holland,2628AL, The Netherlands*

[b]*Managing Director, RVJ Eurasia Food and Agro B.V., Titus Brandsmastraat 39, Breukelen, Utrecht, 3621KA, The Netherlands*

[c] *Lecturer, Inholland University of Applied Sciences, Unit Agriculture, Rotterdamseweg 141, Delft, Zuid Holland, 2628AL, The Netherlands*

Abstract

This study proposes a systematic value chain approach to helping businesses identify and eliminate inefficiencies. The authors have developed a robust framework, which food-sector entrepreneurs can use to increase profitability of an existing business or to create new profitable opportunities. The value chain approach provides win-win opportunities for players within the value chain. To test the robustness of the framework, the authors use food waste as an example of a critical inefficiency and apply it to two different food sector business cases, each operating in diverse conditions. Because the suggested framework addresses the core elements and parameters for the existence and competitiveness of a business, the model can be adapted to other sectors.

Keywords: profitability with sustainability, value chain interventions, market intelligence, innovative entrepreneurship, food waste

[Φ]Corresponding author: Tel: +31.(0)6 21841110
Email: gerry.kouwenhoven@inholland.nl
V.R. Nalla: vijayender@rvjservices.nl
T. Lossonczy von Losoncz: ton.lossonczy@inholland.nl

+The IFAMR is a non-profit publication. The additional support provided from this issue advertisers, Novus International and GlobalGap help keep us open access and dedicated to serving management, scholars, and policy makers worldwide.

Introduction

Food waste management is one of the most relevant and critical issues today due to the loss in economic value, its influence on the environment and its impact on food security. Many studies have demonstrated that the largest percentage of the waste takes place in different links of the food value chain. Some studies estimate the total wastage percentages to be around 40% in the agro-food sector (Waarts 2010). In the Netherlands, the value of the total food wastage is estimated to be around € 4.4 billion a year of which € 2.4 billion worth of food (10% of all purchased food) is thrown away by the end-consumers and € 2 billion worth of food gets wasted along the different links of the food chain (Waarts 2010). The wastage numbers provided above are quite alarming and have unintended repercussions on costs, environment, carbon footprint, energy, water, and other ethical aspects such as animal wellbeing and food security. Because of these concerns, consumers and government expect the food business entrepreneurs to continuously endeavor to reduce the inefficiencies which lead to wastage in food value. However, in addition to consumer and regulatory pressure, sustainable profit opportunity should motivate the entrepreneur to take initiatives to prevent and minimize food waste. The motivation for this study is to provide the entrepreneur with a value chain framework to better enable him to identify and exploit profitable business opportunities in eliminating inefficiencies such as food waste.

The study intends to address the following main research question:

Can a value chain approach help an entrepreneur recognize and develop profitable business opportunities in the reduction of food waste (or other related inefficiencies)?

The following sub questions are set forth to answer this main research question

1. Which value chain parameters/levers are responsible for food waste (or other related inefficiencies)?
2. What are the critical stages for unlocking the profitable potential hidden within food waste (or other related inefficiencies)?
3. What would a robust framework "which is applicable for a variety of businesses operating within the food value chains at different stages of the life-cycle" look like?
4. To what extent is a value chain framework relevant and applicable to other industrial sectors?

To achieve the objectives mentioned above:

1. We analyzed the literature to identify the critical parameters that influence efficiency within value chains. This detailed investigation of the literature helped us identify the pain areas or bottlenecks for value chains.

2. Based on the understanding obtained from step 1, we have suggested a two stage solution approach (the framework) to overcome value chain bottlenecks.

3. Finally, we have tested the robustness of our framework (approach) with two different real-life business cases within the food sector, operating at two different extremes of the value chain life cycle spectrum.

The main contribution of this study is the development of a framework that an entrepreneur can use as an effective tool to increase profitability of an existing business or to create new profitable business opportunities. The suggested framework identifies different parameters which act as critical bottlenecks in the effective performance of the value chains. It divides these parameters into two different categories. The Category-1 challenges are relevant for businesses operating in value chains which are in the early stages of their life cycle. The Category-1 challenges are "Lack of organized financing sources for key value adding stake-holders", "Fragmented supply base", "Centralized processing", "Logistics and other key infrastructural challenges", "Misaligned incentives" and "Quality monitoring and control". Category-2 challenges are "Product and Demand characteristics." A two-staged approach addressing different category challenges is suggested. The Category-2 challenges are relevant for business in both developed and developing countries. However, before businesses address the Category-2 challenges, they must first address the Category-1 challenges.

To test the relevance of the suggested framework in practice, we have applied the framework to two different food sector business cases each operating under different conditions. The first case study is about a dairy value chain in India where all the Category-1 challenges presented within the framework are experienced. The second case is about the vegetable value chain in the Netherlands and how an innovative entrepreneur has created a profitable and sustainable business by addressing Category-2 challenges and creating the right value chain intervention.

Literature Analysis and Motivation

There is a vast body of literature focusing on how social and environmental investments impact financial performance (Dowell et al. 2000; Griffin and Mahon 1997; Roman et al. 1999). However, understanding the contribution of various investments in sustainability initiatives to improved shareholder value, and identifying which projects provide the greatest net benefits to both the company and society, is certainly a major challenge for managers formulating a sustainability strategy (King and Lenox 2002; Martin 2002; McWilliams and Siegel 2001; Prahalad 2010). In order to properly evaluate the impact of investments in sustainability, Epstein and Roy (2003) have proposed a framework to assist managers in making the 'business case' for sustainability initiatives. Other literature studies in the context of global value chains are Gereffi (1999),Gereffi et al. 2005; Kaplinsky 2000; Kaplinsky and Morris 2002; Sturgeon 2001; Gibbon 2001; and, Gibbon and Bair 2008. The focus of all these studies is on governance and upgrading opportunities in developing country value chains. Russo and Fouts (1997), drawing on the resource-based view of the firm, have demonstrated that environmental performance and economic performance are positively linked. Russo (2002) also concluded that for any natural resource-based industry to prosper, the natural, social, and economic influences should converge. The objectives of both the above studies are in line with triple P objectives proposed within this paper.

The most insightful conclusion of Parmigiani et al. (2011), although supply chain oriented, is that firms must leverage their existing technical and relational capabilities within their supply

chains toward social and environmental issues. To develop the most critical capabilities, firms need to consider stakeholder exposure to particular social and environmental issues across their supply chain, which includes control (the degree to which they cause or influence actions in the supply chain) and accountability (the degree to which they must justify their actions). In some ways our study takes a similar standpoint with the difference being that it focuses on the critical and practical operational challenges facing value chains.

Rappaport (2006) proposes 10 very insightful and effective ways for ensuring that executives make decisions without sacrificing the longer-term interests of the shareholders. Our study complements Rappaport (2006) by bringing a value chain perspective which is an additional dimension for sustaining and improving the competitiveness of the business. More importantly, the current study provides a possibility for executives to look beyond their company boundaries for opportunities.

The most recent work by Trienekens (2011) is very insightful since it takes a very holistic approach and suggests a three-component framework for value chain analysis in developing countries. Though our study resembles the work of Trienekens (2011), (we also use the value chain approach and a validation of the framework with a case study), Trienekens's work differs from our study in several ways. Firstly, the components identified within the study of Trienekens (2011) are macro-level value chain factors, whereas the focal point of our study is the entrepreneur within the value chain and how he can drive efficiency and effectiveness within it. Secondly, the framework suggested within this study provides starting points for entrepreneurs operating in value chains which are at different stages of development, whereas Trienekens (2011) specifically addresses the constraints within developing country value chains. Finally, the scope and relevance for our framework may be extended and applied to other non-food sectors to facilitate the elimination of inefficiencies and the reduction of product and service value.

Of significant relevance is the KIT (2010) work which covers a diverse range of case studies in the food and agribusiness sector from a wide range of emerging economies. The basic theme of the study was how providing financing can strengthen the links among all the value chain players and promote a progressive and efficient value chain. The KIT (2010) study shows how channeling funds to a previously underfinanced value chain player empowers him to participate in value chain governance. Traders, processors, retailers are made to build strong relationships with the other value chain partners to achieve value chain efficiency and robustness and this helps ensure the repayment of the loans. This approach has resulted in efficiency enhancement and waste reduction in all the 13 different case studies presented.

The study by Nalla (2008) emphasizes the relevance of incentive alignment for achieving coordination within the chain and for eliminating all the inefficiencies within it. Within this study clear analytical contractual mechanisms have been proposed to eliminate the double marginalization effects which are most prevalent in value chains across different industry sectors. Someren and Nijhof (2010) discuss nine different Dutch case studies of innovative business in the food and agribusiness from the Triple P business development point of view. The study suggests that this approach leads to improved business performance with respect to social (people), ecological (planet) and financial (profit) values. These cases and the Triple P framework discussed within the book have provided insights necessary for the development of the framework within this paper.

The opportunity recognition literature addresses the critical issue of how entrepreneurs identify opportunities for new business ventures. Baron (2006) suggests that entrepreneurs use cognitive frameworks they possess to "connect the dots" between changes in technology, demographics, markets, government policies, and other factors. For experienced entrepreneurs the approach and framework developed within the current study could serve as a support tool for the cognitive framework they have built through experience. For beginning entrepreneurs our study could facilitate the process of building such frameworks in a process driven manner. Guber et al. (2008) suggest that entrepreneurs play a fundamental role in bringing new technologies to market. One of the major claims of our study is that technology is one of the critical interventions for eliminating inefficiencies and for adding value to the products. Hence, our study provides a framework which can improve the process of opportunity recognition for entrepreneurs.

In the next section, we provide a detailed explanation of the proposed framework and the model.

Framework and Model

The detailed analysis and understanding of the literature presented in the previous section enabled us to build the framework described in Figure 1. On the left-hand side of the proposed framework, we discuss the different parameters which form the critical bottlenecks in the performance of value chains. The parameters are divided into two different categories, 1 and 2. On the right-hand side, a two-stage solution approach will facilitate inefficiency elimination in the value chains. A detailed explanation of the parameters in each category and the reasoning behind the two staged approach follows.

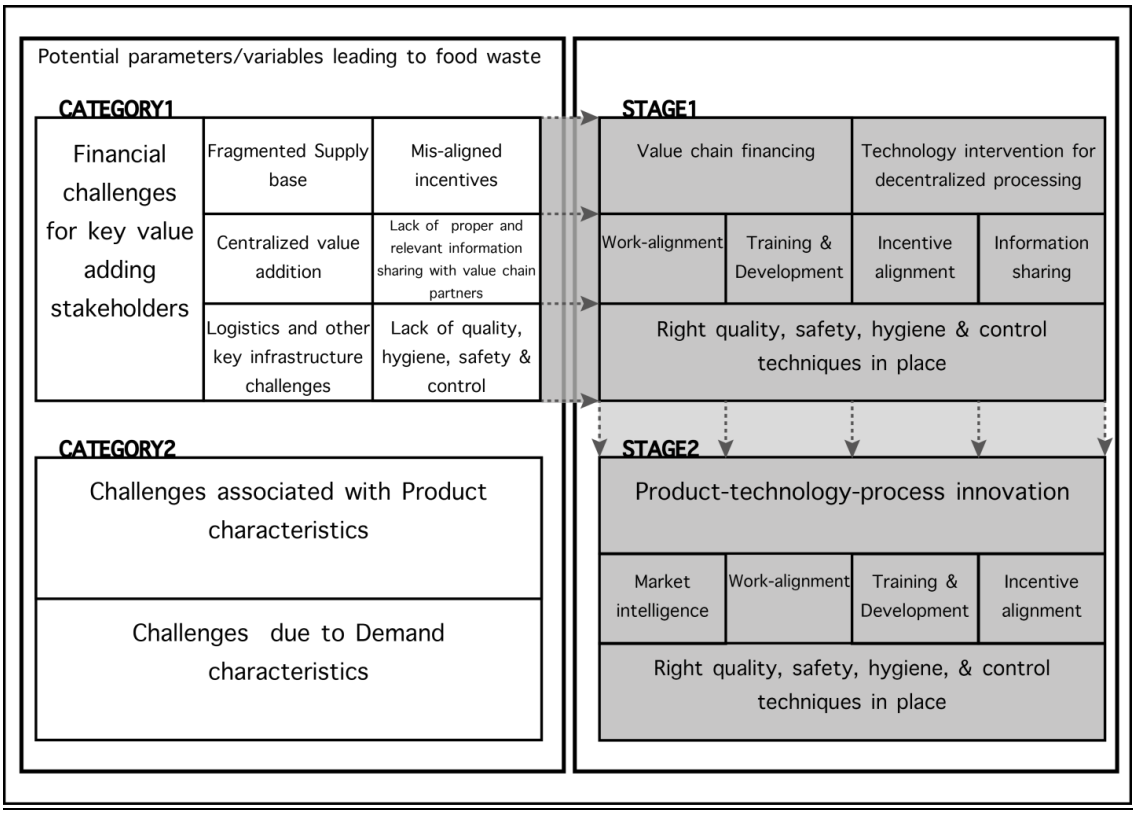

Figure 1. Value Chain Framework

Category-1 Challenges

The Category-1 challenges are relevant for businesses operating in value chains in the early stages of their life cycle. Most food value chains in emerging countries are in this stage

For early stage value chains, lack of access to financial resources for the key stakeholders form the critical bottleneck. This leads to several inefficiencies.

Lack of financial resources for key value adding stake holders is a critical impediment for the smooth functioning of the value chains (KIT 2010). Key value added stakeholders refers to farmers/producers and the collectors/primary processors. This critical constraint leads to several constraints and challenges:.

I. *Fragmented supply base:* Due to the lack of available professional financial sources/resources, an individual farmer is not able to build production volumes and grow his production capacity by increasing his core resources (land holding, number of animals, innovative and high value-added processing capacities, etc.).

II. *Centralized processing:* Most of the available technologies for higher value added processing require higher production volumes and higher upfront capital investments. The low production farmer cannot provide the high raw material capacities and cannot finance the necessary investment from his current production. This fragmented supply base in combination with the high-volume technologies mandates value addition processing be centralized and carried out away from the production/supply base. This centralized processing model facilitates the entry of several echelons of middlemen, most of whom add insignificant value but a lot of overhead costs to the chain.

III. *Logistics and other key infrastructural challenges:* The lack of financial resources creates logistics and infrastructure challenges related to preservation and transport of the raw material, and this can lead to a high level of wastage along the entire value chain.

IV. *Misaligned incentives:* The lack of financial resources, the fragmented supply base and inefficient numbers of echelons within the value chain provides fewer to no negotiation opportunities for the upstream players. This imbalance in negotiation power leads to misaligned incentives.

V. *Lack of proper and relevant information sharing with the value chain partners:* The lack of financial resources, the fragmented supply base, inefficient numbers of echelons with-in the value chain and misaligned incentives creates scope for information asymmetry. In value chains which experience Category-1 challenges, the transactions are mostly carried out at arm-length. The only information that is generally shared is that of price and volumes. This kind of information sharing makes the value chains reactive rather than proactive and hence the value addition possibilities, quality standards and other critical aspects are rarely thought about, discussed and improved upon.

VI. *Quality monitoring and control:* The lack of proper logistics and transportation infrastructure leads to poor quality, less hygiene and a less safe product.

In Figure 1, the Category-1 challenges are presented in three columns (read from left to right). This indicates that the challenge in column-1 (i.e., the lack of access to professional finance) leads to the challenges in column-2, which in turn lead to the challenges in column 3.

Category-2 challenges/inefficiencies are caused by product and demand characteristics. The details related to these challenges are presented below.

Category-2 Challenges

Product characteristics: food products such as milk, fresh produce, meat and marine products have a short shelf life and hence certain inefficiencies related to wastages are inherent within the product characteristics.

Demand characteristics: In addition to the challenges associated with the product characteristics, dynamic and changing consumer behavior leads to further inefficiencies and wastage. Fast changing consumption patterns lead to higher demand uncertainty for existing value chain products in favor of fresh or innovatively processed products.

All businesses within the food and agribusiness sector face both Category-1 and Category-2 challenges at some stage in their value chain life cycle. Mature businesses operating within established value chains, such are common in developed countries, have largely overcome the Category-1 challenges. Within our framework we have suggested a two-stage approach for addressing the challenges within both categories. The details related to each stage are described below.

Two-Stage Solution Approach

Stage-1, proposes a value chain restructuring approach with an objective to fine tune the parameters which are internal to the value chain. Within this stage, value chain financing mechanisms and right technology interventions would be the key drivers of the value chain restructuring. Within this model, financing is not necessarily directed at individual businesses, but is provided only within the context of a value-chain (KIT 2010). As an example, a producer could get financing only after he has signed contracts with a buyer organization or a network of buyers, thereby strengthening the overall value chain and demonstrating his place within it.

Once the value chain finance mechanisms and the right technology interventions are arranged, *work-alignment* becomes critical. The players within the value chain have to carry out different or additional activities than they did before the restructuring. For work realignment to be successful, the incentives for all the players need to be fair and well aligned. The critical guideline for proper *incentive alignment* is that win-win opportunities must be created for all the players within the value chain. Fair incentive distribution requires the *right information sharing tools* be identified and embedded within the value chain. Li et al. (2006) address the level and the quality of information sharing dimensions and relate the importance of these elements to firms competitive advantage. Williamson (2010) and Coase (1937) and several other industrial organization studies support the importance of player risk sharing, information sharing, incentive and work alignment suggested within this paper.

Finally restructuring alone will not sustain value chain change and evolution if the players within the chain are not trained to perform their activities efficiently and effectively. Hence *training and capacity building* are the final critical elements to realize and sustain the benefits of restructuring.

When business in a value chain has overcome Stage-1 challenges, the next evolutionary path is Stage-2. Stage-2 is about innovation in product-process technology. More importantly, its focus almost always is to work out new products and new solutions for the benefits of people-planet-profit (3P) elements of the business (Someren and Nijhof 2010). Market intelligence is identified as the critical element within this process and is appropriately embedded into an efficient value chain. Here the focus is on continuously bringing new and innovative products and creating new and untested markets. The other elements of work alignment, incentive alignment, information sharing and training are as critical as in Stage-1. However, businesses facing Category-2 challenges are facing a different level and type of technology interventions when compared to Category-1 businesses. In most cases, businesses with Category-2 challenges most likely have sources of finance in place. Because Category-2 challenges have to do with product and demand characteristics, businesses continuously experience these challenges and have to adapt to consumer behavior and market signals on a continuous basis.

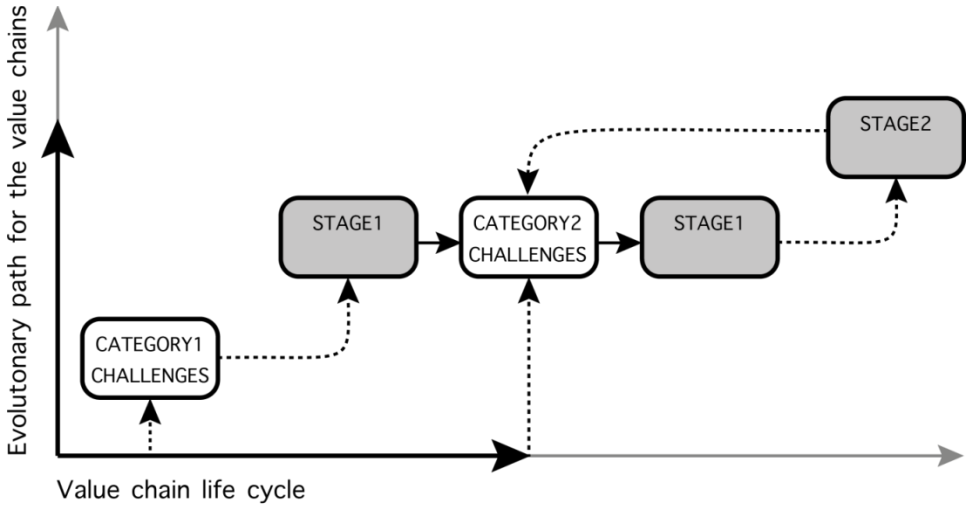

Figure 2. Evolutionary Path for Value Chains

Figure 2 presents the evolutionary path for the value chains and complements the Figure 1 framework. Category-1 challenges are at the lower left end of the value chain life cycle and must be overcome to achieve Stage-1 level of development. Once the value chain realizes Stage-1 improvement, Category-2 challenges come into play. Business in developed countries have to go through Stage-1 first before Stage-2 challenges.

The two case studies discussed in the next section provide greater clarity with regard to the framework developed within this paper. The first case study is about the dairy value chain in India where all the Category-1 challenges presented within the framework are experienced. The

second case is examines the vegetable value chain in the Netherlands and how one company has created a sustainable and profitable business by addressing the Category-2 challenges.

Case Study 1: Dairy Value Chain in India

The dairy value chain in India begins with numerous low volume farmers. The average herd size in India is two-three dairy cows compared to 70 to 80 in a developed country such as The Netherlands. Indian milk is gathered and processed in a four-tier structure as depicted in Figure 3:

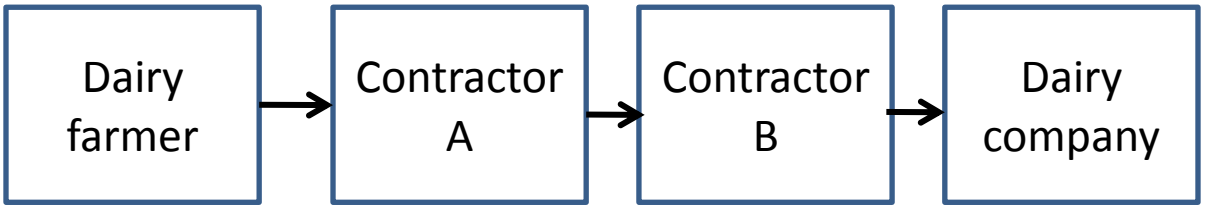

Figure 3. Dairy value chain in India

In a typical private dairy value chain, the farmers bring the milk in buckets or steel vessels to a local collection centre (Contractor A) located in the center of the village. Around 30 – 50 farmers come to these collection centers to sell their milk twice a day. On average, around 500-600 liters of milk are collected and stored in 40-liter cans before being transported in vans arriving from Contractor B. Contractor B represents the pasteurizing center that collects and pasteurizes milk from the various farm collection centers. Daily collected/pasteurized volumes are around 10,000 liters. The pasteurized milk is sold to brand name dairy companies located in the city. The dairy companies receive an average quantity of 40,000 liters of pasteurized milk per day (LPD) from the pasteurizing centers and does further processing and marketing of the milk and milk products.

The highly fragmented, multi-tier chain described above results from ~~a~~ lack of organized financing sources for key value adding stake-holders. The individual farmer is unable to make any value-adding investments (ie increasing herd size and raw milk supply, processing, storage & transportation infrastructure improvement) because he lacks credit worthiness. Hence, the production and collection links within this value chain cannot evolve beyond the high wastages and inefficiencies which characterize such a highly fragmented structure. All the major problems listed in our framework and described below in further detail are caused by the lack of financial help at the level of the farmers and contractors.

I. *Fragmented supply base:* The raw milk is produced by numerous small scale subsistence dairy farmers. The real value-added processing occurs at the dairy company where the higher volumes concentrate (40,000 litres/day).

II. *Centralized processing:* Large scale dairy processing and packaging technologies are designed for volumes ranging from 40,000 liters/day to 1.0 million liters/day. This limits the higher level value addition to big dairy companies capable of making higher investments and marketing greater volume of products.

III. *Logistics and other key infrastructural challenges:* There are a number of infrastructure related bottlenecks. There is a lack of availability of BMCs (Bulk Milk Chillers) and milking machines as well as knowhow of dairy farm management. Investments at the farmer/collector level are not undertaken partly due to the long gestation period /uncertainty regarding returns and the lack of credit worthiness. Hence, the value chain structure does not evolve to address the inefficiencies/wastage within the value chain.

IV. *Misaligned incentives:* Within the value chain structure, the middlemen (contractor A and contractor B) takes up a dominant position by making use of constraints such as farmer fragmentation, the low supply volume of each individual farmer, their geographic distance from the market, and the farmers' day-to-day requirements to make a livelihood.

V. *Lack of proper and relevant information sharing with the value chain partners:* The dairy farmers, easily replaced and at least two tiers removed from the value addition point in the chain, lack information on how their raw milk is used and what end prices can be had for the value added products. In this way they do not gain a good understanding of the market and of any improvement possibilities. At the other end, it is very difficult for the fourth tier dairy company to trace or control the quality of the raw milk or guarantee supply.

VI. *Quality monitoring and control:* Milk is a highly perishable product known to be vulnerable to fast growing micro-organisms. Thus it is important that quality control be carried out at all stages in the milk production chain. Quality control not only refers to micro logical safety but is also related to the nutritional quality of the raw milk and the products made from it. Quality depends on all the value chain players working in coordination and utilizing proper storage and transportation infrastructure to deliver a safe and nutritious product to the end-consumers. The Indian dairy value chain lacks both infrastructure and coordination resulting in uncertain supply and quality.

Solution Approach in Context of the Value Chain Framework

It is clear from this analysis that the challenges within the Indian value chain are not limited to any one individual business but result from constraints imposed by the value chain structure. The traditional business model traps the players, from the farmer producing the raw milk, to the collection and transportation middlemen, into roles that add little product value at each stage of production, and leaves each of them at subsistence production levels that prevent them from taking a progressive and evolutionary course in their dairy farming. What is needed is a way for each of the players in the chain to add value and boost their incomes and participation at their level of production and thereby raise the value of the entire chain.

An innovative and modular technology which can decentralize the transformation of raw milk into high value end products is available to do this. The technology is designed to collect, store and cool the raw milk until enough is available for pasteurization. After pasteurization / homo-genization it can pack the milk into sachets. Furthermore, the technology offers extra options to make yoghurt/curd with cup filling machines and can also perform cheese production. Adoption of this technology moves value added dairy processing down the value chain as it can processes capacities ranging from 5000LPH (liters per hour) (120,000 liter/24hr day) to 10000LPH. This

value chain intervention can occur at the level of contractor B because of the match with the volumes(10,000 liters/day) available at his level. The new technology makes contractor B or even A finance worthy within a value chain finance model [KIT (2010)]. However, the benefits are not limited to contractor B but provide incentives for the entire value chain to improve efficiency, effectiveness and transparency.

The modular processing technology facilitates higher levels of value addition for smaller quantities and more importantly as per market requirements. This ability to process smaller quantities pushes the value addition further upstream. This increases shelf-life, reduces wastage, improves overall quality and increases the price realization for the upstream players. More importantly, such intervention reduces the need for high margin, low value adding middlemen who trade on the perishability of raw milk. For any downstream player to exist within the chain he has to add significant value, not simply high margin/high wastage collection and transportation services, The proposed intervention reduces the number of transactions and brings higher efficiencies into the value chain and this further increases the price that can be got from the end-consumer. The above argument is in line with the industrial organizations literature (Williamson (2010) and Coase (1937). Below, we explain other critical elements to be addressed in Stage-1.

Information Sharing

With the proposed intervention, information sharing along the entire value chain becomes more symmetric. Inventory level information and overall market demand for refined milk products now concern contractor B. Contractor B will have to provide contractor A with his procurement plans. Based on these inputs contractor A in turn makes his procurement plan and communicates it to the farm base. The farm base plans its deliveries accordingly. Contractor B is now making refined dairy products, not simply collecting and pasteurizing. Concern for the quality and supply volume of the raw milk is now shifted down the chain, and the entire process of milk production must be documented, made traceable and all product safety information (timing of milking, storage conditions, bacterial count at each step made publically available.

Work Alignment

The shift in the location of production means that all the players must change the way they do things. Contractor B communicates his procurement plans to the farmers (directly or optionally via A) and ensures milk-quality and traceability which means that he is taking initiatives to match the supply with demand and facilitate higher quality standards. Contractor A will produce higher value-added products and supply them to the established dairy companies. No longer having a monopoly on producing refined dairy products, the dairy companies will focus on their core strength which is marketing and distribution, strengthening their brand and increasing the sales volume. Significant gains in overall production volumes can be expected due to reduction in product loss due to spoilage. The increase in demand due to the new emphasis on marketing means incentive for the farmers to produce more milk. This new work structure will create a greater incentive for the value chain players to adapt and evolve.

Incentive Alignment

As each player is carrying out more activities and adding higher value, the value chain as a whole realizes higher value and a higher profit is created. For example, if the above modular machine is purchased by contractor A (or for that matter any entrepreneur) to make a local product called curd (which is more simple variant of Yoghurt) total higher value can be created for the same 10,000 liters of milk which can be distributed along the entire value chain. Already in the Indian context there is a price realization that varies from 60-100% for the farmers operating within different value chains. The difference in price is the final consumption form of the base product. In cases where lower prices are attained the milk is offered in its most basic form and value added products such as curd, local cheese types, butter, clarified butter and other products obtain the higher price.

Training and Development

To realize the above possibilities the right training and capacity development should take place at each link of the value chain. NGO and developmental organizations can begin initiatives to offer training and extension services which helps the farm level players increase their income levels. Several value chains are being supported by local NGO organizations for training and capacity building.

Even with the best processing capabilities and the best value chain infrastructure there is a limitation to the shelf life for a product such as milk. Furthermore, Indian consumers preferences are changing dynamically as they are starting to seek for new and innovative products for consumption. Hence, once the dairy value chain solves the challenges within the first category the next evolutionary stage would be to enhance value by addressing the product and demand characteristics. In the next subsection we present a Stage-1 solution which addresses the concerns related to the Category-1 challenges which are the critical addressable bottlenecks for the Indian dairy value chain.

Case Study 2: Vegetable Value Chain in the Netherlands

The turnover of vegetables constitutes over 30% of the entire horticulture industry in the Netherlands. The total area of vegetables under glass is about 5.041ha (in 2010), which is about 48% of the total area under glasshouses. From these 5.041 ha 33% consists of tomatoes, 31.9% sweet peppers, 17% cucumbers and the rest consists of other vegetables (e.g., eggplants, radishes) (Productschap Tuinbouw 2010). According to the statistical data from 2010, world exports in vegetables total € 9.3 billion, of which one-third were trans shipments via the Netherlands and 10% of all vegetables traded in the world market were grown in the Netherlands. Traditionally, Dutch vegetable supply chains consist of growers, auctions, wholesalers, and retailers. The auctions are a common marketplace where growers and wholesalers and/or retailers meet and the auction clock determines the price of the goods. The simple value chain in its operational form is depicted in Figure 4.

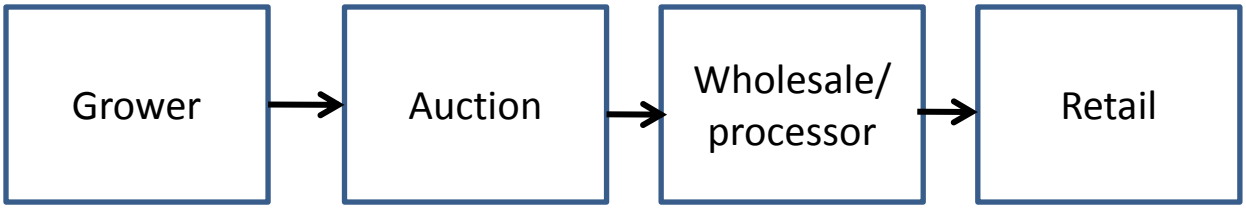

Figure 4. The Vegetable Value Chain in the Netherlands

In a drive to improve efficiency the Dutch vegetables value chain has reduced the number of auctions from 28 in 1990 to six in 2001. The largest ones are Greenery, Zon, and Fruitmasters. In 1996 most Dutch horticultural auctions merged into the Greenery (except for Zon) (Bijman 2002). The aim of the newly established auction was to convert the traditional auction, which only offered products to potential buyers, into a market organization selling products through long-term relationships and arranged weekly prices and delivery according to the requirements of the client. Many large leading growers did not join the Greenery, but formed growers' associations to market their tomatoes, sweet peppers, cucumbers and eggplants under their own brand names. These groups were the first offering flexible, last minute and year-round delivery, high quality standards, certifications, and 'tracking and tracing'. Another group of growers made delivery arrangements with different big exporters/wholesalers on a yearly basis (e.g. Holland crop with Bakker Barendrecht BV). Some of these exporters also formed growers' associations to take advantage of EU subsidies for marketing activities (Bijman 2002). In developing their marketing strategy, growers' associations sell: 1) through the auction or contract negotiation, 2) under producer or retailer brand, 3) to a specific wholesaler or retailer, 4) individual products or packages of products (Boonekamp 2002). The emergence of growers' associations is a response to the increasing differentiation of demand and supply in agri-food markets (Hendrikse and Bijman 2001). Growers in associations are considered more flexible in terms of making specific products for different outlets.

The financial markets in the Netherlands are well developed and quite accessible to all the key value-adding stakeholders within the value chain. A strong and feasible business case is, of course, a necessary condition to get to the finance, but the means or channels to achieve finance for demonstrated business cases are well established.

I. *Fragmented supply base:* The supply chain is not fragmented into unmanageable levels and because of the presence of the auction system and market connectivity the grower is in a good position to sell his produce through transparent and efficient channels.

II. *Centralized processing:* The processing and value addition as desired by the customer base occurs at each link of the value chain ensuring better price realizations for all the value chain players.

III. *Logistics and other key infrastructural challenges:* During the transformation phase for efficiency improvement, the logistics system for handling vegetables has also improved its effectiveness and is considered to be one of the most efficient systems in the world.

IV. *Misaligned incentives:* Transparent market information provided by a well-structured public auction system, gives symmetric negotiating strength to each value chain player.

V. *Quality monitoring and control:* Stringent quality standards are created and maintained by all the players within the value chain.

It is clear from this analysis that the vegetable supply chain in the Netherlands has very effective systems in place and has evolved beyond Category-1 challenges. However, about 2.5% of the 1.6 billion kilograms of greenhouse vegetables produced in a year are rejected by the market. Produce may be rejected because it is aesthetically unappealing or is not packaged or processed to meet the growing demand for freshly cut, packed products. Currently the majority of this 40 million kg left-over flow is turned into compost, resulting in a substantial loss which affects the entire value chain. The value chain needs to overcome Category-2 challenges concerning product and demand characteristics in an innovative manner to eliminate/reduce this inefficiency.

Solution Approach in Context of Proposed Framework

An innovative European company has managed to create a profitable business by converting the horticulture waste into fresh vegetable juices and natural food colors. It has developed various patented technologies (in cooperation with a number of partners) to enable reprocessing of class 3 greenhouse vegetables into consumer products. Since the technology is mobile it can easily be transported to fresh-cut industry production sites and greenhouses. The left-over generated at these sites is converted into fresh juices and natural colorants which are subsequently bottled and processed by other companies and made into consumer products. The demand for these products is growing by 10% each year. In essence, the company has facilitated new links within the produce value chain in a way that benefits all the value chain players. This initiative has generated substantial positive returns for all the players in the horticulture value chain (including the end consumers) making this one of the most successful examples of sustainable and socially responsible entrepreneurial initiative. Repurposing previously leftover produce results in enormous cost savings in the transportation of residual products and compost. Estimates have shown that a total distance of 750,000 kilometers is traveled to transport compost every year. Collecting and recycling left-over flows on site at the production/sales facility results in an enormous reduction of transportation costs and CO2 emissions, reduces the impact on the environment, and increases the yield of the horticultural food chain.

The above initiative has facilitated the restructuring of the value chain (See Figure 5). It demonstrates that a new value chain has emerged out of the waste flow. This new value chain has made it possible to bring high value products in the form of natural and healthy juices into the market. The new link increases the overall value generated within the value chain because it facilitates only the best grade products get to auction and enables an alternative for unsold products to be redirected into the new chain.

Because this value chain is newly created, it faces many of the Stage-1 challenges previously discussed. Financing must be procured by all the participatory and value adding stakeholders. Also, new logistical systems and market connections needs to be worked out. i.e., the Stage-1 elements become the critical starting points for the newly developed value chain to function.

Once the stage one elements are in place the most critical Stage-2 elements need to be worked out. For the Stage-2 developments, the right mix of product-process-technology becomes critical. The new technology for making new product has created the possibility of a new value chain. This new product technology combination will need to evolve new links within the older value chain. The elements described below describe how this is created and sustained in the context of the value chain framework.

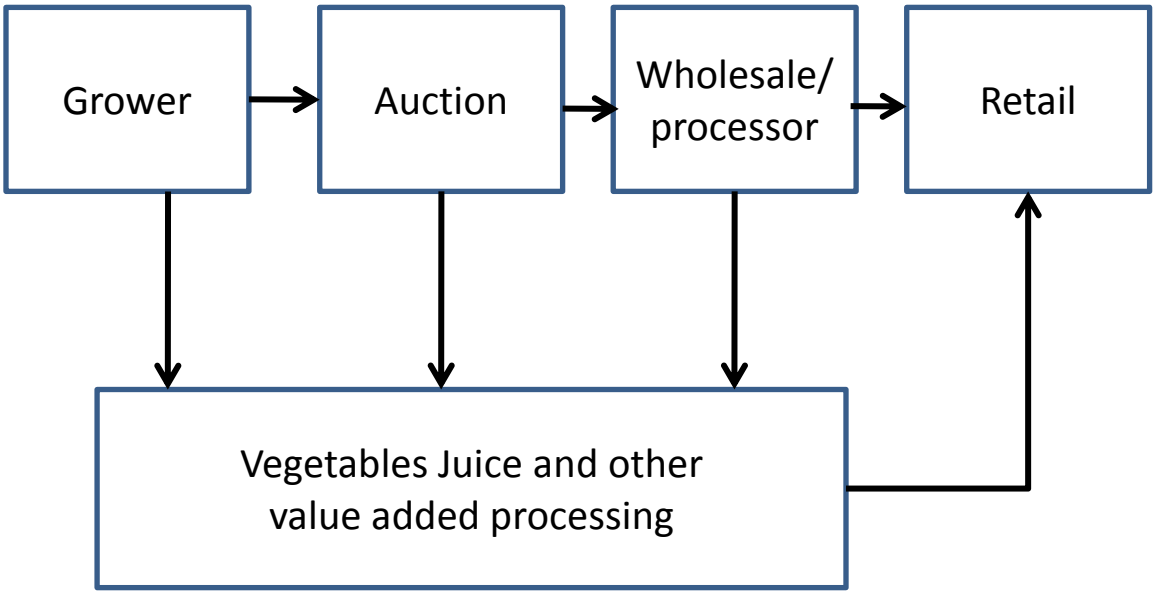

Figure 5. Reengineered vegetable value chain in the Netherlands

Market Intelligence

Because the products are new and innovative, market intelligence and understanding of the consumer is very critical for success. This market intelligence needs to be embedded into the innovation process for launching new products or fine-tuning existing ones.

Insformation Sharing

Information sharing has to be more robust because of the creation of the new links within the value chain. For example, communication needs to be very clear concerning the quantities of produce that can be sourced from growers/wholesalers to the juice bottling companies and subsequently to the retailer for purposes of production, marketing and distribution. These new specifications will also affect the available quantities and grades negotiated between the auction houses and the growers.

Work Alignment

The grower will now treat the product previously considered waste as a product variant and should handle it according to the needs and requirements of the bottling company. The right preservation standards and quality control standards need to be developed and maintained.

Similarly, if the auction houses or wholesalers anticipate selling the left over good quality produce through this newly created channel they should also have the required processes in place. Hence, it is clear that the work needs to be aligned based on the requirements and transactions carried out within this newly created value chain.

Incentive Alignment

The success and sustainability of the new value chain depends on smooth and symmetric information flow and also on the proper alignment of incentives. The grower gets higher revenue as he is able to sell his previous waste at a premium. The auction houses have less wastage as they can choose to take only the top grade products from the grower which they can also sell at a premium All of this reduces costs due to wastages or losses and increases useful inventory. The bottler and new retail channels are selling a premium product made out of a very ordinary, low value product and this leads to better price realization for all players in the channel.

Training and Development

New technologies and their created value chains require new skills. In this case the European company in collaboration with various universities has initiated training and capacity building programs for the players within the value chain.

Conclusions

The proposed framework within this study presents the entrepreneur with a potent tool to analyze the value chain and bring in the most appropriate and profitable interventions. Our main objective is to show how a value chain approach can aid an entrepreneur to recognize and capitalize on the revealed opportunities. Secondarily, by contributing to overall efficiency and reducing wastage, we hope to contribute to a more sustainable economic future, particularly in the generalized case of food value chains.

Although this framework was applied only to the food sector, we believe it to be valid and relevant to other industrial sectors.

This study has limitations regarding the quantification of the results that can be obtained using the suggested value chain framework. Analytical tools to improve quantification would be very valuable and could be a topic for future research. In addition, detailed further development of the framework parameters and interventions as well as its direct application to other industrial sectors suggest other interesting research opportunities.

References

Baron, R. A. 2006. Opportunity Recognition as Pattern Recognition: How Entrepreneurs 'Connect the Dots' to Identify New Business Opportunities. *Academy of Management Perspectives* February: 104-119.

Bijman, J. 2002. Essays on Agricultural cooperatives and governance structures in fruit and vegetable chains. PhD Thesis, Erasmus University, Rotterdam.

Coase, R.H .1937. The Nature of the Firm. *Economica* 4(16): 386-405.

Dowell, G., S. Hart and B. Yeung .2000. Do Corporate Global Environmental Standards Create or Destroy Value? *Management Science* 46(8): 1059-74.

Epstein, M.J., and M.-J. Roy. 2003. Making the business case for sustainability: Linking Social and environmental actions to financial performance. *The Journal of Corporate Citizenship* 9: 79-96.

Gereffi, G. 1999. International Trade and Industrial Upgrading in the Apparel Commodity Chain. *Journal of International Economics* 48: 37-70.

Gereffi, G., J. Humphrey, and T. Sturgeon. 2005. The Governance of Global Value Chains. *Review of International Political Economy* 12(1): 78-104.

Gibbon P. 2001. Upgrading Primary Production: A Global Commodity Chain Approach. *World Development* 29(2): 345-363.

Gibbon, P., J. Bair, and S. Ponte. 2008. Governing Global Value Chains: An Introduction. *Economy and Society* 37(3): 315-338.

Griffin, J.J., and J.F. Mahon. 1997. The Corporate Social Performance and Corporate Financial Performance Debate: Twenty-five Years of Incomparable Research. *Business and Society* 36(1): 5-31.

Gruber, M., I.C. MacMillan, and J.D.Thompson. 2008. Look Before You Leap: Market Opportunity Identification in Emerging Technology Firms. *Management Science* 54(9): 1652-1665.

Hendrikse, G.W.J., and W.J.J Bijman. 2001. On the emergence of growers associations: Self-election versus market power. Working paper ERIM report series research in management. ERS-2001-34-0RG.

Kaplinsky, R. 2000. Globalisation and Unequalisation: What Can be Learned from Value Chain Analysis. *Journal of Development Studies* 73(2): 117-146.

Kaplinsky, R., M. Morris and J. Readman. 2002. The Globalization of Product Markets and Immiserizing Growth: Lessons from the South African Furniture Industry. *World Development* 30(7): 1159-1177.

King, A., and M. Lenox. 2002. Exploring the Locus of Profitable Pollution Reduction. *Management Science* 48(2): 289-99.

KIT. 2010. *Value Chain Finance : Beyond Microfinance for rural entrepreneur.* Royal Tropical Institute Publishers, Netherlands.

Lia, S., B. Raghu-Nathan, T.S. Raghu-Nathan and S.S. Rao. 2006. The impact of supply chain management practices on competitive advantage and organizational performance. *Omega* 34(2): 107–124.

Martin, R.L. 2002. The Virtue Matrix: Calculating the Return on Corporate Responsibility. *Harvard Business Review* 80(3): 68-75.

McWilliams, A., and D. Siegel. 2001. Corporate Social Responsibility: A Theory of the Firm Perspective. *Academy of Management Review* 26(1): 117-27.

Nalla, V.R .2008. *Contract Mechanisms for coordinating operational and marketing decisions in a supply chain: Models and Analysis.* PhD diss., Nyenrode Business Universiteit, Breukelen, The Netherlands.

Parmigiani, A., R.D. Klassen and M.V. Russo. 2011. Efficiency meets accountability: Performance implications of supply chain configuration, control, and capabilities. *Journal of Operations Management* 29(3): 212-223.

Prahalad, C.K. 2010. *The fortune at the bottom of the pyramid: eradicating poverty through profits.* 5th edition: Wharton School Publishing.

Productschap Tuinbouw. 2010. http://www.tuinbouw.nl/artikel/tuinbouwcijfers (accessed November 2011).

Rappaport, A. 2006. Ten ways to create shareholder value. *Harvard Business Review*. http://analystreports.som.yale.edu/internal/S2008/tenways.pdf (accessed January 2012)

Roman, R.M., S. Hayibor and B.R. Agle .1999. The Relationship between Social and Financial Performance: Repainting a Portrait. *Business and Society* 38(1): 109-25.

Russo, M.V., and P.V. Fouts. 1997. A Resource-based Perspective on Corporate Environmental Performance and Profitability. *Academy of Management Journal* 40(3): 534-559.

Russo, M. V. .2003. The emergence of sustainable industries: building on natural capital. *Strategic Management Journal* 24: 317–331.

Someren van, T.C.R. and A.H.J. Nijhof . 2010. *Triple P business development in Dutch agro-food sector.* Van Gorcum publisher.

Sturgeon, T. J. 2001. How Do We Define Value Chains and Production Networks? *IDS Bulletin* 32(3): 9–18.

Trienekens J.H. 2011. Agricultural Value Chains in Developing Countries: A Framework for Analysis. *International Food and Agribusiness Management Review* 14 (2): 51-82.

Waarts, Y. 2010. *Less Food in the Garbage.*. http://www.kennisonline.wur.nl (accessed December 2010)

Williamson, O.E. 2010. Transaction Cost Economics: The Natural Progression. *American Economic Review* 100(3): 673–690.

International Food and Agribusiness Management Review
Volume 15, Issue 3, 2012

Factors Affecting the Export Demand for U.S. Pistachios

Zijuan Zheng[a], Sayed Saghaian[Φb] and Michael Reed[c]

[a] *MS. Graduate, Department of Agricultural Economics, University of Kentucky, 328 Charles. E. Barnhart Building, Lexington, Kentucky, 40546-0276, USA*

[b] *Associate Professor, Department of Agricultural Economics, University of Kentucky, 314 Charles. E. Barnhart Building, Lexington, Kentucky, 40546-0276, USA*

[c] *Professor, Department of Agricultural Economics, University of Kentucky, 308 Charles. E. Barnhart Building, Lexington, Kentucky, 40546-0276, USA*

Abstract

This study evaluates the U.S. role in world production and trade of pistachios and identifies major factors affecting export demand for U.S. pistachios. We incorporate 21 major markets accounting for 78 percent of total U.S. pistachio exports. The impacts of market conditions and the effects of food safety shocks are investigated. The results indicate U.S. pistachio producers should take advantage of their advanced technology and reputation for higher food safety standards to enhance international market share. Necessary ingredients for a successful marketing strategy include compliance with marketing order regulations, improved food safety, and product diversification.

Keywords: export demand, food safety, marketing orders, pistachio nuts

[Φ]Corresponding authors: Tel: +1 859. 257.2356
Email: ssaghaian@uky.edu

Tel: +1 859.257.7259
Email: mrreed@uky.edu

+The IFAMR is a non-profit publication. The additional support provided from this issue advertisers, Novus International and GlobalGap help keep us open access and dedicated to serving management, scholars, and policy makers worldwide.

Introduction

Due to high levels of aflatoxin, the European Union (EU) rejected a large pistachio shipment from Iran in September 1997, then the world's largest producer and exporter of pistachios. Since this incident, European countries have shifted their original importing source for pistachios from Iran to the United States (U.S.), which has created a large market for U.S. growers. This food safety incident caused catastrophic and long-lasting effects on pistachio markets. Iran's pistachio export market share stopped growing after the incident and has fluctuated around 150,000 metric tons (Figure 1).

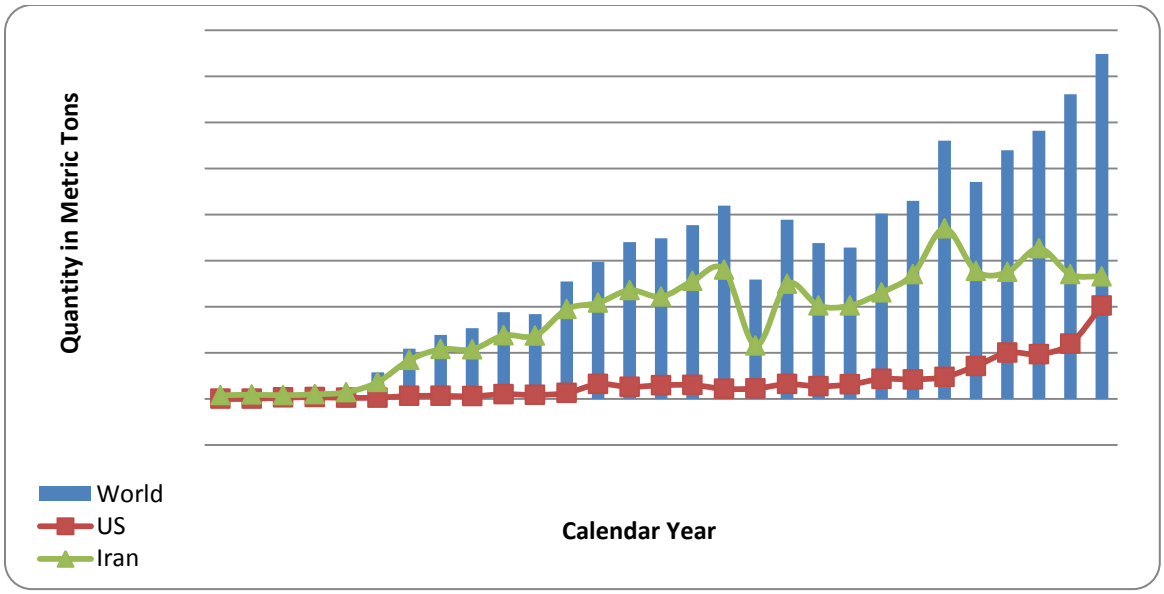

Figure 1. The U.S., Iran, and World Pistachio Exports in Quantity, 1980-2009.
Source. FAO TradeSTAT

This incident highlights the significance of food safety in international trade – food scares can radically change the competitive environment. It certainly changed the world pistachio export market situation. As shown in Figure 1, the U.S. has experienced a much faster growth rate in pistachio exports since the incident and has been catching up with Iran from 1998 to 2008. Yet there are many confounding factors that are important in this U.S. export growth. This research investigates the factors that have affected the U.S. pistachio industry's growth.

As Iran's major competitor in the world pistachio export market, it is important for the U.S. industry to understand the factors that cause it to maintain or increase its global export share for pistachios. As a result, a comprehensive econometric model is established including variables such as U.S. pistachio export price, Iran's pistachio export price, foreign markets' GDP, the real exchange rate between foreign currencies and the U.S. dollar, U.S. export prices of substitutes (almonds, walnuts, and pecans,) and two indicator variables specifying the impact of food safety shocks. Data for the 21 major exporting destinations, which together account for 78 percent of the total U.S. pistachio exports, are used in the analysis.

The next section presents background information on the U.S. pistachio industry, including production, exports and food safety considerations. The third section provides a discussion of current food safety issues, a description of each food safety incident that occurred during the studied period, and an explanation of the role of pistachio marketing orders. Then the analytical framework used to estimate the effects of selected variables on U.S. pistachio exports is presented. This is followed by empirical results and elasticity analysis. The paper ends with conclusions, agribusiness and marketing implications, limitations and suggestions for future studies.

Back ground

According to the United States Department of Agriculture (USDA), approximately 98% of U.S. pistachios are produced in California; other states producing pistachios include Arizona, Nevada, New Mexico and Texas. According to Food and Agricultural Organization (FAO) Production Indices, the top four world pistachio producers in 2008 were Iran at 192,269 metric tons (mt) (35% of the world's production), the U.S. at 126,100 mt (23%), Turkey at 120,113 mt (22%), and Syria at 52,600 mt (9.6%). Figure 2 shows the dominant position of Iran and the U.S. in world pistachio production. As shown, the production growth rate slowed in Iran after 1997, while the U.S. experienced faster growth.

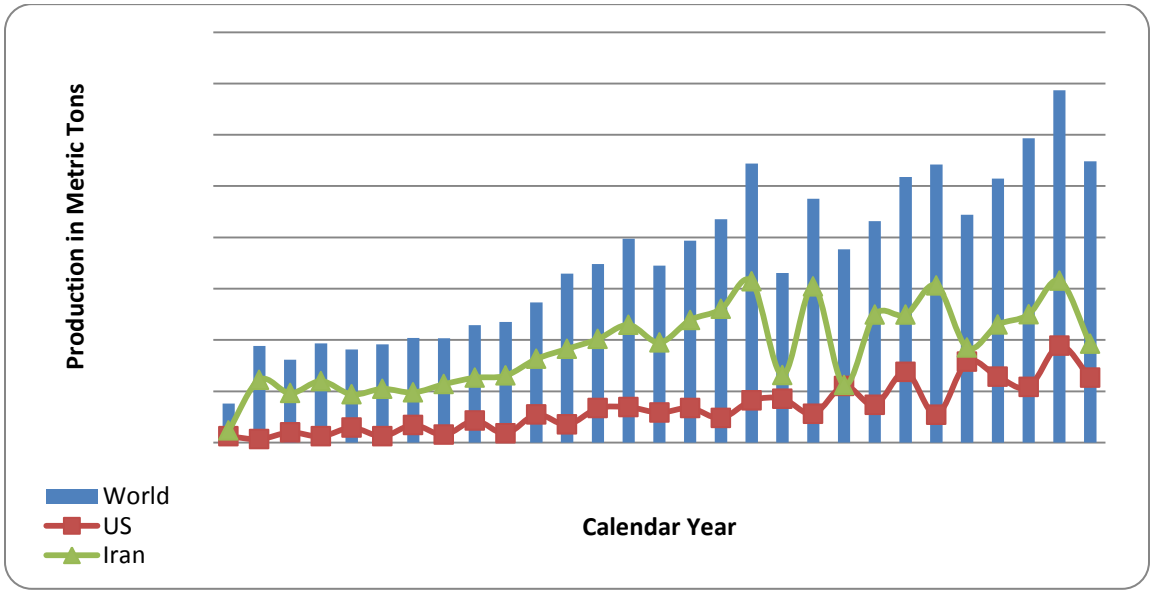

Figure 2. Iran, the U.S., and World Pistachio Production Situation, 1980-2008.
Source. FAO Production Indices

Iran has a much larger pistachio harvested area than the U.S. because of its desirable climate and long history of pistachio production. Pistachio harvested area in Iran has been steady over the decade. Virtually all the commercially produced pistachios in the U.S. are grown in California (USDA). Although having great advantages in harvested area, the yield in Iran has declined over time, whereas yield in the U.S. has been increasing. The U.S. has been making much better use of its existing harvested area by adopting advanced technology and more skilled labor, and its production has been catching up with Iran, especially in recent years.

Alternate Bearing

There are significant variations in production of pistachios every year. Pistachios like many tree nuts, suffer from 'alternate bearing,' which means if there is a large crop in one year, there will be a smaller crop the following year. In order to stabilize the price, the U.S. established a marketing order that holds a reserve pool to compensate for shortages in the "off" years. Jolly and Norris (1992) modeled this by simulating U.S. pistachio prices using a simple linear regression model to estimate the relationship between production and bearing acres. Their results showed the effect of bearing acreage on production is highly significant. This implies the importance of proactive management such as pistachio carryover stocks in "on" years in order to counter the "off" years' effects on price variations.

Pistachio Shell Splitting

Most of the time, pistachio shells split naturally just prior to harvest with the hull covering the intact nut, protecting the kernel from invasion by molds and insects until harvest. For nuts with poor hull protection in the orchard, contamination is much more likely to occur. However, "early splits" can happen, resulting in the splitting of both the hull and the shell. Approximately one to five percent of the nuts are early splits. Sommer, Buchanan and Fortlage (1986) and Doster and Michailides (1995) examined the effects of early splits and found that about 20 percent of early splits were contaminated with aflatoxin, while the rate was zero percent in nuts with intact hulls. Aflatoxin and insect contamination caused by early splitting have posed a great danger to consumer health and it is very difficult to detect when nuts have become contaminated by early splits.

Furthermore, early split nuts not infected in the orchard could still become contaminated during processing, transportation, and storage if the environment is humid and warm. Late harvesting, bird damage and cracking may also cause hull rupture. The navel orange worm (NOW) sometimes damages the hulls of nuts and can cause aflatoxin contamination. Fortunately, NOW-infected nuts are easy to prevent and they can be eliminated by hand sorting. Hence, the timing of splitting is of great importance in pistachio production. On one hand, early splits increase the risk of aflatoxin contamination; yet late splitting leads to market discounts because of the extra cost incurred when opening the shells mechanically. This shows the importance of timing the shell splitting in order to minimize aflatoxin contamination and to maximize the market value of the nuts. For U.S. tree nut production, the total loss in sales to aflatoxin contamination averages up to $50 million per year and is much higher in years with greater insect damage (Cardwell et al. 2001).

Improved timing of pistachio shell splitting requires future research by biologists and agricultural engineers. Before harvest, 'early splits' caused by insect damage is an important factor leading to aflatoxin contamination. As a result, developing better insect control in pistachio orchards has become more and more important because of the increased resistance to pesticides (Varela et al., 1993). After harvest, sorting will greatly reduce the aflatoxin counts in pistachios. Campbell et al. (2003) documented the major sorting steps. They are (in order): "trash removal, water flotation to segregate empty-shell and immature nuts, hull removal, drying to 5-6% water content, sorting to remove closed-shell (again somewhat immature) nuts, electronic color sorting to seg-

regate and remove stained shell nuts and, if required, hand sorting to complete the electronic process and also remove nuts with visible insect damage. Finally, nuts are size sorted." P. 251.

U.S. Pistachio Consumption and Exports

U.S. exports are not significantly affected by these production dips because of the reserve pool held by the marketing order to mitigate price swings, and have been growing steadily. Also, consumption in the U.S. used to be relatively low, but it has been growing progressively over time as production has gone up. Per capita consumption of pistachios reached 0.23 pounds in 2007 (Economic and Research Service, ERS). Moreover, nutritional research has helped increase the consumption of tree nuts as people are pursuing healthier diets. Karim and Vardan (2003) documented a long term study showing that consuming nuts at least five times a week reduces the risk of heart disease. U.S. pistachio production, consumption, and export from 1989 to 2008 are presented in Figure 3. The data shows that domestic consumption while growing over time, has slowed in recent years, and in contrast exports have gone up sharply, suggesting export expansion has moved the inventory resulting from increased production.

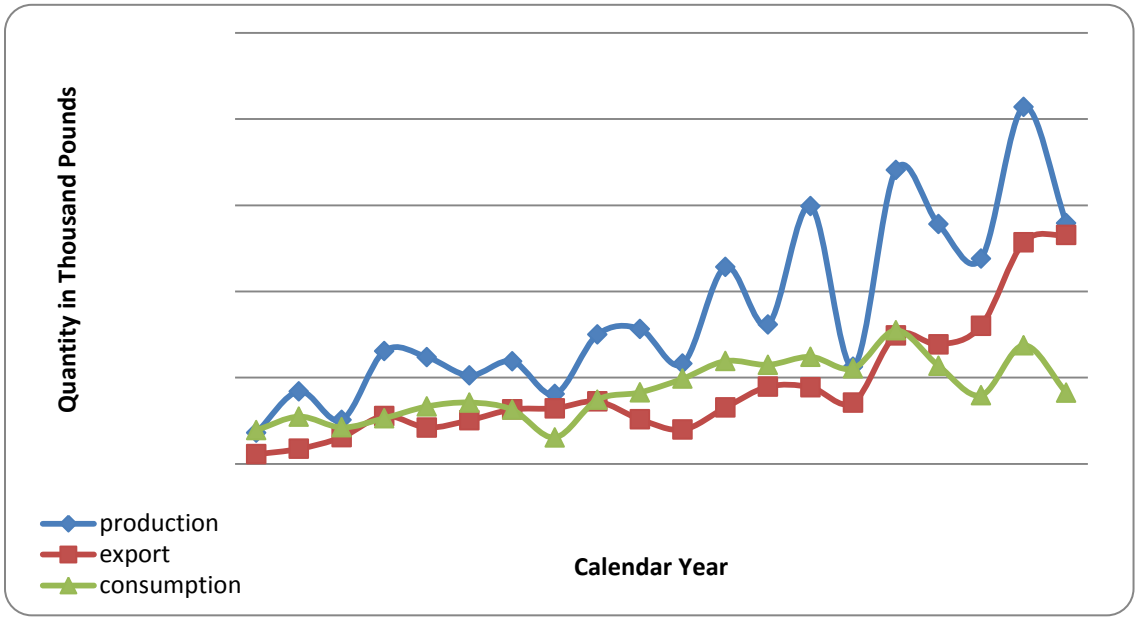

Figure 3. U.S. Pistachio Production, Export, and Consumption, 1980-2008.
Source. USDA

The food safety scare pulled U.S. producers into the world market and they have been increasingly successful because of higher production levels. In the 1980s, Iran dominated world pistachio exports, while export growth in the U.S. was progressive and slow. However, the market situation experienced a dramatic change in the 1990s, when Iran's exports were stagnant and U.S. exports began to catch up with Iran, especially in 1998, a year after the Iranian aflatoxin incident. Politics might have also contributed to this shift. In the 1980s and 1990s the U.S. banned importation of Iranian pistachios twice, once in 1979-1981 during the hostage crisis, and another time in 1987-2000 during the Iran-Iraq war. Also, a ban was imposed on importation of

Iranian pistachios into the U.S. in 2010, which increased U.S. domestic market share significantly. According to the Western Pistachio Association (WPA), on the average 262,000 pounds of Iranian pistachios have entered into the U.S. each year since 2000 and this increased to almost a million pounds during the 2009-2010 period. They argue that the recent U.S. ban on Iranian pistachios has little impact on their pistachio pricing. However, the trade embargo has prevented market access for the U.S.'s major competitor, Iran, and has left the whole U.S. pistachio market, worth $700 million, to domestic pistachio growers, which benefits domestic pistachio farmers and processors. The trade embargo can create opportunities for rent seeking, and influence the commodity terms of trade in the international markets. This policy can have welfare implications and affect both consumer and producer surplus. Currently, one billion pounds of pistachios are sold globally with 35 percent of U.S. pistachio production (about 130 million pounds) sold domestically and 65 percent exported (WPA).

The EU's shift from Iran to the U.S. as their primary importing source of pistachios created a large export market regulated by stricter aflatoxin standards. European countries, including Belgium, Luxembourg, Netherlands, Germany, France, Spain, Italy, and United Kingdom, account for a large proportion of total U.S. exports. The maximum allowable concentration of aflatoxin set by U.S. Food and Drug Administration is 20 parts per billion (ppb), but European markets usually reject shipments with concentrations of 4 to 15 ppb according to their new community regulation on aflatoxin levels. This shift to stricter standards explains the main reason for the change in U.S. and Iran's market share in the world pistachio trade. According to Campbell et al. (2003), "The low thresholds for aflatoxin contamination have significantly increased the probability for rejection of tree nut shipments by the major importing nations of the EU and Japan." Figure 4 shows the dramatic increases in U.S. exports to EU countries, especially in the last decade, using ten year intervals.

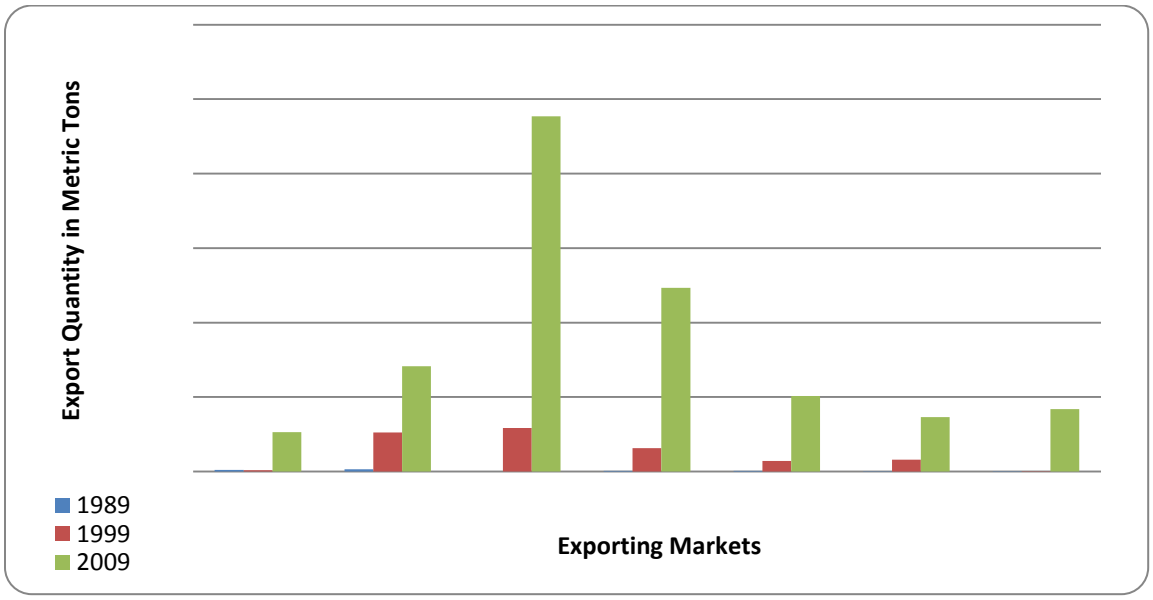

Figure 4. Percentage Growth of Export Share in European Markets, 1989, 1999, and 2009.
Source. USDA-ERS-GATS

Food Safety Events in International Pistachio Markets

Food safety has received more and more attention by industries, consumers, and policy makers in recent years. As mentioned by Buzby et al. (2008), food safety concerns may have far-reaching implications such as reduced demands, altered international trading patterns, and limited access to foreign markets for the rejected products. As transportation infrastructure and marketing networks develop, as well as per capita income and consumer demand increase, international food trade is expanding along with the pace of globalization (Buzby et al. 2008). The globalization of the food supply chain can spread food safety risks to a much wider geographic area. The most far-reaching food safety concern for pistachio consumption originated from the 1997 Iran aflatoxin contamination. Iran's production share fell from 53.7% in the 1980s to 44.6% after 2000; their export share fell from 64.3% in the 1980s to 54.5% since 2000. In contrast, the U.S. experienced a steady growth in production share from 11.0% in the 1980s to 23.5% after 2000; U.S. export share increased from 6.8% in the 1980s to 14.9% after 2000. The change due to the food safety incident in Iran caused significant market share loss for Iran and gains for the U.S. Figure 5 and Table 1 illustrate the change in both production and export market shares of Iran and the U.S. in the last three decades.

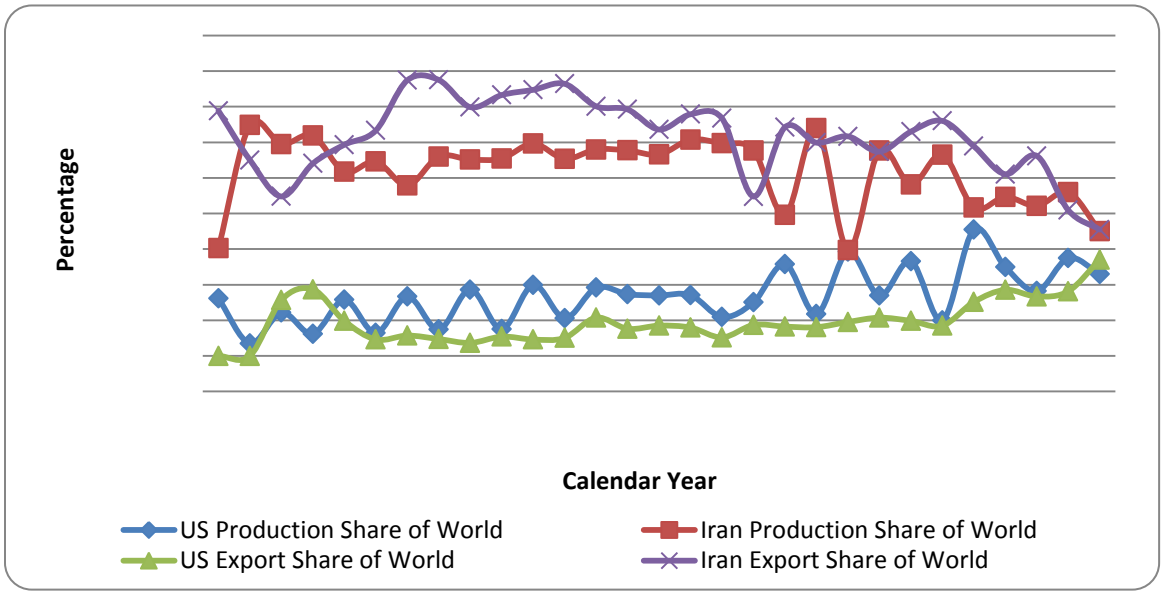

Figure 5: Production and Export Shares for Iran and the U.S., 1980-2009.
Data Source. FAO Production Indices and TradeSTAT

Table 1. World Production and Export Share for the U.S. and Iran, 1980-2009.

Country	Production Share in 80s	Production Share in 90s	Production Share after 2000	Export Share in 80s	Export Share in 90s	Export Share after 2000
Iran	53.7%	56.9%	44.6%	64.3%	65.8%	54.5%
US	11.0%	16.5%	23.5%	6.8%	7.5%	14.9%

Source. FAO Production Indices and TradeSTAT

The first EU ban on Iranian pistachio imports in September 1997 was lifted in December when Tehran assured customers that it would improve food safety inspections and product quality. However, EU import demand for Iranian pistachios was affected for a much longer period. According to FAO TradeSTAT, exports to EU countries dropped from 102,698 mt in 1997 to 59,619 mt in 1998. This was the first of many food scares for pistachios. According to a South Korean newspaper, Thrifty Payless Ice Cream was discovered to have potentially dangerous bacteria contamination in November 1997. The six contaminated flavors include Pistachio Nut, Medieval Madness, Chocolate Chip, Cookies and Cream, Strawberry, and Strawberry Cheese. In 1999, a German inspection group reported that eight out of eleven sampled pistachios from supermarkets contained higher than allowable aflatoxin levels and that the highest levels were found in California pistachios. In 2000, several articles were published in Germany's *Der Spiegel* and *Sueddeutsche Zeitung* as well as regional newspapers reporting discoveries of high aflatoxin levels in pistachio ice creams. Surveys indicated the continued reoccurrence of high levels of aflatoxins worldwide. For example, pistachios were recalled in Australia, Japan and France due to high levels of aflatoxin later that year.

In September 2007, a shipment of pistachios from the U.S. was rejected by China because it contained ants. In August 2008, a U.S. newspaper reported that "popcorn, pistachios, Tic Tacs, and Skittles are the latest threat to local children". In March 2009, Kraft recalled its Nature Nantucket Blend trail mix, which contained pistachios that might have been tainted with salmonella. As mentioned earlier, the effects of each food safety incident differ from case to case. The 1997 aflatoxin event in Iran and South Korea led to disastrous and long-lasting consequences; while the other incidents, which were discovered quickly and solved right away, did not spread concerns among consumers. Although it is difficult to see direct correlation between food safety incidents and pistachio exports from the above figures because of confounding factors, it is of obvious importance to regulate food safety standards in order to prevent such disastrous food safety incidents from happening in the future. Table 2 provides an overview of the food safety incidents associated with pistachios in the studied period. The third column describes the location of the incident. The fourth column describes the severity of each event in terms of its effects on export quantity and price. The right column states the source of pistachios that are contaminated.

Table 2. Pistachio Food Safety Incidents

Year	# of Incidents	Country	Severity	Source of Pistachios
1997	2	Iran/S. Korea	High/High	Iran/US
1999	1	Germany	Low	US
2000	3	Australia/Japan/France	Low/Low/Low	US/US/US
2007	1	China	None	US
2008	1	US	None	US
2009	1	US	None	US

Source. Google News Timeline

In 1981, California pistachio producers formed the California Pistachio Commission (CPC) to provide support through government relations, marketing, and research funding with $0.035 per pound collected from pistachios produced in California. The timing of this event was important for expanding U.S. export markets. According to Alston, et al. (2005), the CPC has sponsored

research on a wide variety of production challenges such as disease and insect control, methods of increasing production yields, and cultivar improvement. The CPC receives funding under the USDA's Market Access Program to promote pistachio exports to Japan, Korea, China, Malaysia, Philippines, Thailand, Canada, and the United Kingdom. Market Access Program funds to the pistachio industry averaged about one million dollars per year during the four years ending in 2009 (USDA, FAS). This funding has been important to U.S. pistachio promotional efforts.

Furthermore, the pistachio marketing order was established in August 2005 to enhance better product quality by setting a maximum aflatoxin tolerance level as well as inspections for defects and size. A federal marketing order is a collective action taken by an industry, with support of the federal government, to increase consumer demand, consumer confidence and producer returns by controlling quality standards through inspection and packing regulations, and investing in market promotion, research, and development. Marketing orders allow industries to regulate the product quantity available in the market through volume controls, which include production limitations, diversions of some products to reserve pools, and market allocation restrictions (Berke and Perloff 1985).

Analytical Framework and Data

Model Development

The behavior of both exporters and importers are addressed mainly in the international trade literature. Export demand estimation methods have been commonly used to investigate different agricultural commodities. For example, Eenoo, Peterson, and Purcell (2000) investigated economics of export demand for U.S. beef, Hussein (2009) examined structural changes in the export demand function for Indonesia, and Bahmani-Oskooee (1984), studied the determinants of international trade flows. The vast majority of the previous literature on commodity export models has focused on how the importing countries' income and exchange rate affect export demand. Senhadji and Montenegro (1999) used time series techniques to estimate the aggregate export demand elasticities for 53 developing and industrial countries and found a significant effect of the trading country's income and relative prices on export demand, especially in the long run. Cosar (2002) studied the price and income elasticities of Turkish aggregate export demand using cross sectional data and concluded that Turkish export demand is elastic with respect to foreign income but inelastic with respect to the real exchange rate in both the short run and the long run.

In 2005, Alston et al. developed a stochastic simulation model of supply and demand to assess the impact of the proposed federal marketing order for California pistachios. They estimated the effects of the marketing order over a 50 year period by comparing the two simulations of outcomes generated from economic indicators in the industry with and without the marketing order. The cost-benefit analysis showed that the measured benefits from the marketing order would greatly exceed the costs for producer compliance.

However, there is a lack of more comprehensive empirical research exploring effects of more factors on export demand variations for pistachios. This paper offers new evidence in explaining the variations of export demand for US pistachios. The export demand function used in this article takes the traditional form and includes all the variables typically included in such equations (Arize, 2001). Export demand is a simple linear regression relating U.S. pistachio exports to the

effects of food safety shocks and several independent variables, including pistachio export price, the major competitor's export price (i.e., Iran), the average U.S. export price of substitute tree nuts (almonds, walnuts and pecans), importing country's GDP, and the real exchange rate between the country's currency and the U.S. dollar. As previously stressed, food safety shocks affect export demand by threatening consumer confidence; as a result, two indicator variables, one for Iran and the other for the U.S., are created to investigate the effects of such concerns. Hence, the model incorporates all the important variables mentioned in the literature, such as the effects of substitutes or complements, as well as food safety shocks.

Export demand specification is crucial for meaningful export forecast, international trade planning and policy formulation (Arize, 2001). The critical economic indicators affecting export demand are hypothesized to be own price, cross prices, importer's GDP, the real exchange rate, and food safety shocks (Bahmani-Oskooee, 1984; Peterson, and Purcell, 2000; Arize, 2001; and Hussein, 2009). Equation (1) specifies the export demand function for U.S. pistachios:

$$(1)\ \ln(Q_{i,t}) = \beta_0 + \beta_1 * \ln(EP_{i,t}) + \beta_2 * \ln(CEP_t) + \beta_3 * \ln(PNUTS_{i,t}) + \beta_4 * \ln(GDP_{i,t}) + \beta_5 * \ln(RER_{i,t}) + \beta_6 * FS1_t + \beta_7 * FS2_t + \varepsilon$$

The average price of other tree nuts is

$$(2)\ PNUTS = \frac{PA_{i,t}+PW_{i,t}+PP_{i,t}}{3}.$$

The real exchange rate is

$$(3)\ RER = \frac{P_d}{e*P_f},$$

where $e = \frac{F_c}{\$}$ or foreign currency per U.S. dollar

In equation (1), $Q_{i,t}$ is US exports of pistachios to country i in time t; $EP_{i,t}$ is U.S. pistachio export prices to country i in time t; CEP_t is Iran's pistachio export price in time t; $PNUTS_{i,t}$ is the U.S. average export price of other tree nuts to country i in time t. In equation (2), $PA_{i,t}$ is the U.S. almond export price to country i in time t; $PW_{i,t}$ is the U.S. walnut export price to country i in time t; $PP_{i,t}$ is the U.S. pecan export price to country i in time t; $GDP_{i,t}$ is GDP of country i in time t; $RER_{i,t}$ is the real exchange rate between country i's currency and the U.S. dollar in time t. In equation 3, P_d is the domestic price level in the importing countries; P_f is the price level in the U.S.; e is the nominal exchange rate, which is defined as the number of units of the domestic currency (F_c) that can purchase a unit of a given foreign currency ($);$FS1_t$ is a zero-one dummy variable, one for the food safety incident at the time of the event and zero otherwise, and identifies a food safety shock from Iran in time t, assuming the value of one for 1997; $FS2_t$ is also a zero-one dummy variable that identifies a food safety shock from the U.S. in time t, assuming the value of one for years 2007 through 2009.

The model utilizes a logarithmic functional form, which is more flexible and the coefficients are elasticities. Among all the variables, the competitor's export prices and food safety shocks are time variant but cross sectional invariant. All other variables are both time variant and cross sectional variant, making it a panel data set. The own price elasticity is expected to be negative; the

cross price elasticity is expected to be positive; the Iranian export price is used as a proxy for all U.S. competitors and its coefficient is expected to be positive; the income elasticity is expected to be positive; the expected sign for RER is negative; and the food safety shock in Iran should positively influence exports, while the food safety shock in the US should negatively impact exports.

Data Description

Twenty-one major importing markets are selected as the studied sample: Canada, Mexico, Brazil, Venezuela, United Kingdom, Germany, Belgium and Luxembourg, Netherlands, France, Italy, Spain, Australia, Taiwan, Hong Kong, South Korea, Japan, Philippines, Singapore, the United Arab Emirates, Israel, and Egypt. Annual data for the studied variables are available from 1989 to 2009. Data for Iranian pistachio export values and quantities were collected from Food and Agriculture Organization (FAO) TradeSTAT. Data for the real exchange rates and GDPs were acquired from USDA and are in real U.S. dollars with 2005 as the base year. Data for export quantities and values for almonds, pecans, and walnuts to each country were from USDA General Agreement on Trade and Services (GATS) statistics. Total price and quantity values are the sum of all types of nuts, which are fresh/dry/shell, fresh/dry/no-shell, and preserved. Export prices are the average values calculated by dividing the total export values by the total export quantities. Data for food safety shocks were collected using Google News Timeline. All the variables were formatted as indexed values with year 2000 as the base. This makes each time series unit free and allows a closer comparison among countries with different prices and exchange rate units. (The descriptive statistics of the model variables are excluded from this article because of its large size, but it is available upon request.)

Empiricial Results

There are two types of models for panel data analysis: the fixed effects model and the random effects model. A Hausman test is used to determine the best fitting model with unbiased, consistent, and efficient estimators. The test determines whether there is a significant difference between the fixed and random effects estimators by testing the null hypothesis that the difference between the fixed and random effects is zero. A random effects estimator is more efficient than fixed effects estimator by saving degrees of freedom and correcting the composite errors. In the model the Hausman test is chi-square distributed with 6 degrees of freedom, which is the number of time-varying regressors. The test result generated by Data Analysis and Statistical Software (STATA) is chi-square (6) = 3.77 with p-value = 0.7077, indicating no evidence to reject the null hypothesis. Therefore, the random effects estimator is chosen. Moreover, the random effects estimator allows estimation of coefficients on time-invariant variables as well, so their effects are not eliminated. Although the random effects model has the above advantages, it should only be used when the Hausman test supports it.

Point Estimates

The results from the regression analysis are reported in table 3. U.S. pistachio export price and the real exchange rate have a statistically significant negative impact at the 1% level, as expected, whereas the average export price of other tree nuts and the importing regions' GDP are

positive and significant at the 1% level. A food safety shock in Iran has a negative and significant impact at the 1% level, the food safety incident in Iran affected consumer confidence in consuming U.S. pistachios. Consumers must associate food safety problems from Iran to the rest of the world. Since Iran is the largest pistachio producer and exporter, it is understandable that consumers reduced their confidence in all pistachio products after the 1997 incident. The coefficient for various U.S. food safety shocks has an unexpected positive sign that is significantly different from zero, but its absolute value is less than one. This is an indication that the food safety incident was not severe in terms of its effects on U.S. export volume and prices. The results for Iran's pistachio export demand was consistent with a previous research indicating that pistachio food safety shocks had a negative and highly significant impact on Iran's pistachio export demand (Shahnoushi et al. 2011).

Of all the parameter estimates, only the price of other tree nuts is not significant. This indicates no apparent correlation between U.S. pistachio exports and the export price of other tree nuts. An increase in other tree nut prices will not encourage countries to import more pistachios. A depreciation of the US dollar (higher aggregate U.S. prices or lower aggregate importer prices) will lead to a higher real exchange rate and more pistachio exports.

Table 3. Parameter Estimates for the Overall Export Demand Function

Variable	Parameter	Expected Signs	Estimate	95%LB	95%UB
US Pistachio Export Prices	$_1$	-	-1.786 **	-2.469	-1.102
Iran's Pistachio Export Prices	$_2$	+	1. 353**	0.440	2.267
GDP's in importing countries	$_3$	+	1.111**	0.359	1.863
Real Exchange Rate	$_4$	-	-1.592**	-2.323	-0.862
Other Tree Nuts Export Prices	$_5$	+/-	0.221	-0.089	0.531
Food Safety Shocks in Iran	$_6$	+/-	-1.079**	-1.716	-0.443
Food Safety Shocks in the US	$_7$	-	0.789**	0.474	1.104
Constant	$_0$	n.a.	-0.651 **	-1.082	-0.220

Note. **: statistically significant at the one percent level; withinR^2: 26.94%; between R^2: 1.33%; Overall R^2: 17.67%; χ^2_6: 143.63, $p < .0001$.

As mentioned earlier, the model is a double log function so coefficients are elasticities. The own export price elasticity is -1.79, the cross price elasticity is 1.35, though it is not significantly different from zero. A 1% increase in foreign income increases exports by 1.11%, while a 1% increase in the real exchange rate will decrease exports by 1.59 % (which is close to the own price elasticity). All of these elasticities are greater than one, which indicates that US pistachio export demand is own-price elastic, cross-price elastic, income elastic, and real exchange rate elastic. These results are reasonable because pistachios are not a necessity and have plenty of substitutes in the market. Pistachios are more expensive than most tree nuts (see Table 4), so they are favored as consumer incomes grow. Finally, there is little brand identification with pistachios (Brunke et al., 2004) and there is competition among alternative suppliers, so one would expect demand to be elastic.

Table 4. Tree Nut Retail Prices (in Dollars Per Ton)

Tree Nut	Price
Almond	3,500
Groundnut	450
Hazelnut	2,410
Pecans	4,600
Pistachio	4,440
Walnut	2,110

Source. National Agricultural Statistical Service (2010)

Summary and Management Implications

Estimation results show that pistachio's own-price and the real exchange rate between foreign currencies and the U.S. dollar have a negative effect on the amount demanded by international markets; the elasticities are estimated at -1.79 and -1.59, respectively. Foreign GDP and Iran's price are affecting the quantity demanded positively; their elasticities are estimated at 1.11 and 1.35, respectively. These results answer the first objective. The variable identifying Iranian food safety scares is negative, indicating the spillover effect of the 1997 food safety incident from Iran to the U.S. The food safety shock coefficient for the U.S. is positive, meaning food safety concerns benefit U.S. exports. It seems that the first scare from Iran, the largest pistachio producer and exporter, was the only incident that negatively affected U.S. pistachio exports. After that, other countries (particularly Europe) established stricter aflatoxin standards and the market became more confident in U.S. suppliers. Pistachios are more expensive than most tree nuts and they seem to be a luxury food item. The fact that EU countries consume more pistachios is in part due to their higher income levels (Karim and Vardan, 2003), and as incomes grow throughout the world, there should be more pistachio consumption. This increased consumption of pistachios will likely drive growth in the U.S. industry, increasing labor demand and employment.

The U.S. has been taking advantage of its modern technology in production and packaging, higher than average expertise in product marketing and advertising, and higher standards for food safety. These are the underlying factors that led to the U.S.'s success. However, compared to Iran, its biggest competitor with 45% of world production and 55% of world exports, both U.S. production and export shares are still lagging. Moreover, the variety of pistachio products in the U.S. market is limited. The most commonly seen products are salted/unsalted or shelled/unshelled. In contrast, there is a much wider variety of products in Iran -- for example, different shapes, flavors, colors, and packages . There is much scope for the U.S. industry to expand into high-valued processed pistachio products which will increase profits and exports. There are many roasted flavors in Iran, such as lemon juice sprinkled with salt, smoked, garlic onion, chili lemon and saffron flavors. The colors vary for decorative purposes from the natural color to red, orange, green and purple.

The added flavors and shell colors make the nuts much more fun to consume. The packages of Iranian pistachios are fancy and beautiful as well and they have become an art in the Iranian culture. Product shapes vary as well. Round, long, and jumbo Fandoghi (round) pistachios are the most widely available and account for 40% of all pistachio orchards in Iran. Kalleh Ghouchi

(Jumbo) pistachios account for 20% and they have become popular among farmers because of high yields. Akbari (long) pistachios account for 15% and are the longest type of pistachio and the easiest to open. Aghaei (long) pistachios account for 12% with high yield rates, shorter times to maturity, and the whitest shells. These pistachio products are the second leading export item from Iran (after oil). In order for the U.S. to capture these higher valued international markets, growers should focus on market segmentation and product diversification as the next step. It may be difficult to develop different product shapes in a short period of time, but improving roasting techniques and expanding flavors, colors, and packaging choices are much easier, and there is great potential in the U.S. market for expanded pistachio sales. U.S. pistachio producers must understand consumer attitudes toward these various flavors and colors in light of health concerns and the demand for fresher, healthier, less processed products. Market segmentation and product diversification can help to satisfy different consumer demands and increase consumer and producer surplus.

Proper packaging is important to improve food safety. Improperly packaged pistachios can be contaminated during processing, transportation or storage. Therefore, safer packaging techniques and marketing management from farm to warehouse will reduce losses from unsafe products. The California pistachio marketing order, which was established in the mid-2000s, sets regulations for pistachio inspection and safety. It reduces the risk of aflatoxin contamination affecting pistachios. It provides quality assurance to domestic pistachio consumers and consumers in importing countries. These standards ensure higher quality pistachios and reduce the negative consequences of food safety concerns. Those factors indirectly affect the price of pistachios in international markets (Alston et al. 2005).

U.S. producers must continue to be vigilant about food safety. Pouliot and Summer (2008) show traceability improvement is a way to clarify liability in which the traceability system not only motivates suppliers to improve food safety, but also reduces liability. Hobbs (2004) also mentions that the traceability system "provides ex post information" that helps consumers and suppliers to specify allocation of liability and stimulates compliance with food safety regulations. Thus it is beneficial to consumers, marketers and farmers for policy makers to consider mandatory traceability. It is beneficial for firms and marketers because the system clarifies liability and stimulates firms to implement stricter food safety rules. It is beneficial for consumers because they can consume safer food and, in case of a food safety event, they will have much better chances of getting compensated, leading to improved consumer confidence.

Acknowledgements

Journal Manuscript Number 12-04-035 of the Kentucky Agricultural Experiment Station.
The authors thank the editors of the journal and two anonymous reviewers for their helpful comments.

References

Alston, J. M., H. Brunk, R. S. Gray, D. A. Summer, and A. K. A. Acquaye. 2005. *Economic Consequences of Mandated Grading and Food Safety Assurance: Ex Ante Analysis of the Federal Marketing Order for California Pistachios.* University of California.

Amirtaimoori, S. and A. H. Chizari. 2007. The USA and Iran's Status in Pistachio Export: A Comparative Advantage and Specialization Approach. *American-Eurasian Journal Agricultural and Environment Science* 2(6):775-783.

Arize, A.C, 2001. Traditional Export Demand Relation and Parameter Instability. *Journal of Economic Studies* 28(6):378-396.

Bahmani-Oskooee, M. 1986. Determination of International Trade Flows. *Journal of Development Economics* 20:107-123.

Berck, P. and J. M. Perloff. 1985. A Dynamic Analysis of Marketing Orders, Voting, and Welfare. *American Journal of Agricultural Economics* 67: 487-96.

Brunke, H., J. M. Alston, R. S. Gray, and D. A. Sumner. 2004. Industry-Mandated Testing to Improve Food Safety: the New US Marketing Order for Pistachios. *German Journal of Agricultural Economics* 53: 334-43.

Buzby, C. J., L. J. Unnevehr and D. Roberts. 2008. *Food Safety and Imports: An Analysis of FDA Food-Related Import Refusal Reports.* Economic Information Bulletin No. 39, U.S. Department of Agriculture.

Campbell, B. C., R. J. Molyneux, and T. F. Schatzki. 2003. Current Research on Reducing Pre- and Post-harvest Aflatoxin Contamination of US Almond, Pistachio, and Walnut. Toxin Reviews. *Journal of Toxicology* 22(2 & 3): 225-66.

Cardwell, K. F., A. Desjardins, S. H. Henry, G. Munkvold, and J. M. Robens. 2001. "The Cost of Achieving Food Security and Food Quality."APS*net* Features. doi: 10.1094/APSnetFeature-2001-0901(accessed October 2011).

Cosar, E. E.. 2002. Price and Income Elasticities of Turkish Export Demand: A Panel Data Application. *Central Bank Review 2*: 19-53.

Doster, M. A.and T. J. Michailides. 1995. The Relationship Between Date of Hull Splitting and Decay of Pistachio Nuts by Aspergillus species. *Plant Disease* 79(8): 766-769.

Eenoo, E.V., E. Peterson, and W. Purcell. 2000. Impact of Exports on the U.S. Beef Industry. Paper presented at the NCR-134 Conference on Applied Commodity Price Analysis, Forecasting, and Market Risk Management, Chicago, April 17-18.

Hausman, J. A. 1978. Specification Tests in Econometrics. *Econometrics* 46(6):1251–1271.

Hobbs, J. E. 2004. Information Asymmetry and the Role of Traceability Systems. *Agribusiness 20*: 397-415.

Hussein, A. 2009. Structural Change in the Export Demand Function for Indonesia: Estimation, Analysis and Policy Implications. *Journal of Policy Marketing* 31: 260-271.

Jolly, A. D. and K. Norris. 1992. Models Simulate US Pistachio Prices. *California Agriculture*: 46(3):14.

Karim, K. MH and E. U. E. Vardan. 2003. Global Pistachio Production and Marketing Challenge. University of S and B, Iran (http://economics.ca/2003/papers/0460.pdf) (accessed in October 2011.

Pouliot, S. and D. A. Summer. 2008. Traceability, Liability, and Incentives for Food Safety and Quality. *American Journal of Agricultural Economics* 90(1): 15-27.

Senhadji, A. S. and C. E. Montenegro. 1999. Time Series Analysis of Export Demand Equations: A Cross-Country Analysis. IMF Staff Papers 46:3.

Shahnoushi, N., S. Saghaian, and N. Ashktorab. 2011. An Analysis of Aflatoxin Food Safety Concerns and other Factors Affecting Iran's Pistachio Exports to European Union and Japan. Presented at the 21th Annual World Forum and Symposium, International Food and Agribusiness Management Association (IFAMA), June 20-23, Frankfurt, Germany.

Sommer, N. F., J. R. Buchanan, and R. J. Fortlage. 1986. "Relation of Early Splitting and Tattering of Pistachio Nuts to Aflatoxin in the Orchard." *Phytopathology* 76(7): 692-694.

Western Pistachio Association, (http://www.westernpistachio.org/pdf/EmbargoQA.pdf) (accessed in March, 2012.)

International Food and Agribusiness Management Review
Volume 15, Issue 3, 2012

Integration of Smallholders in Modern Agri-food Chains: Lessons from the KASCOL Model in Zambia

Sepiso Mungandi[a], Daniel Conforte[b] and Nicola Mary Shadbolt[Φc]

[a]*Graduate Student, Institute of Food Nutrition and Human Health, Massey University, Private Bag 11 222, Palmerston North, Manawatu 5451, New Zealand.*

[b]*Senior Lecturer Agribusiness, Institute of Food Nutrition and Human Health, Massey University, Private Bag 11 222, Palmerston North, Manawatu 5451, New Zealand.*

[c]*Professor, IFNHH, Massey University, Private Bag 11222, Palmerston North, Manawatu,4442, New Zealand*

Abstract

The Kaleya Smallholders Company Limited (KASCOL) model has been considered in Zambia a success in increasing smallholders' participation, ownership and governance in an agri-food value chain. This study explores if and why this was a successful experience. The evidence gathered revealed that along its thirty years of existence, the model was able to grow the smallholder ownership and governance role. Although the context, governance structures and managerial competence were necessary factors in the sustainability of the model, the variables related to social capital were key determinants for the long term successful inclusion of the smallholders.

Keywords: Agri-food value chain, smallholders, contract farming, social capital, KASCOL, Zambia

[Φ]Corresponding author: Tel: + 64.63569099
Email: N.M.Shadbolt@massey.ac.nz
S. Mungandi: sepisomun@yahoo.com

+The IFAMR is a non-profit publication. The additional support provided from this issue advertisers, Novus International and GlobalGap help keep us open access and dedicated to serving management, scholars, and policy makers worldwide.

Introduction

As the fight against poverty continues, policy makers in developing countries explore ways to improve the livelihood of small farmers. At the same time, agribusiness firms have been increasingly engaging in closer vertical coordination arrangements to better meet changing customer and consumer needs (Hennessy 1996; Kliebenstein and Lawrence 1995; Young and Hobbs 2002). One of the strategies for fighting rural poverty has been to integrate smallholders in agri-food value chains. However, this has its challenges and, as identified by a number of researchers, many such attempts have not made a difference to the livelihood of small farmers (Baumann 2000; Glover and Kusterer 1990; Kherallah and Kirsten 2002; Patrick 2004; Porter and Phillips-Howard 1997; Sartorius and Kirsten 2007; Singh 2002; Sriboonchitta and Wiboonpongse 2005; Warning and Key 2002). A close examination of successful experiences of smallholders' inclusion in agri-food value chains is therefore required to more accurately identify the solutions to the challenges noted above.

In the Zambian sugar industry, an example of successful smallholders participation in a vertical coordination model has been in existence since 1980 (Bangwe 2009; Church et al. 2008; Nakaponda 2006). This model which is known as KASCOL, involves a sugar milling company (Zambia Sugar Company), a farmer association (Kaleya Smallholders Trust), 160 smallholders, and a company named Kaleya Smallholders Co. Ltd (KASCOL). Although the parties to this model have been together for almost 30 years and the participation and governance role of the smallholders have increased significantly, no in-depth investigation has been conducted so far to understand the reasons of such success.

The objectives of this paper are (1) to understand the KASCOL model and how the smallholders' participation changed over time; and (2) to identify the reasons underpinning the model's sustainability and successful smallholder participation.

Background Theory

Smallholder Participation in Agri-food Value Chains

Smallholder farmers in developing countries have found it hard to participate in commercial agriculture and the production of high value products (Catelo and Costales 2008; Jauch 1999; Pletcher 2000; Seshamani 1998). There are various suggestions presented for this; one is the market liberalisation policies promoted by the World Bank and the International Monetary Fund (IMF) in the 1980s and 1990s (Mwanaumo 1999) that transferred government responsibility for the provision of agricultural inputs and of a market for farmers' produce (Catelo and Costales 2008; Pletcher 2000) to the private sector. Others include the lack of collateral for smallholders to access loans from lending institutions, no guaranteed market for their produce, lack of investment by governments in infrastructure (roads, power, water and education) and poor engagement with agri-food value chains which offer them very little opportunity for growth and expansion. There are also those smallholders who have been empowered by change and now participate effectively in markets, examining one such group was the purpose of this research.

Governance of Vertical Coordination Arrangements

The governance of vertical coordination arrangements refers to how the consecutive stages of production, marketing, and processing are synchronised, and who carries the responsibility of conducting which activity (Frank and Henderson 1992; Martinez 2002). Buvik and John (2000, 53) define management of vertical coordination as "the purposive organization of activities and information between independent firms." What form of vertical coordination strategy to engage in is an important aspect of every firm's decision-making process because it can affect efficiency and thus returns from business undertakings. Firms choose from a range of possible forms of vertical coordination, which can also be referred to as governance structures, based on transaction cost economics considerations (Frank and Henderson 1992; Hobbs and Young 2000; Schulze, Spiller and Theuvsen 2007). In business, transaction costs occur during the planning and implementation phases of an operation, and also during the process of checking that operations are progressing according to what is desired (Williamson 1981). A firm will therefore try to find which governance form best reduces its transacting costs. According to New Institutional Economics, governance structures are bound to change over time as the institutional environment and the nature of transactions change, and firms continue to seek and find ways that best reduce these costs (Kherallah and Kirsten 2002; Frank and Henderson 1992; Martinez 2002; Sartorius and Kirsten 2005; Williamson 1981).

Contract Farming

Contracts are one form of transaction governance. Smallholders in developing nations have been offered contracts to participate in commercial farming (Kirsten and Sartorius 2002). Contract farming has a potential for reducing poverty. The benefits of contract farming for smallholders include better access to new technologies; access to inputs and markets; pre-determined prices; and overall increase in farm incomes (Baumann 2000; Glover and Kusterer 1990; Weatherspoon, Cacho and Christy 2001). Firms that contract with smallholder farmers, here called the focal company, also stand to benefit from these arrangements. Among the benefits is that they are able to more directly influence delivery of a desired supply of both quantity and quality that enables them to run their processing plants at optimal capacity (Baumann 2000; Glover and Kusterer 1990; Weatherspoon et al. 2001). In so doing, they are better positioned to meet the new food standards of their customers.

Contract farming is, however, not without problems. Frequent problems arise from the unequal power relations where the focal firm has more power and control over the farmers; the shifting of management decisions from the farmer to the firm; and the problem of quality control. Furthermore, agro-industrial firms tend to prefer to engage with relatively larger farmers, or collectives/cooperatives of smaller farmers, in order to reduce transaction costs thus leaving out the small individual farmers (Baumann 2000; Glover and Kusterer 1990; Kherallah and Kirsten 2002; Patrick 2004; Porter and Phillips-Howard 1997; Sartorius and Kirsten 2007; Singh 2002a; Sriboonchitta and Wiboonpongse 2005; Warning and Key 2002).

Several studies have explored how to mitigate the problems of contract-farming. From the focal company point of view, the possible solutions include: (a) operating under monopsonic conditions which reduces the chances of farmers reneging and selling their produce elsewhere (Glover

and Kusterer 1990; Singh 2002b); (b) working with smallholders organized in groups so as to reduce transaction costs (Coulter, Goodland, Tallontire and Stringfellow 1999; Hovhannisyan, Urutyan and Dunn 2005; Patrick 2004); and (c) using liaison agents who can assist the firm bridge communication gaps with their contracted farmers; these can be in the form of extension officers who also offer technical assistance and other support services to the farmers (Porter and Phillips-Howard 1997).

The suggested solutions for increasing the benefits for smallholders are (a) avoiding monopsonic markets or potential hold-up situations (Sriboonchitta and Wiboonpongse 2005; Warning and Key 2002); (b) having alternative sources of income which can enable them to pull out of an unsatisfactory arrangement (Porter and Phillips-Howard 1997); (c) having previous experience of working with large firms, a situation which is said to prevent them form being naïve (Porter and Phillips-Howard 1997); (d) having ownership of the main production assets such as land and equipment and also having water rights which enables them to have a voice in the arrangement (Porter and Phillips-Howard 1997; Warning and Key 2000; and (e) being represented by a farmer group so that they have a common voice (Coulter et al. 1999; Patrick 2004; Sartorius and Kirsten 2007). Other solutions include the use of community contacts in the selection process (Warning and Key 2002); setting up of common property to enable them to access production resources (Chen 1989); and engaging them in the production of more labour intensive crops so that they are able to utilise family labour (Glover 1987; Patrick 2004).

Social Capital

Social capital in organizations "consists of the stock of active connections among people, the trust, mutual understanding, shared values and behaviours that bind the members of human networks and communities and make cooperative actions possible" (Gabbay and Leenders 2001, 4). Social capital grows with increased trust and trustworthiness between collaborating partners (Adler and Kwon 2002; Cohen and Prusak 2001; Fischer, Gonzalez, Henchion and Leat 2007; Tsai and Ghoshal 1998) and also with the sharing of information (Adler and Kwon 2002; Tsai and Ghoshal 1998). Tsai and Ghoshal (1998) in their study of the role that social capital plays within a firm found that the nurturing of social capital overtime results in increased benefits as resources are exchanged and combined more effectively. For Nahapiet and Ghoshal (1998, 260) "differences between firms, including differences in performance may represent differences in their ability to create and exploit social capital." Both studies suggest that the development of social capital occurs over a long period of time and that social capital is a major determinant of efficient relationship management. The following constructs are related to the stock of social capital in organizations.

Initial Conditions

According to Arino and De La Torre (1998), Doz (1996), and Hoffmann and Schlosser (2001), the prevailing "initial conditions" to a collaboration arrangement contribute to its success. Initial conditions can include the parties' expectations; whether or not the roles of the parties are well defined; and how the parties involved will be expected to interact and coordinate their activities. Doz (1996) points out that these initial conditions can either create a conducive learning environment or otherwise make learning very difficult.

Interdependence

Interdependence is "a firm's inability to replace its [existing] partner" (Kumar, Scheer and Steenkamp 1995, 349). That is, partners need each other to succeed in their undertakings. Monczka et al. (1998) in their study of 'strategic supplier alliances' found that interdependence contributes to the success of a partnership. Kumar, et al. (1995) found that relationships that tend to have a greater 'interdependence asymmetry, which is when one partner is more dependent than the other, are more likely to have increased conflicts and distrust, thus a lower chance of survival and success.

Power Relations

Power can be defined as "the ability to influence, control, or resist the activities of others" (Huxham and Beech 2008, 555). In collaborations, it is not expected that the parties involved will share power equally, however, collaborations which have little power imbalance are more likely to work better than otherwise (Fischer et al. 2009; Reynolds, Fischer and Hartmann 2008). When there is evidence of power asymmetry between collaborating parties, the more powerful party will tend to impose its will on the less powerful one (Matopoulos, Vlachopoulou, Manthou, and Manos 2007). This has the potential to reduce free negotiations and commitments, thus resulting in dissatisfaction by the less powerful partner.

There are various sources of power in collaborations, and according to Huxham and Beech (2008) these can be grouped into macro-level and micro-level. Their summary of the sources of these categories of power is provided in Table 1.

Table 1. Sources of Inter-organizational Power

Macro-Level		**Micro-Level**	
Power based on need imbalance (e.g. skills, information, money)	Power based on importance imbalance (e.g. strategic centrality, uniqueness, sanctions)	Power based on structural position (e.g. formal authority, network centrality, discursive power)	Power based on day-to-day activities (points of power inherent in the relationship process)

Source. Huxham and Beech (2008)

Communication

Effective communication between collaborating parties can determine the sustainability of that relationship (Reynolds et al. 2008). Effective communication indicates the sharing of information that is relevant for better decision-making and achieving of set goals and thus a long-term relationship (Fischer et al. 2009; Mohr and Spekman 1994; Monczka et al. 1998; Reynolds et al. 2008).

Trust

Bachmann and Zaheer (2008) argue that trust makes the risks of transactions more bearable for the parties. Firms that do not trust each other will tend to put in place monitoring measures that can prove to be costly. Eventually only trusting relationships are sustainable. Studies conducted

by Monczka, et al. (1998) and Mohr and Spekman (1994) showed that there is a strong positive correlation between trust and the success of a collaboration.

Learning

Collaborating parties go through a process of negotiating and re-negotiating their commitments, and of constant evaluation and adjustments of collaborative arrangements in terms of efficiency and equity. The more the parties move along this cycle, the more they learn about alternative courses of action, outcome preferences, and the institutional rules, resources and settings in place (Cheng and Van de Ven 1996) and the more they get to implement measures that are more efficient and more equitable for them (Arino and De La Torre 1998; Ring and Van de Ven 1994). This is consistent with the empirical findings of Doz (1996) that "alliances" that continuously go through this process tend to perform better and last longer than those that are rigid. The capacity to learn collectively affects an organization's ability to deal with coordination and conflict resolution problems.

Coordination

When collaboration is formed, coordination becomes an important aspect of that relationship (Pfeffer and Salancik 2003) since it affects operational efficiency. Coordination specifies who is going to carry out what activity, and how the parties are going to work together to achieve their goals. Coordination contributes to the success of collaborations as evidenced in the studies conducted by Mohr and Spekman (1994) and Monczka et al. (1998).

Conflict Resolution

Conflicts in collaborations are inevitable and their handling is important to the success of that collaboration (Gray 2008). Arino and De La Torre (1998) argue that putting in place good conflict resolution strategies have a positive impact on the quality and longevity of the relationship. Monczka et al. (1998) and Mohr and Spekman (1994) in their separate studies found that the use of conflict resolution tactics that are more 'constructive', that is those that involve finding solutions through mutual understanding between partners, result in the success of collaborations unlike the use of 'destructive' methods that involve demeaning each other.

Methodology

A single case study approach was followed based on in-depth interviews. Twenty face-to-face interviews were conducted in Zambia during mid 2010 with representatives from each of the four parties to the model, that is, two representatives of the Kaleya Smallholders Trust (KAST); four management members of the Kaleya Smallholders Company Ltd (KASCOL); two managers of the Zambia Sugar Company; and with several smallholders – eight long time members and four successors. The interviewees were selected to assure that representative participants from each of the relevant groups were interviewed (Ritchie and Lewis 2003). The responses were cross-checked between participants. The responses from the in-depth interviews were also cross-checked with other key informants outside the stakeholders groups, to validate the data and also (as suggested by Yin, 2009) they helped to "provide insights into a [the] matter and…[to] initiate

access to corroboratory or contrary sources of evidence" (p. 107). These other key informants included government officials at national and district levels; a retired CDC employee, who happened to be amongst those responsible for setting up KASCOL; civil society; traditional leaders; 'Mazabuka Cane Growers Trust' representatives; and representatives of the 'Mazabuka Cane Growers Association'. These interviews were digitally recorded, except for the interview with the former CDC employee; in this case a list of questions was emailed to him and he returned a typed script of his responses. Furthermore, a document search of company and government records was conducted to validate background information and the sequence of key events.

All interviews were digitally recorded. The recorded interviews were transcribed verbatim. A combination of methods for analysing process data were used (Langley 1999). The data were first categorised under seemingly relevant themes as suggested both by the literature and by the interviewees' own narrative (Ritchie and Lewis 2003)**.** This process was helpful for data reduction and for providing a preliminary understanding of the KASCOL model, its process of development, and its key components. Then visual mapping and narrative analysis approaches were used for sense-making, identification of events and categories, and process description (Langley 1999; Pozzebon and Pinsonneault 2001). Explanatory accounts were used to identify patterns in the refined data (Pettigrew 1997), and for hypothesis building. As indicated by Ritchie and Lewis (2003), the process of analysing and sense-making was not linear but one of consecutive iterations through which categories and themes were refined and meanings and explanations gradually emerged.

The limitations of this study stem from the fact that the study relied on the participants' memory in order to track the evolution of the KASCOL model and how the participation of the smallholders had changed over time. Therefore the accuracy of the data collected could have been flawed. In addition, the inability to get hold of some of the originators of this project in terms of the initial management and those who were involved as things were getting started may have resulted in some pertinent issues being missed.

Findings

This section presents the findings from the study. It begins by describing the KASCOL model, how it changed over time, and how the participation of the smallholders also changed over time. Ten propositions suggesting the reasons for the success of the model are presented.

The Kascol Model

Initial Stakeholders, Goals and Circumstances

Two drivers triggered the establishment of the KASCOL model. One was the need of the Zambia Sugar Company, at the time the sole sugar milling company in the country, to expand the area of sugarcane after it had expanded its plant processing capacity in the Mazabuka district. The other was the interest of the Zambian government to improve the incomes of the poor by involving them in the sugar industry.

Organization

The Commonwealth Development Corporation (CDC) was asked to suggest an organizational model based on its experience with similar projects in Africa. The model suggested by CDC would create a sugarcane production and farming services company (KASCOL) which would, (1) own the 4,179 hectares of land given by the Zambian government for the development of this project; (2) would lease part of the 2,500 hectares of arable land to smallholders for the production of sugarcane; (3) would plant its own sugarcane on the remaining area to cover its overhead costs; (4) would provide agricultural services and advice to the smallholders; and (5) would facilitate relationships between the smallholders and the Zambia Sugar Company who would provide irrigation water and buy the sugarcane. The smallholders would assume the responsibility of activities such as ridging, smut rouging, chemical application, weeding, and irrigating their cane fields. KASCOL would be responsible for cane-harvesting; supervising the farmers' field activities; replanting the cane; water management; providing the technical, financial, and managerial and leadership skills; grading community roads; and providing other social amenities such as domestic water and recreational facilities to smallholders. In 1980, the company was formed.

Ownership

The initial four shareholders of KASCOL were CDC and two commercial banks who provided loans for financing infrastructure and equipment, and Zambia Sugar Co. who provided irrigation water. CDC provided the managerial resources and expertise based on its previous experience with similar projects in Africa.

Smallholders

It was not until 1984, after everything had been set up, that the first smallholders were integrated to the model. Only eight smallholders responded to the first public invitation to join the project; people were dubious of both the sugarcane crop, not a traditional crop, and of organizational arrangement. The first eight smallholders were subjected to a selection process by a panel comprised of a district agricultural officer, representatives from the Zambia Sugar Co. and KASCOL, four district chiefs and the district governor, as chairperson of the group. These first smallholders had prior experience in sugarcane farming hence no training was necessary; each was immediately given a four hectare cane field, plus half hectare plots, to build his/her house on and grow subsistence crops. These first volunteers happened to be ex-employees of KASCOL and all had a relationship with KASCOL management and hence trusted the proposed system. However, the following year interest in the project grew after the 8 smallholders received their income. As a result, the number of smallholders increased to 160 over a period of 10 years until the entry of new farmers was closed in 1994.

Governance

The initial Board of Directors of KASCOL consisted of a proportional representation of shareholders from CDC, the Zambia Sugar Co. and of the two commercial banks. In addition, the Zambian government appointed a high ranking official from the Ministry of Agriculture, who had a strong inclination to serving the interest of the smallholders.

Zambia Sugar Co. and KASCOL signed a renewable three years sugarcane supply and irrigation contract. Under this contract KASCOL would only supply its cane to the Zambia Sugar Co. and in turn would receive irrigation water. On the other hand, KASCOL and the smallholders signed an agreement by which the smallholders would lease land from KASCOL for a renewable 14 years period, would grow cane following the stipulated agronomic practices, and would receive agronomic services and irrigation.

In 1985 the smallholders formed an association called the Kaleya Smallholder Farmers Association (KASFA). This initiative was in response to advice given by KASCOL. The initial farmer association executive was composed mostly by the first eight smallholders to join the project. The primary role of KASFA was to represent the smallholders in negotiations with KASCOL. The chairperson of the farmer association also attended the KASCOL board meetings.

Changes Overtime

Significant changes happened over time in terms of ownership, governance, management and the participation of smallholders. One change was an increase in the participation and voice of the smallholders. In 2001, as a result of the lobbying of the farmer association, the smallholders had their individual cane production areas increased from the initial 4 hectares to up to 7.5 Ha. This increase brought the cane land ratio between KASCOL's own plantation and the smallholders' to almost 50/50. In addition, the farmer association successfully lobbied for an increase in the payout for their sugarcane. Another change came in 2005 after KASCOL had fully repaid all its initial loans. CDC and one of the banks sold their shares in KASCOL to the public. The shares were purchased by a variety of people including smallholders and KASCOL employees through two separate consortiums. Also, Zambia Sugar Co. donated its shares to the Mazabuka Cane Growers Trust (MCGT), a trust it had created to support sugarcane growers. Yet another change was in 2006 when the farmer association was transformed into a Trust (Kaleya Smallholder Trust, KAST) which allowed them to participate in the acquisition of the shares disposed of by CDC and one of the banks, thus gaining representation in the KASCOL board. The new Board of Directors was integrated then by representatives of the remaining bank, the two shareholding consortiums, and the Mazabuka Cane Growers Trust. At this point the smallholders and KASCOL employees held a 25% share in KASCOL through two consortiums and one trust. KAST was also able to secure a cane-cutting contract with KASCOL in 2006.The last main change occurred when CDC, which was a foreign development agency, stepped down in the late 1980s from its managing role in KASCOL and turned it over to Zambian nationals.

Reasons for the Success of KASCOL

The KASCOL model is considered a success not only because it was sustainable but, most importantly because it increased smallholders participation, governance role and ownership over time. There is also evidence of an increase in the smallholders' farm sizes and payouts overtime.

Four orders of factors played a role in the sustainability of the KASCOL model and the successful integration of smallholders, (1) the context that created an enabling economic and social environment; (2) the governance structure that helped to balance power between the parties involved; (3) the managerial and leadership skills which were instrumental for operational

efficiencies at all levels; and (4) the growth of social capital expressed in terms of trusting relationships, communication and conflict resolution.

The initial goals of the Zambia Sugar Co. to increase its mill throughput, and of the Zambian government to involve ordinary Zambians in the sugar industry, were the major drivers for this initiative. In addition, the presence of CDC with their experience and desire to bring about development created the initial conditions that encouraged the required commitment from the stakeholders to remain in the arrangement and make it work. As indicated by one of the former CDC officials who had a leading role in the initial set up of KASCOL,

"*CDC had an office in Lusaka [Zambia] which was charged with seeking investments to contribute to the development of the Zambian economy. As a development organization, CDC was also keen to build on the success of its smallholder settlement schemes in Swaziland and Malawi and to provide opportunities for Zambian farmers to join the project and improve their livelihoods."*

Proposition 1: The converging interests of the major partners and initiators have a positive effect on the sustainability of initiatives aimed at integrating smallholders in modern agri-food chains.

The industrial context, in terms of the sugar industry in general and the Zambia Sugar Co in particular, was one of growth. The model of integration may have had a different outcome in the context of an unsustainable sugar industry and/or a struggling focal company.

Proposition 2: Smallholders will not be successfully integrated in vertical coordination arrangements if the industry and/or the focal company in the chain are struggling.

The initial ownership structure of KASCOL and the individual interests of the owners were aligned with the long term interest of integrating smallholders in the ownership structure. This was pointed out by the former CDC official who had worked in setting up the KASCOL project:

"It was always envisaged that the settlers [smallholders] could become shareholders in the company and thus associate their own future success with that of "their" company. Whilst I was there it was envisaged that the shares would be sold and not given away."

This interest was maintained as the ownership structure changed overtime as evidenced by the fact that smallholders eventually became shareholders in KASCOL. Obvious as it may seem, it is unlikely that an ownership structure without genuine interest in including and maintaining small farmers would actually do so.

Proposition 3: The effective integration of smallholders requires a long term interest (political, economic or otherwise) on the part of the controlling stakeholders or senior partners.

The assets involved in sugarcane production and processing are highly specific to the industry. In the case of the KASCOL model, it is not only the high asset specificity in the sugar industry that may have kept the parties working together, but that the parties involved were also very

dependent on each other. The Zambia Sugar Co. capacity expansion could not be satisfied by their own plantations, and therefore had to outsource. On the other hand, KASCOL as a company was dependent on the Zambia Sugar Co. for irrigation water, and the smallholders on KASCOL for land to grow their cane. The land was provided to KASCOL by the Zambian government. Therefore, aside from the fact that the parties, in particular, the Zambia Sugar Co. and KASCOL had high asset specific investments made, they all were dependent on each other to operate as desired.

Proposition 4: Asset specificity and interdependency create an environment conducive to building and managing long term relationships.

Initially the smallholders depended very much on government influence to have their demands met. One smallholder, former chairperson for the farmer association, remembers:

"What I used to do was, I would write them [KASCOL management] a letter and say 'Management, I am coming with my committee at 14hrs.' We would go there, and discuss a particular point. If we did not agree, then I would push it to the Board, where we would settle the matter. If at the Board we agreed, and then the manager here decided to go contrary… I would simply call the governor, 'Governor, can you please come, there is a problem here. This person is not wanted by farmers so let him pack and go!' That is what I used to do, and he would go straightaway."

The evidence given shows that even though smallholders had no power, they still had an advocate in the form of the government of Zambia who provided leadership and exhibited greater power over all the other stakeholders.

Proposition 5: A powerful partner's interest and leadership in including smallholders increases the chances of smallholders being eventually included.

Overtime the parties began to communicate and resolve their differences with little involvement of outsiders. The level and quality of communication and mutual trust increased with time which in turn increased social capital. As relationships improved the parties learned how to manage the conflicts and bring about acceptable changes. When required they would bring their differences to conflict resolution committees integrated by their own member representatives. In cases where all these avenues failed, external mediation would be sought. According to one manager from Zambia Sugar Co., KASCOL and Zambia Sugar Co had never had any need for such a move because they always managed to resolve their differences between them. The situation was similar in the relationship between KASCOL management and the smallholders, as was pointed out by the farmer association chairperson:

"We call meetings [when we have issues we want to raise]. I can propose a meeting to management [KASCOL management], and management will listen because I am the representative of the smallholders. So once that meeting is organized, we sit down and share those ideas with management. If we feel that issue requires the involvement of the Directors, the Board itself, then the matter goes to the board…Then from the Board if we feel it still cannot be resolved, we involve external consultants…We do nt have a permanent external mediator because we do not

expect to have permanent problems, so we would not want to have a permanent person sitting in that capacity."

Over time, the smallholders have been able to bring to the attention of KASCOL management proposals for their farm sizes and payouts to be increased with positive results. Furthermore, the smallholders were able to receive information from KASCOL management concerning the sale of the shares from CDC and one of the banks. They also received advice to transform their association into a trust so as to participate in the buying of the shares. The smallholders went from relying on the government to mediate and solve problems to a situation where they could engage directly in meaningful discussions with KASCOL management to resolve their differences. An indication of trust is the increasing handing over of responsibilities from KASCOL management to the Kaleya Smallholder Trust (KAST) growers.

"…we were advised by KASCOL's business consultants that if you want to participate in buying shares, you cannot do that as an association, you have to form a trust. So that is how we opted to come up with a trust," states the current farmer association chairperson when questioned on the reasons behind transforming the association into a Trust.

Proposition 6: As relationships last the parties learn how to respond to mutual demands, manage conflicts, and bring about acceptable changes.

The model provided efficient governance mechanisms – board of KASCOL, farmer representation, and contracts - to regulate transactions and to provide efficient incentives. The penalties and costs of breaching the contracts were severe. For KASCOL it would mean not getting irrigation water from the Zambia Sugar Company; for the smallholders, eviction by KASCOL from the leased land. Furthermore farmers can't renege on their contracts; they do not own the land and irrigation was provided by the Zambia Sugar Company through KASCOL. One smallholder puts it this way:

"When it comes to that agreement [the Cane Farmers Agreement with KASCOL] and the obligations the farmer has, we are very conscious because we do not want to get into any trouble."

The presence of the farmer association, much as it helped in reducing the transaction costs of KASCOL management's dealings with the smallholders, it also helped in increasing the smallholders' bargaining power and achieve a more balanced relationship. In addition, the presence of a government official on the board helped to serve the interests of the smallholders because the government's primary intent in this model was to improve the livelihoods of the smallholders. Furthermore, the pooling of the smallholders' shares in KASCOL through the two separate consortiums unified farmers' voice amongst them and with other minority shareholders like the Zambian businessmen and KASCOL employees. This created an environment in which the parties could continue working together and responding to mutual demands. The KAST chairperson says,

"We are actually the four directors on the Board…I represent 25% of the shares for KASCOL, such that all the critical decisions that involve the shareholder directors, I am part of them,"

Proposition 7: Efficient governance creates an environment conducive to mutual responsiveness and has a positive effect on smallholders' integration.

From a coordination point of view, the distribution of roles and responsibilities between the parties proved to be operationally efficient. The size of operations of KASCOL provided for economies of scale which were passed along to the farmers in the form of efficient agricultural services and technical support. The efficient agricultural services that the smallholders received were evident in the results obtained. Even though the smallholders cultivated a total of 1,067 Ha against KASCOL's 1,100 Ha, the records show that they usually contributed a higher amount of sugarcane supplied to Zambia Sugar Co. than that from KASCOL's own plantation (see Table 2).

Table 2. KASCOL Sugarcane Yields

Year	KASCOL own cane (nucleus estate)	Smallholders
2005	128,383.24	131,514.10
2006	121,924.94	123,189.68
2007	116,342.38	123,995.44
2008	97,173.28	117,863.74
2009	107,148.56	101,116.78

Source. KASCOL records
Note. In 2008, there was a stand over (fallowed land) on some of the nucleus estate land

Efficient coordination resulted in the improvement of farmers' performance and sustainability. Obvious as this may seem, inefficient farming is not sustainable regardless of the characteristics of the integration model and consequently is unlikely that unsustainable farmers could be integrated in food chains.

Proposition 8: For smallholders to be successfully integrated in vertical coordination arrangements their farming operations must, at some point in time, reach acceptable levels of performance.

Managerial competence was a big factor in the success of the model as it affected operational efficiency at several level of the value chain. Evidence of coordination and learning to bring about efficiency and equity is present in the evolution of the model. The smallholders had all their necessary inputs delivered on time, and their cane fields were harvested according to the designed schedule such that no smallholder incurred any loss due to delayments. Management motivation in increasing smallholders satisfaction was based on the fact that performance of smallholders, KASCOL and Zambia Sugar are all interdependent. The smallholders are customers of KASCOL; KASCOL provides production services to the farmers and its future earnings depend on how well farmers do. Once smallholders became part owners of KASCOL they became both customers and owners of the company which increased even further management motivation to respond to smallholders needs. Arguable at this point the relationship between farmers and KASCOL management is similar to the one between management and farmers in a cooperative.

One smallholder expresses this and his satisfaction in the following way:

"… on cane there is no loss: water is ever there; fertiliser is ever there. There is nothing like, 'Where are we going to get fertiliser this year?' No, it is a must. Then again, transport is a must, cane cutters are a must. Now, even if they give you ZMK40,000,000 every year, it is like you are just given that money free of charge, because if you add labour, irrigation and weeding, it is only about ZMK2,000,000. So the whole ZMK38,000,000 is yours as your profit. Now if you were settled at Mwanachingwala there on a 7 Ha land, growing maize, you cannot get ZMK 40,000,000, never! So in short, we are well up!"

Similarly, an aspect of learning is observed in that over time KASCOL management changed the business arrangements to bring about more efficiency and satisfaction. Examples of this are the changes in the methods of payment and retentions. Eventually KASCOL management started to relinquish some of its previous roles and allowing the smallholders take on more responsibilities. This is expressed by one participant from KASCOL management:

"… originally there were some things that people thought were too big to be done by farmers [smallholders], especially those that require heavy implements and machinery. Some of these they are supposed to be slowly taking over. I do not think there are a lot that they have not taken over."

Proposition 9: Skilful management, through coordination and learning, improves performance and breeds satisfaction and inclusion.

After about 22 years of being involved in the KASCOL model, the smallholders significantly started increasing their ownership and governance role in KASCOL. This was facilitated by the willingness of all stakeholders to see this happen. One participant from KASCOL management states:

"We are trying to encourage them [smallholders] to do things on their own because there are total benefits there. Because the whole aim of [KASCOL] is to give at least two thirds of the land to smallholders so that it [KASCOL] becomes just their property."

Proposition 10: In an environment of social capital growth, smallholders will increase their participation and ownership.

Discussion

Previous studies of unsuccessful experiences of smallholders integration have concluded with statements like 'smallholders tend to be relegated to the role of mere labourers because of the power imbalance between them and the firm' (Little and Watts 1994); 'the firm assumes all decision-making roles with the smallholders being at the receiving end without any say in what happens' (Glover and Kusterer 1990), and; 'there is little evidence to show that the equity of smallholders increases as they get into such kinds of arrangements' (Watts et al. 1988, as cited in Porter and Phillips-Howard 1997). Contrary to these studies, in the KASCOL experience, the smallholders were able to increase their voice and participation to the point of owning shares in KASCOL.

The KASCOL experience happened in an initial context where smallholders had no alternative markets for their produce; had only one major source of income; did not own the production assets; had no previous experience in dealing with big corporation, and; were involved in the cultivation of a crop that was largely capital intensive. This type of context, as reported in the contract-farming literature, although favourable to the focal company, is not conducive to successful inclusion of smallholders (Glover 1987; Patrick 2004; Porter and Phillips-Howard 1997; Sriboonchitta and Wiboonpongse 2005; Warning and Key 2002). How was it then that smallholders gained voice and ownership? The following factors explain the success of KASCOL.

Context

The Zambia sugar industry, in general, and the Zambia Sugar Co. in particular, were viable enough to pay acceptable prices for the cane (Church et al. 2008) and to secure satisfactory income and profits for farmers and shareholders. The parties were not "struggling to command a share of diminishing margins within the chain" (Fischer, et al. 2007, 46).

The sugar industry requires investments in highly specific assets by all the parties involved which generates high co-dependency (Williamson 1981; Martinez 2002). KASCOL relied on the Zambia Sugar Co. for its irrigation water, and the Zambia Sugar Co. needed sugarcane supplied by KASCOL in order for its factory to operate at optimal capacity. The smallholders, on the other hand, relied on leasing land from KASCOL for their sugarcane production. This interdependency contributed to the sustainability of the model as the main stakeholders needed each other if they were to keep operating in the sugar industry.

The initial goals and intent of the Zambia Sugar Co., the Zambian government, CDC, and the other stakeholders, created an environment conducive to sustainability and inclusion. The Zambia Sugar Co. needed extra supply of cane for its expanded mill factory and had no extra land. The Zambian governement wanted to involve poor Zambians in the sugar industry to reduce poverty. CDC had useful experience and was looking for development projects to fund. In addition, the Zambian government, which at that time had majority shareholding in Zambia Sugar Co., had greater power over the other stakeholders and used this power to provide visionary leadership and promote and support the inclusion of the smallholders.

The controlling shareholders had expressed, from the onset of the project, a genuine interest to include the smallholders in the governance and ownership structure. The smallholders were informed and aware of such intent. This expectation gave them hope and motivation to stay in the arrangement. These findings are consistent with studies (Arino and De La Torre 1998; Doz 1996; Hoffmann and Schlosser 2001) in which the initial conditions were considered to affect the success of long term relationships.

Governance

The effect of governance mechanisms in KASCOL's success can be observed in terms of the contracts, the composition of the board, and the farmers' association and representation. The farming contracts provided efficient incentives for the parties to work together. Although some evidence suggests that contracts may work against building trust, binding contracts tend to foster a greater sense of commitment as compared with informal agreements (Malhotra and Murnighan 2002).

The initial involvement of the Government of the Republic of Zambia in the KASCOL board contributed to protecting the interests of the smallholders and to balance power between the smallholders and the other parties. As the interests and goals of some of the shareholders and outside stakeholders changed, the composition of KASCOL board changed accordingly. At a later stage, as farmers acquired an interest in KASCOL, they gained direct representation at the board and developed their own voice. A healthy balance of power in the board was achieved.

Management

There was clear evidence of managerial competence and it was considered instrumental for overall satisfaction. All parties involved were clear on the role they were to play, and activities were run as scheduled. Operational efficiency is considered important to the success of any collaboration (Mohr and Spekman 1994; Monczka et al. 1998) as it ensures that the goals of the various parties are met (Pfeffer and Salancik 2003). Along the years, several changes were implemented in how KASCOL management worked with the smallholders. These changes reflected learning processes, as KASCOL management sought new ways of creating efficiency in the system as well as increasing the smallholders' satisfaction. The smallholders received their inputs as required, and the harvesting programme was according to schedule. Moreover, when it came to the field activities, supervision was available for the smallholders through KASCOL's extension service, thus ensuring that all tasks were carried out on time and as desired. The smallholders were contributing significantly to the KASCOL overall output as they were contributing over half of KASCOL's total supply to the Zambia Sugar Co. Learning and implementation of changes was also a way to nurture social capital as continuous communication and information-sharing was required. This claim finds support in Arino and De La Torre (1998), Doz (1996), and in Ring and Van de Ven (1994) who consider that learning and personal bonds mutually affect each other.

Social Capital

Although the initial conditions, governance structures and managerial competence were key to the sustainability of the model, social capital was the most relevant factor affecting the integration and inclusion of the smallholders. Social capital can be assessed in terms of the presence and nature of personal relationships, communication, and trust (Tsai and Ghoshal 1998) and (Nahapiet and Ghoshal 1998). There was evidence of a very open communication between the parties in KASCOL. The fact that the first smallholders to join the model were ex-employees of KASCOL, and that these same farmers were majority in the first farmer association executive, helped to keep the communication lines open and to continue building personal bonds. The initial personal bonds facilitated communication and the sharing of information (Adler and Kwon 2002; Tsai and Ghoshal 1998), and vice-versa, communication and information sharing improved personal relationships. This finding is consistent with the claim by Ring and Van de Ven (1994) that continuous collaboration and interactions result in closer personal bonds and ultimately to more constructive ways of conflict resolution as suggested by Monczka et al.(1998) and Mohr and Spekman (1994) which over time increases the level of trust (Adler and Kwon, 2002; Cohen and Prusak, 2001; Fischer et al. 2007; Tsai and Ghoshal 1998).

Figure 1 presents a theoretical model to explain the dynamic interdependency of the variables at

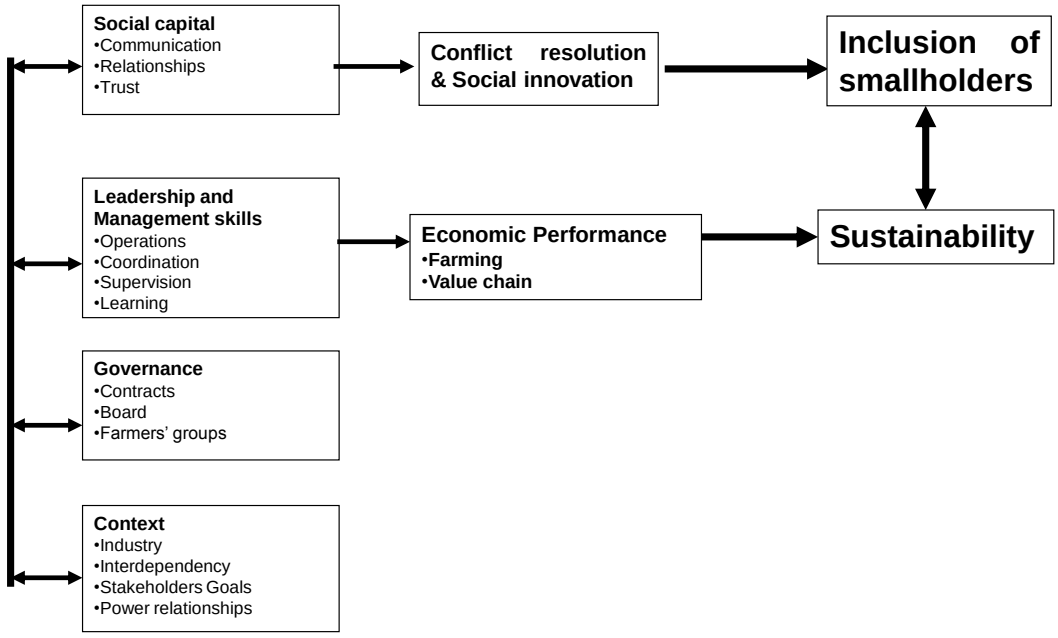

Figure 1. Factors affecting sustainability and inclusion in the KASCOL model

Final Reflections

The KASCOL model, so far, constitutes an example of successful smallholders' integration in agri-food value chains. The context of the model, its governance structures, managerial competence, and social capital were all found to be significant determinants of sustainability. Without any of them it is unlikely that an initiative like the one studied here could have succeeded. But the main claim resulting from this study is that the goal of smallholders' inclusion and increasing ownership is highly unlikely without significant growth in social capital, even when all the other factors are in place. There are reasons to believe that the significant levels of social capital observed in the KASCOL experience did not emerge by chance but as a result of senior stakeholders purpose, efficient governance structures, and skilful management and leadership. Therefore, the overall managerial implication of this study is that agro-industrialisation projects seeking to include smallholders must not only get governance and management right but must get the required levels of social capital right.

Several questions remained to be answered and require further investigation. Why would the initial shareholders want to sell shares to farmers and at what price in models like this one? In the KASCOL case this happened because the Government of Zambia, established it as a condition for providing land for the project, and because the banks, after collecting the outstanding debt, decided to sell their share. The share pricing mechanism used in this case was not investigated. What seems clear is that, in any case, for an effective transfer of ownership to take place, some sort of covenants must be in place early on to ensure that the transfer to farmers takes place under desirable conditions.

Although the KASCOL model seems in principle similar to a Build-Own-Operate-Transfer (BOOT) model, for effective integration to take place much attention should be paid to building not only the production and marketing capabilities of the project but most importantly the human and social capital capabilities. Also the timing, phasing and degree of transfer to farmers should be subject to careful consideration. In KASCOL transfer of ownership too early to farmers may have ended up in unwanted consequences. It took almost 25 years of fostering mutual trust, knowledge and communication for partial ownership transfer to happen. At this stage the majority ownership, more than 70% is still held by outside investors. It remains to be seen what will happen if and when farmers might hold a majority stake.

It is not clear from the field work if formal or managed mechanisms were in place for improving communication and for conflict resolution. One of the weaknesses of retrospective research methods is that memories are fuzzy and that interviewees, at the time when such events happened, may have not paid attention to events or phenomena that what we, as researchers now, consider relevant. This question should be further explored.

An area for future research would be to look at if and how the change in ownership of KASCOL, which took place in 2005 and 2006, will have any long term effect in the future sustainability of the model. Our questioning to the interviewees was not around how recent events of integration affected overall performance but how during 25 years the integration came to be. What we know is that KASCOL has so far improved the wellbeing of farmers and has increasingly started integrating them in ownership and governance positions.

References

Adler, P., and S. Kwon. 2002. Social capital: Prospects for a new concept. *Academy of Management Review* 27(1): 17-40.

Arino, A., and J. De La Torre. 1998. Learning from Failure: Towards an evolutionary model of collaborative ventures. *Organization Science* 9(3): 306-325.

Bangwe, L. 2009. Comparative analysis of outgrowers in irrigated agriculture in Zambia Paper presented at the The National Consultative Stakeholder Workshop on Joint Ventures and Outgrower Schemes in Zambia.

Baumann, P. 2000. Equity and efficiency in contract farming schemes: the experience of agricultural tree crops. Working Paper-Overseas Development Institute.

Buvik, A., and G. John. 2000. When does vertical coordination improve industrial purchasing relationships? *The Journal of Marketing* 64(4): 52-64.

Catelo, M., and A. Costales. 2008. Contract farming and other market institutions as mechanisms for integrating smallholder livestock producers in the growth and development of the livestock sector in developing countries. PPLPI Working Paper.

Chen, M. 1989. Women's work in Indian agriculture by agro-ecologic zones: Meeting needs of landless and land-poor women. *Economic and Political Weekly* 24(43): WS79-WS81+WS83-WS89.

Cheng, Y. T. and A. Van de Ven. 1996. Learning the innovation journey: order out of chaos? Organization Science Providence R I, 7(6): 593.

Church, A. D., G. M. Groom, D. N. Thomson, and V. R. Dlamini. 2008. Small-scale cane grower development models: Some lessons from sub-Saharan Africa. *Proc S Afri Sug Technol Ass.* 81: 116-127.

Cohen, D., and L. Prusak. 2001. *In good company: How social capital makes organizations work*: Harvard Business Press.

Coulter, J., A. Goodland, A.Tallontire, and R. Stringfellow. 1999. Marrying farmer cooperation and contract farming for service provision in a liberalising sub-Saharan Africa. *Natural Resource Perspectives* 48: 1-4.

Doz, Y. 1996. The evolution of cooperation in strategic alliances: Initial conditions or learning processes. *Strategic Management Journal* 17(7): 55-83.

Fischer, C., M. Gonzalez, M. Henchion, and P. Leat. 2007. Trust and economic relationships in selected European agrifood chains. *Food Economics-Acta Agriculturae Scandinavica, Section C* 4(1): 40-48.

Fischer, C. et al. 2009. Factors influencing contractual choice and sustainable relationships in European agri-food supply chains. *European Review of Agricultural Economics*.

Frank, S., and D. Henderson. 1992. Transaction costs as determinants of vertical coordination in the US food industries. *American Journal of Agricultural Economics* 74(4): 941-950.

Gabbay, S., and R. Leenders. (Eds.). 2001. *Social capital of organizations*: Emerald Group Publishing.

Glover, D. 1987. Increasing the benefits to smallholders from contract farming: Problems for farmers' organizations and policy makers. *World Development* 15(4): 441-448.

Glover, D., And K. Kusterer. 1990. *Small farmers, big business: contract farming and rural development*. London: Macmillan Press.

Gray, B. 2008. Intervening to improve inter-organizational relationships *The oxford handbook of Inter-organizational Relations*: Oxford University Press.

Hennessy, D. 1996. Information asymmetry as a reason for food industry vertical integration. *American Journal of Agricultural Economics* 78(4): 1034.

Hobbs, J., and L. Young, L. 2000. Closer vertical co-ordination in agri-food supply chains: a conceptual framework and some preliminary evidence. *Supply Chain Management: An International Journal* 5(3): 131-142.

Hoffmann, W., and R. Schlosser. 2001. Success Factors of Strategic Alliances in Small and Medium-sized Enterprises—An Empirical Survey. *Long Range Planning* 34(3): 357-381.

Hovhannisyan, V., V. Urutyan and D. Dunn. 2005. The role of cooperatives in milk marketing: the case of Armenia. Paper presented at the XXI International Co-operatives Research Conference, University College, August. Cork, Ireland.

Huxham, C., and N. Beech. 2008. Inter-organizational power *The Oxford Handbook of Inter-Organizational Relations*. 555-579: Oxford University Press.

Jauch, H. 1999. Structural Adjustment Programmes: Their Origin and International Experiences *Background Paper*. http://www.larri.com.na/papers/SAPS.doc

Kherallah, M., and J. Kirsten. 2002. The new institutional economics: applications for agricultural policy research in developing countries. *Agrekon* 41(2): 111-134.

Kirsten, J., and K. Sartorius. 2002. Linking agribusiness and small-scale farmers in developing countries: is there a new role for contract farming? *Development Southern Africa* 19(4): 503-529.

Kumar, N., L. Scheer, and J. Steenkamp. 1995. The effects of perceived interdependence on dealer attitudes. *Journal of Marketing Research* 348-356.

Langley, A. 1999. Strategies for Theorizing from Process Data. *Academy of Management Review* 24(4): 691-710.

Little, P., and M. Watts, (Eds.) 1994. *Living Under Contract: Contract Farming and Agrarian Transformation in Sub-Sahara Africa Contract farming and the development question*. London: University of Wisconsin Press.

Malhotra, D., and J. Murnighan. 2002. The effects of contracts on interpersonal trust. *Administrative Science Quarterly* 47(3): 534-562.

Martinez, S. 2002. Vertical Coordination of Marketing Systems: Lessons from the Poultry, Egg, and Pork Industries. *Agricultural Economics Report 807*.

Matopoulos, A., M. Vlachopoulou, V. Manthou, and B. Manos. 2007. A conceptual framework for supply chain collaboration: empirical evidence from the agri-food industry. *Supply Chain Management: An International Journal* 12(3): 177-186.

Mohr, J. and R. Spekman. 1994. Characteristics of partnership success: partnership attributes, communication behavior, and conflict resolution techniques. *Strategic Management Journal* 15(2): 135-152.

Monczka, R., K.. Petersen, R. Handfield, and G. Ragatz. 1998. Success Factors in Strategic Supplier Alliances: The Buying Company Perspective. *Decision Sciences* 29(3): 553-577.

Mwanaumo, A. 1999. *Agricultural Marketing Policy Reforms in Zambia.* Paper presented at the Workshop on Agricultural Transformation in Africa, June. Nairobi, Kenya.

Nahapiet, J., and S. Ghoshal. 1998. Social capital, intellectual capital, and the organizational advantage. *Academy of Management Review* 23(2): 242-266.

Nakaponda, B. 2006. *Socio - Economic Impact of the EU's Sugar Reforms on the Zambian Sugar Sector.* Prepared in association with Newton Lungu and Associated for the European Commission.

Patrick, I. 2004. Contract farming in Indonesia: Smallholders and agribusiness working together. ACIAR *Technical Reports* 54. Canberra : ACIAR

Pettigrew, A. 1997. What is a processual analysis. *Scandinavian Journal of Management* 13(4): 337-348.

Pfeffer, J. and G. Salancik. 2003. *The External Control of Organizations: A Resource Dependence Perspective*. California: Stanford Business Books.

Pletcher, J. 2000. The Politics of Liberalizing Zambia's Maize Markets. *World Development,* 28(1): 129-142.

Porter, G., and K. Phillips-Howard. 1997. Comparing contracts: an evaluation of contract farming schemes in Africa. *World Development* 25(2): 227-238.

Pozzebon, M. and A. Pinsonneault. 2001. *Structuration Theory in the IS Field: an Assessment of Research Strategies*.

Reynolds, N., C. Fischer and M. Hartmann. 2008. Determinants of Sustainable Business Relationships in Selected German Agri-food Chains. *British Food Journal* 111(8): 776-793.

Ring, P., C. Huxham, M. Ebers and S. Cropper. 2008. Trust in Inter-organizational Relations. In *The Oxford Handbook of Inter-Organizational Relations* Edited by Bachmann, R. and A. Zaheer, 20.Oxford Handbooks Online.

Ring, P., and A. Van de Ven. 1994. Developmental processes of cooperative interorganizational relationships. *Academy of Management Review* 90-118.

Ritchie, J., and J. Lewis. 2003. *Qualitative research practice: A guide for social science students and researchers*: Sage Publications Ltd.

Runsten, D. 1994. *Transaction Costs in Mexican Fruit and Vegetable Contracting: Implications for Asociación en participación*. Paper presented at the XVIII International Congress of the Latin American Studies Association.

Sartorius, K., and J. Kirsten. 2005. The boundaries of the firm: why do sugar producers out-source sugarcane production? *Management Accounting Research* 16(1): 81-99.

Sartorius, K., and J. Kirsten. 2007. A framework to facilitate institutional arrangements for smallholder supply in developing countries: an agribusiness perspective. *Food Policy* 32(5-6): 640-655.

Schulze, B., A. Spiller and L. Theuvsen. 2007. A broader view on vertical coordination: lessons from German pork production. *Journal on Chain and Network Science* 7(1): 35-53.

Seshamani, V. 1998. The impact of market liberalisation on food security in Zambia. *Food Policy* 23(6): 539-551.

Singh, S. 2002a. Contracting Out Solutions: Political Economy of Contract Farming in the Indian Punjab. *World Development* 30(9): 1621-1638.

Singh, S. 2002b. Multi-national corporations and agricultural development: a study of contract farming in the Indian Punjab. *Journal of International Development* 14(2): 181-194.

Sriboonchitta, S. and A. Wiboonpongse. 2005. Analysis of Contract Farming in Thailand. *Editorial Policy*. 4(3): 361.

Tsai, W., and S. Ghoshal. 1998. Social capital and value creation: The role of intrafirm networks. *Academy of Management Journal* 41(4): 464-476.

Warning, M., and N. Key. 2002. The social performance and distributional consequences of contract farming: An equilibrium analysis of the Arachide de Bouche program in Senegal. *World Development* 30(2), 255-263.

Weatherspoon, D., J. Cacho and R. Christy. 2001. Linking globalization, economic growth and poverty: impacts of agribusiness strategies on sub-Saharan Africa. *American Journal of Agricultural Economics* 722-729.

Williamson, O. 1981. The economics of organization: The transaction cost approach. *American Journal of Sociology* 87(3): 548-577.

Young, L., and J. Hobbs. 2002. Vertical linkages in agri-food supply chains: changing roles for producers, commodity groups, and government policy. *Review of Agricultural Economics* 24(2): 428.

IFAMA Business Office • P.O. Box 14145 • College Station, TX 77841-4145, USA
Tel: 1-979-845-2118 • Fax: 1-979-862-1487 • E-mail: ifamr@ifama.org • Web: http://www.ifama.org

The IFAMR (ISSN #: 1559-2448)