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International Food and Agribusiness Management Review

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International Food and Agribusiness Management Review

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EDITOR'S NOTE

Dear Colleagues,

The IFAMR was mentioned in a recent *Chicago Tribune* story about its progressive Open Access (OA) model of publishing. [full article]

So what is OA?

Open Access makes research freely available online without having to go through a paid subscription service or library. The IFAMR (every article published since 1998) is free to anyone with Internet access, and new issues are available immediately upon publication. We hold no material back. We initiated OA in 2009 and moved from about 350 individual subscribers and twelve fee-paying libraries, to complete access through our website, numerous search services, and a global mailing to over 12,000 scholars, managers, and policymakers. An OA publication model was necessary if we wanted to broaden our scholar network and research scope to include the fast growing emerging markets. Open Access is one reason we have seen a 24% compound annual growth rate in submissions since 2008.

In one sense OA can be done by anyone, since anyone can publish and distribute on the Internet. One challenge or concern is whether a publisher can simultaneously provide OA and achieve high quality. More specifically can it provide OA and have an Impact Factor? The IFAMR has achieved both. One of the largest journal publishers in the world—Springer, publishes over 200 OA journals, and less than 20% have an Impact Factor. Thus, one might conclude that OA limits a journal's ability to obtain an ISI Impact Factor. Vice President for Thomson-Reuters, James Pringle, says no. He stresses that nothing about being OA intrinsically limits the ISI impact of a journal, (full article). OA reflects the lows barriers of entry to publish, whereas achieving the strict criteria of receiving an Impact Factor indicates the quality of the journal.

Finally, going back to the focus of the above *Chicago Tribune* article, another issue with the OA movement is the direct and highly adverse effects it has on the traditional publishing and library subscription model. Universities are tired of paying salaries of researchers and then having to pay publishers again for access to the scientific writing of their university employees. Consequently, there is a big movement underway towards OA publishing, and large publishing houses are very concerned. The IFAMR represents a new sustainable publishing model that melds OA with high quality.

Our strategy is to better serve emerging markets and this issue continues to deliver. We have five continents represented by the authors and research settings in this edition. The IFAMR family continues to grow. We are excited about the forthcoming September issue of the journal that focuses on papers coming through in conjunction with IFAMA's 2016 Best Paper Competition. This year, submissions to IFAMA's annual Symposium occurring in Aarhus, Denmark is off the charts with many authors looking to take advantage of an accelerated blind peer-review process, fast track publishing and—one of the few journals with an Impact Factor. That's value!

Enjoy the issue. Keep those submissions coming and thank you for helping to serve as a reviewer—it keeps us rolling.

Peter Goldsmith, Executive Editor, IFAMR

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Farmer-led Seed Enterprise Initiatives to Access Certified Seed for Traditional African Vegetables and its Effect on Incomes in Tanzania

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Abstract

Farmers need access to certified seed stocks for efficient production of traditional African vegetable seed. However, access to quality certified seed is constrained by several factors. Primary data from four selected regions of Tanzania was analyzed to examine the causal linkages among traditional African vegetable farmers' decisions to participate in farmer-led seed enterprises and their access to quality certified seeds. The effect of farmers' access to certified traditional African vegetable seed on revenue generated from their seed sales in the study locale was assessed. This study concludes that farmers' revenue from traditional vegetable seed sales is positively and significantly influenced by access to certified seed. Indeed, access to certified seed can be increased, if farmers participate in farmer-led seed enterprises, and if they have more frequent contact with village extensionists. Relevant policy actions and recommendations for improving farmer-led seed enterprises are offered.

Keywords: smallholder market participation, traditional African vegetables, African indigenous vegetables, contract farming, quality declared seed, certified seeds

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Introduction

In most Sub-Saharan African countries, diets of African consumers are often deficient in essential micronutrients and vitamins, resulting in widespread malnutrition. Increasing consumption of traditional African vegetables such as amaranth (*Amaranthus* spp.), African eggplant (*S. aethiopicum, S. anguivi* and *S. macrocarpon*), African nightshade (*Solanaceae*), and jute mallow (*Corchorus* spp.) ensures staple-based diets are balanced and provide both food and nutrition security (Yang et al. 2009; Keatinge et al. 2011; Afari-Sefa et al. 2012; Keding et al. 2012; Keatinge et al. 2015). In recent years, the demand for traditional African vegetables has increased but limited availability and accessibility of quality seeds of preferred varieties has constrained the ability of farmers to deliver improved produce to consumers (Afari-Sefa et al. 2013). Most vegetable producers are thus seed-insecure (McGuire and Sperling 2011). Most traditional vegetable species are open-pollinated and farmers can easily save seed over many seasons, thereby discouraging commercial investment in seed production (Karanja et al. 2013). There are several other reasons why farmers utilize poor quality vegetable seed in their fields. These include lack of information about quality seed production methods, lack of availability of improved varieties of seeds, lack of updated market information and support systems, and lack of credit to purchase farm inputs. Poor infrastructure raises the cost of inputs and lowers revenue from crop sales (Daniel and Adetumbi 2004; Ellis-Jones et al. 2008; Thomas et al. 2008; Minot 2011).

Good quality certified seed enhances crop yields and their subsequent contribution to food security, the value of the product in the market, and economic growth (Lanteri and Quagliotti 1997; Daniel and Adetumbi 2004; Toenniessen et al. 2008; Louwaars and De Boef 2012; Keatinge et al. 2015). Increasing smallholder access to good quality inputs is often desirable for addressing yield gaps and increasing output, as most farmers would otherwise resort to using farmer-saved seed (Gildemacher et al. 2011). To improve the accessibility of certified seed from formal seed markets, some studies have proposed that national seed regulatory agencies shift their role from direct supervision of seed production toward technical and policy support for the development of a wider range of seed provision options (Tripp 1997; Tripp and Rohrbach 2001). In addition to the urgent need for seed policy reforms, Daniel and Adetumbi (2004) suggest that vegetable seed supply systems can be improved when breeders and seed producers regularly assess consumers' preferences and factor them into their participatory breeding and seed supply systems. Almekinders et al. (1994) identified the potential of local informal seed markets for improved seed supplies in developing countries when they are properly integrated with the formal sector.

David (2004) argues that farmer-led seed enterprises might offer a sustainable solution to accessibility of good quality and certified seed, but scaling up this approach in Eastern and Southern Africa remains a challenging task. However, in Tanzania, Afari-Sefa et al. (2013) found that community seed producers have a lower average input cost and higher returns than contract seed growers, and note that seed companies operate in a dynamic business environment and have profit-oriented motives that might contravene development objectives. The authors investigated two farmer-led seed enterprise models (FLSE) namely, contract seed production with private seed companies (formal seed system) and the community-led Quality Declared Seed (QDS) production systems (semi-formal system). The QDS system is regarded as an improved

alternative seed supply system that caters for regional specific varietal preferences and provide opportunities for establishing linkages with formal institutions to produce good quality seed and meet farmers' complex and diverse seed requirements. However, the authors suggested that because the majority of farmers obtain seed from informal sources, strengthening informal seed production systems by integrating them with semi-formal and formal seed systems must be seen as an urgent priority if the supply-side bottleneck is to be successfully addressed.

In the 1980s, many African farmers obtained their inputs and agricultural credit from semi-formal markets or state-owned commodity marketing boards, but these have failed to deliver good quality inputs and services mostly due to inefficiency in delivery systems. Therefore, during the 1990s several African countries including Tanzania liberalized their seed markets. In East Africa, the liberalized seed trade primarily benefited commercial staple crops such as maize; additional investment was required to develop seed markets for other crops (Rohrbach et al. 2003). In countries across the region, particularly Tanzania, many traditional African vegetables are well-adapted to local agroclimatic conditions and are highly valued in local markets. However, the informal markets and networks that smallholders rely on to obtain seed of these crops typically fail to provide reliable, good quality cultivars (Karanja et al. 2013). Ellis-Jones et al. (2008) estimated that 70-75 percent of traditional vegetable seeds come from the informal sector, whereas the semi-formal and formal seed sector together constitute 25-30 percent. Weinberger and Msuya (2004) estimated that the share of traditional vegetable seed sold in the formal market is about 10 percent, with about 15 hectares under formal seed production. Informal seed markets thus play a vital role in the buying and selling of vegetable seed. The Tanzanian government is trying to improve the efficiency of the vegetable seed value chain through semi-formal and formal seed markets via various policy reforms. Yet formal markets are an increasingly important source for affordable certified quality seed and other input services in Tanzania (World Bank 2012).

Many studies (e.g. Shiferaw et al. 2008; Alene et al. 2008; Asfaw et al. 2012) have analyzed the causal linkages between adoption of improved seed varieties and machinery as well as the economic benefits attained from adopting improved seed varieties in sub-Saharan African countries. The conclusion of these studies is that adopting improved or certified seed varieties has contributed to the welfare of rural households. Some studies (e.g. Fischer and Qaim 2012; Boniphace et al. 2014) identified factors that constrain farmers' decisions to participate in seed markets. The authors conclude that transaction costs incurred by farmers when seeking price information and during produce sale transactions influence their decisions to participate in viable markets. Not surprisingly, the studies highlighted above focus mainly on cereals and pulses. Several other studies (Weinberger and Msuya 2004; Ellis-Jones et al. 2008; World Bank 2012; Karanja et al. 2013; Afari-Sefa et al. 2012; Afari-Sefa et al. 2013) analyzed the performance of vegetable seed markets and policy reforms in East Africa. However, there has been limited research to explicitly examine the causal linkages among farmers' access to certified traditional African vegetable seed and the revenue generated from their seed sales.

This study aims to (i) examine the causal linkages among farmers' decisions to participate in farmer-led seed enterprises and farmers' access to certified traditional African vegetable seed within four regions of Tanzania, and (ii) measure the effect of accessibility of certified traditional African vegetables on revenue generated from the traditional African vegetable seed sales in

Tanzania. The research questions underlying our study include: Do farmers' decisions to participate in farmer-led seed enterprises improve accessibility to certified traditional African vegetable seed? Does increased accessibility to certified seed lead to increases in revenue from seed sales? These hypotheses were tested using an endogenous treatment effect model complemented by a two-stage instrumental variable model, both of which are explained in more detail in the econometric framework of the methods section.

Seed Policies and Regulations in Tanzania

Following the liberalization of seed trade in the late 1990s, Tanzania introduced several policies and regulations to improve quality certified seed supply and distribution systems, and the production and marketing of crops including: Plant Protection Act of 1997, Plant Breeders Act 2002, Seed Act 2003, Seed Regulation 2007, Protection of New Plant Varieties (Plant Breeders' Rights) Regulations (2008). Despite the modest achievements gained from these policies and regulatory acts, explicit variety release requirements and procedures, seed certification standards, and conditions for import and export of vegetable seeds remain largely unclear. The regulations do not clearly differentiate between seed of staple crops and those of horticultural crops, especially vegetables. In the guidelines and procedures, priority is given to staple crops rather than vegetables. However, a concerted advocacy effort by AVRDC – The World Vegetable Center and its national partners to increase awareness of the value of traditional vegetable crops among government regulators resulted in the release for the first time in 2010 of seven new varieties of traditional vegetables in Tanzania (AVRDC 2011, Afari-Sefa et al. 2012).

To improve seed quality and a more secure seed supply in deficit areas, the Tanzanian government introduced the Quality Declared Seed (QDS) program, which was developed by the Food and Agriculture Organization of the United Nations (Food and Agriculture Organization 2004). The objective of the QDS program is to improve the availability of quality seed to farmers in seed deficit areas such as Central Tanzania. Most of the country's private seed companies operate from northern Tanzania, a considerable distance from potential customers located in central Tanzania; thus, they seldom can deliver seed in a timely manner. The QDS functions most effectively where formal seed markets are not active and government resources are too limited to reach target farmers.

As a part of the seed regulatory process, the government has established an independent institute known as the Tanzania Official Seed Certification Institute (TOSCI) to regulate seed businesses in accordance with the Seed Act of 2003. TOSCI certifies seed of registered cultivars for official trading in Tanzania. There are three major steps involved in producing certified seed: technical, administrative, and legislative. The technical aspect requires cultivars to be registered according to relevant eligibility criteria. New cultivars must then undergo National Performance Trials (NPT) and certain tests to release new varieties, namely Distinctness, Uniformity and Stability (DUS) to demonstrate that the new variety adds value in terms of productivity, adaptability and tolerance/resistance to pests and diseases. Administrative steps include registration of seed growers, applications and certification services, and monitoring of seed trading. TOSCI follows legislative guidelines to complete the first two steps (Afari-Sefa et al. 2013).

The Tanzanian government has established an independent body called the Agricultural Seed Agency (ASA) with the key mandate of promoting the use of improved seed as well as promoting private sector participation in seed production, processing and marketing. Although ASA encounters logistical and resource bottlenecks, its policies and regulations have changed the seed production and marketing system in Tanzania (Ministry of Agriculture and Co-operatives 1997). Despite the improved policies and interventions to address spatial and time gaps in its seed supply system the country is still beleaguered by low production and productivity of vegetables. This is due to limited use of inorganic fertilizers, quality seed, and pesticides; inefficient input distribution systems; poor infrastructure facilities; and climate change (Rohrbach et al. 2002).

Vegetable Seed Systems in Tanzania

A seed system is defined as "an interrelated set of components including breeding, management, replacement and distribution of seeds" (Maredia et al. 1997; Thiele 1999). Vegetable breeding is mainly done at the Horticultural Training and Research Institute, Tengeru (HORTI-Tengeru) and to some extent at Sokoine University of Agriculture and other agricultural research institutes. Due to the lack of research investment, no breeding programs are currently underway at HORTI-Tengeru. Therefore, AVRDC – The World Vegetable Center Eastern and Southern Africa, based in Arusha, Tanzania, contributes by breeding improved cultivars of global and African traditional vegetables to suit farmers' needs and consumers' preferences. Although AVRDC provides germplasm and the requisite plant breeding and seed production expertise, HORTI-Tengeru is the most active participant in the varietal release process for all public cultivars. Several private companies are involved in varietal development and release, albeit with a strong focus on hybrids; these companies need to emphasize exclusivity in plant varietal protection rights to ensure they can re-coup their investments and accrue profits (Nazeem et al. 2010).

AVRDC develops new vegetable lines and releases the lines as varieties in collaboration with public sector partners such as HORTI-Tengeru in Tanzania (Afari-Sefa et al. 2013; Dinssa et al. 2015). AVRDC researchers multiply and maintain breeder seed[1], which is then sent to the Agricultural Seed Agency (ASA), an independent public entity, for further multiplication and preparation of foundation seed[2] for distribution to private seed companies. Private seed companies in turn multiply the foundation seed to obtain commercial certified seed for sale to farmers in domestic, regional and international markets. As of January 2015, there were 23 seed companies procuring foundation seed of different crops (including vegetables) from ASA[3], most through contracts with farmers. To increase timely access to adequate foundation seed for the production of certified seed by the private sector, AVRDC introduced an online ordering

[1] Breeder seed is defined as "Seed that is produced by a breeding unit in small quantities for multiplication to reach the desired volumes for sale to farmers" (Minot et al. 2007)

[2] Foundation seed is defined as "seed produced by a public or private enterprise mandated multiplication unit, technically one breeding generation after breeder seed". It requires subsequent multiplication by private seed companies before being sold to farmers as formal certified seed (Minot et al. 2007). In Tanzania, ASA has the national mandate for providing foundation seed of publicly released and maintained varieties to private seed companies.

[3] List of 23 companies received from ASA, Morogoro, Tanzania

platform, "VegOneX" in May 2015 (http://asa.worldveg.org/). Seven companies have registered to use VegOneX and now order foundation seed from ASA through this platform.

In areas where private companies are not able to provide seed to farmers in a timely manner, ASA produces commercial seed that is sold directly to stockists and to seed growers as certified seed. Farmers may receive seed from other farmers through exchange or seeds saved from their own fields. Some farmers receive seed from nongovernmental organizations as part of development project or via emergency aid relief. Within the seed supply and distribution system, TOSCI has authorized district inspectors who handle quality control for all actors/stakeholders involved in the supply chain system.

Materials and Methods

Study Sites

A survey of ninety farm households that cultivate traditional African vegetables for seed production were selected in four administrative regions of Tanzania: Arusha, Tanga, Morogoro, and Dodoma (Figure 1). The survey was conducted between January and May 2013. Study regions, districts, wards, and villages were selected using a multistage procedure based on a combination of project deliverable requirements, the importance and volume of traditional vegetable produced in various wards and villages, the extent of market access, and interviews with key informants and officials from the Ministry of Agriculture.

The Arusha region falls under the Northern Highlands agroclimatic zone with an altitude of 1400 m and experiences bimodal rainfall of 760–1200 mm per annum (usually from October-December and March–May). The temperature in Arusha region varies between 5–30 ^{o}C. The Tanga region (Lushoto district) is located within the Western Usambaras, with an altitude ranging from 1000–2100 m, characterized by steep slopes and narrow valleys (Vainio-Mattila 2000) with a relatively high population density of 210 persons/km of agricultural land. Land use is a combination of traditional subsistence farming and modern cash crop production.

Subsistence crops such as maize, field beans, bananas, cassava and sweet potatoes are grown on hillsides, while vegetables are mostly grown in valley bottoms (Vainio-Mattila, 2000). Compared to most other agroclimatic zones of the country, the Lushoto study site enjoys a relatively cool climate with temperatures ranging from 18-23 ^{o}C, with the maximum occurring in March and minimum in July, and high rainfall of 600–2000 mm per annum. The area is characterized by high rainfall variability. The Morogoro region has a coastal climate with temperatures ranging from a minimum of 19 ^{o}C to maximum of 30 ^{o}C, mean annual precipitation of 854 mm, and an altitude of 366–549 m. The Dodoma region study site in central Tanzania has a semi-arid (savanna) type of climate with a unimodal rainfall regime of 500-700 mm per annum, usually starting as early as mid-November in some places and ending around mi-May, followed by a long dry season (Stigter et al. 2005). The rainfall is relatively low in amount and rather unpredictable in frequency. The unreliability of rainfall in these regions imposes a pattern of risk aversion in traditional farming. During the long dry season, persistent desiccating winds and low humidity contribute to high evapotranspiration and soil erosion (Afari-Sefa et al. 2015).

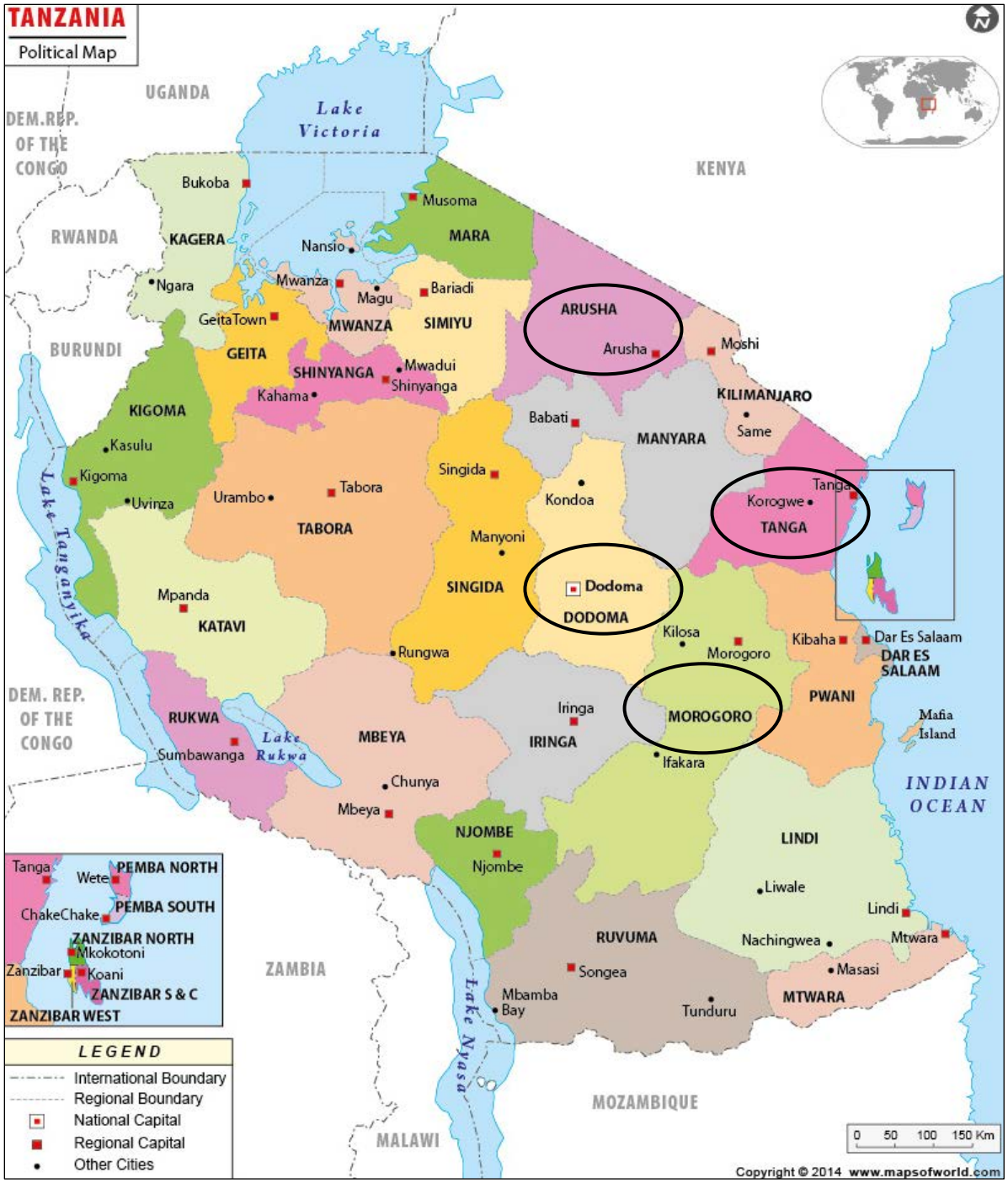

Figure 1. Survey regions cultivating traditional African vegetables for seed production include: Tanzania: Arusha, Tanga, Morogoro, and Dodoma.

Study Approach and Data

The primary survey was undertaken in three stages: pre-pilot, pilot, and main survey. In the pre-pilot survey, the survey team met with several clusters of farmers to learn about their agricultural activities. Based on the pre-pilot survey, a structured questionnaire was developed and pre-tested with a few farmers selected for the pilot survey. The questionnaire was then revised and

implemented for the main survey from March-May 2015. For the main survey, 90 sampled farm households were selected for one-on-one interviews with the guidance of village executives, extension officers, and local opinion leaders. The 12-month cropping year reference period for primary data collection was from March 2012 to February 2013.

Econometric Model

A household's vegetable seed income can be modeled as a sequential decision. Typically, a household first decides to choose a treatment (accessibility of certified vegetable seeds) which then endogenously impacts on its outcome (vegetable seed income). The decision on the household's accessibility of certified seed is endogenous in the sense that there might be some unobserved characteristics that influence both the accessibility of certified vegetable seed and vegetable seed income. This implies that ordinary least-squares regression cannot identify the average treatment effect, and hence an alternative and more robust identification strategy should be employed. To control for endogenous sample selection bias, this study adopted a standard treatment effect model from the causal modelling literature in econometrics (Heckman 1979, Maddala 1983). To validate the robustness of the treatment effect model while complementing the ensuing results, we also estimated a two-stage or extended Instrumental Variable (IV) model. To this end, a household's decision on accessibility of certified seed can be denoted as an unobserved latent variable such that:

$$P_i^* = \delta_0 + \delta_1 X_i + \delta_2 Z_i + u_i \text{ where the observed decision is}$$

$$(1) \quad P_i = \begin{cases} 1 \text{ if } P_i^* > 0 \\ 0, \text{ otherwise} \end{cases}$$

The farm household then chooses to have better accessibility of certified vegetable seeds in terms of timely availability, with lower prices if $P_i^* > 0$ where X_i and Z_i are exogenous covariates and u_i is random error term. The outcome of interest equation is written as

$$(2) \quad Y_i = \beta_0 + \beta_1 P_i + \beta_2 X_i + \varepsilon_i$$

where P_i is a dummy variable indicating whether or not a household have better and timely access to certified vegetable seeds at lower prices[4]. Thus we have a continuous outcome variable (vegetable crop income) and a limited dependent binary treatment variable (accessibility of certified vegetable seeds). Consistent with addressing variable endogeneity issues, we suppose that u_i and ε_i are correlated. To jointly estimate (1) and (2), we then assume two errors follow the bivariate normal distribution.

The estimation of the two step model under the bivariate normality assumption, proceeds as follows:

[4] Farmers were asked three questions: (i) Do you encounter any bottlenecks in the timely availability of certified seed? (ii) Do you encounter any bottlenecks in obtaining quality seed? and (iii) Do you have any concerns regarding the price of seed? If the farmer reported for all questions that they did not experience any bottlenecks for accessing certified under these constraints, then it is recorded as 1, otherwise 0.

a. Estimate a Probit regression of P_i on X_i and Z_i.
b. Use the fitted model to calculate the predicted Inverse Mill's Ratios. For participants this would be $\hat{\lambda}_i = \frac{-\phi(\hat{\delta}_0 + \hat{\delta}_1 X_i + \hat{\delta}_2 Z_i)}{\Phi(\hat{\delta}_0 + \hat{\delta}_1 X_i + \hat{\delta}_2 Z_i)}$ where $\phi(.)$ is the standard normal density and $\Phi(.)$ is the standard normal cumulative density.
c. Regress Y_i on P_i , X_i and $\hat{\lambda}_i$.

The two-step estimator was implemented in STATA Software Package. A significant coefficient of Inverse Mill's Ratio would imply that the error terms are correlated.

Y_i is the revenue generated from the vegetables by a household as a dependent variable, which is a continuous outcome variable in the endogenous treatment effect model.

The effect of accessibility of certified vegetable seed (treatment variable) on vegetable seed income (outcome variable) was measured by the endogenous treatment effect model. The first step involves measuring the casual linkages between respondents' participation in farmer-led seed enterprises and accessibility of certified vegetable seed. The second step measures the effect of accessibility of certified vegetable seed (treatment variable) and vegetable seed income along with other explanatory variables.

Two explanatory variables—gender and age of the household head—affected both the treatment variable and outcome variable. Afari-Sefa et al. (2012) highlighted that when farmers participate in farmer-led seed enterprises, they have better access to certified quality seed, thereby improving their crop income. Other studies (Almekinders et al. 1994; World Bank 2012) also observed that the formal seed marketing system can provide better access to certified seed in many developing countries. Batt (2008) argues that receiving frequent extension services influences farmers' access to certified seed. Therefore, this study included two explanatory variables that might influence the treatment variable: farmers' participation in farmer-led seed enterprises and farmers' frequent contacts with village extension workers.

Other variables that directly influenced the outcome variable in our model were net cultivated area and irrigated area. Rajendran et al. (2015) argued that net cultivated area represents total area under irrigation and unirrigated land, which explains farm size as well. It implies that the larger the farm size, the greater the opportunity to apply new technologies and have a better output value. The implication is that medium and large farms derive more gains from application of more capital than do small farms, and also depend on the possibility of a larger share of irrigated land to total land size. Based on a household survey from five administrative regions in Tanzania, irrigated land area influences output value, particularly the value of vegetable production; hence, the inclusion of irrigated area as an independent variable is required.

Accessibility of credit by farmers also influences farmers' crop income (Diagne and Zeller 2001). In our study, this variable was measured as a dummy variable, where farmers receiving credit for their agricultural activities are assigned a value of 1, otherwise zero. As a complement to the endogenous treatment effect model, this study also estimated an extended Instrumental Variable (IV) model to account for the possibility of inconsistent parameter estimation due to endogenous regressors in the main treatment effect model. In the IV model, individual characteristics such as head of household, collective household characteristics such as family

size, accessibility of credit by farmers, and agricultural characteristics including irrigated area under cultivation are exogenous regressors or instruments. Farmers' participation in farmer-led enterprises is an excluded instrument or exogenous variable excluded from the regression. Accessibility of certified seeds is an endogenous regressor that is being instrumented.

Results and Discussion

It is important to understand the number of sales transactions through various types of seed distribution channels existing across the different farm size categories and regions. Farm size was categorized as marginal, small-, medium- and large-scale farmers. Smallholder farmers were defined as marginal and small-scale farmers that own or/and cultivate less than 2.0 hectare of land. Medium-scale farmers were defined as farmers that own or/and cultivate between two and four hectares of land. Large-scale farmers were defined as farmers that own or/and cultivate more than four hectares of land.

Marginal, small- and medium-scale farmers constituted 96% of the sample (Table 1). Out of the 90 farm households surveyed, 15% and 33% were engaged in contract farming and QDS systems, respectively, while 52%, including smallholders, sold their seed through the informal system. The high percentage of smallholders selling seed through semi-formal and formal systems may indicate a preference for low risk factors associated with formal sub-sector arrangements compared with the informal seed marketing system. This indicates that the share of seed sold through the informal system is larger than the semi-formal and formal marketing systems in the study region, which validates the findings of Wekundah (2012) and Shiferaw et al. (2008).

Within the Arusha region, it was observed that although almost all types of seed marketing channels exist, the major seed distribution channel was through contract farming. The survey results show all respondents in Dodoma region produce and sell their seeds under the QDS system. In Tanga and Morogoro regions, only the informal seed marketing system was active. This reflects the comparative advantage Arusha has over other regions in Tanzania in attracting private seed companies.

Table 1 shows the share of sales transactions by farm size, regions for each seed marketing channel (column percentage); and shares of sales transaction by marketing channels under each farm size category and regions (row percentage).

Table 2 provides details of land ownership and cultivated area for all crops and vegetable seed by farm size under identified marketing channels. Small and medium farm categories accounted for most of the land volume (61%), which indicates that small- and medium-scale farmers play an important role in seed production. In the contract farming system, there is little difference between net operated and net irrigated area, which indicates that contract companies prefer farmers who have irrigation facilities to grow their crops.

Table 1. Farms by Size, Marketing Channel and Region

By Farm Size Category	No of HH*	Formal system (Contract grower)	Semi-formal system (QDS)	Informal system (Farm-saved seed)	Overall (% of HH*)
Marginal farm (0> to 1 ha)	24	31 (17)	27 (33)	26 (50)	27 (100)
Small farm (>1 to 2 ha)	32	38 (16)	27 (25)	40 (59)	36 (100)
Medium farm (>2 to 4 ha)	30	23 (10)	40 (40)	32 (50)	33 (100)
Large farm (above 4 ha)	4	8 (25)	7 (50)	2 (25)	4 (100)
Total	90	100 (15)	100 (33)	100 (52)	100 (100)
By Regions					
Arusha	18	100 (72)	10 (11)	6 (17)	20 (100)
Tanga	19	-	-	40 (100)	21 (100)
Morogoro	25	-	-	53 (100)	28 (100)
Dodoma	28	-	90 (100)	0	31 (100)
Total	90	100 (15)	100 (33)	100 (52)	100 (100)

Note. Figures in parentheses indicate row percentage. In the farm size category, size of area mentioned in the bracket is a range of landholding size by various farm categories. * Household (HH)

Table 2. Land Ownership and Cultivated Area for all Crops and Vegetable Seed by Farm Size under Each Marketing Channel

By Farm Size Category	Formal system (Contract grower)	Semi-formal system (QDS)	Informal system (Farm-saved seed)	Overall
Land ownership and cultivated area size (ha) under each marketing channel				
Total own area	1.5 (1.5)	2.0 (1.3)	1.6 (0.9)	1.7 (1.6)
Net operated area (NOA) for all crops	2.0 (1.9)	1.9 (1.2)	1.6 (0.9)	1.7 (1.2)
Net operated irrigated area (NOIA) for all crops	2.0 (1.9)	0.4 (0.3)	0.8 (1.0)	0.8 (1.0)
Area under vegetable seed cultivation	1.7 (1.1)	0.4 (0.3)	0.6 (0.5)	0.7 (0.7)
NOA by farm size category under each marketing channel		**Land Size (ha)**		
Marginal farm (0-1 ha)	0.7 (0.2)	0.6 (0.2)	0.5 (0.3)	0.6 (0.3)
Small farm (1-2 ha)	1.5 (0.2)	1.4 (0.3)	1.3 (0.2)	1.4 (0.3)
Medium farm (2-4 ha)	2.8 (0.7)	2.6 (0.5)	2.5 (0.5)	2.6 (0.5)
Large farm (above 4 ha)	7.7 (0.0)	4.9 (1.1)	4.5 (0.0)	5.5 (1.6)
Overall	2.0 (1.9)	1.9 (1.2)	1.6 (0.9)	1.7 (1.2)
% of NOA under each marketing channel (weighted by household)		**(Share %)**		
Marginal Farm (0-1 ha)	11	8	8	9
Small Farm (1-2 ha)	29	20	33	29
Medium Farm (2-4 ha)	32	55	50	51
Large Farm (above 4 ha)	30	17	6	14
Overall	100	100	100	100

Note. Standard Deviation in brackets

Table 3 depicts the basic socioeconomic characteristics of farm households. Out of 90 sampled farm households, 38% were headed by women. Interestingly, contract farming had the highest level of women's participation. The average age of respondents was 45 years.

Table 3. Basic Socioeconomic Characteristics of Farm Households

By Farm Size Category	HH	Formal system (Contract grower)	Semi-formal system (QDS)	Informal system (Farm-saved seed)	Overall
By Gender					
Female-headed	35	54 (20)	47 (40)	29 (40)	38 (100)
Male-headed	56	46 (11)	53 (29)	71 (61)	62 (100)
		100	100	100	100
Age Group of Respondent					
0-35 years	23	15 (9)	27 (35)	27 (57)	25 (100)
35-50 years	39	38 (13)	57 (44)	35 (44)	43 (100)
50 above	29	46 (21)	17 (17)	38 (62)	32 (100)
		100	100	100	100
Level of Education					
Number of Years	90	5.5	7.1	7.3	7
Family Size					
Number of People	90	4.8	5.9	5.6	5.6

On average, contract farmers had comparatively lower levels of education compared with QDS and non-QDS farmers.

Marketed surplus as a percentage of output is higher in contract farming (98.4%) than in QDS and informal systems (Table 4). QDS and informal systems had relatively smaller marketed surplus, implying that farmers sell their produce in the market under these systems and also keep their own seed for production in subsequent seasons, to exchange with neighboring farmers, or to give out to neighbors and relations as gifts. Farmers who produce under the contract seed model system tend to sell more of their produce compared with farmers who produce seed under the QDS and informal systems; however, contract farmers received higher crop income per ha/season than those under the QDS and informal systems (Table 4).

Farmers' self-perceptions about social norms, perceived control, and adoption of new agricultural technologies under different seed marketing systems are presented in Table 5. The values were measured using a 5-point Likert scale, where the set of ordinal scale perceptions of respondents were elicited under three major psychological indicators: attitude, social norms, and perceived control. *Attitude* includes an individual's evaluation of a given innovation. *Subjective norm* measures his or her perception of how important the opinions of others are regarding an identified innovation.[5] An innovation may not be adopted if it is against the prevalent cultural norm or has a negative effect on neighbors. *Perceived behavioral control* measures an individual's perception of his voluntary control of the adoption process. Even if a given

[5] Feder and Savastano (2006) analyzed how opinion leaders' views on a technology affect adoption of the technology by others.

innovation appears attractive and acceptable to others, individuals may not adopt it if it requires behaviors that are difficult to control, such as saving cash for use in the next season.

Table 4. Traditional African Vegetable Seed Yield and Marketed Surplus

				Marketed Surplus		Income from Seed Crop Sales	
Farm Size	**No. of HHs**	**Area Operated under Seed**	**Seed Production (kg/ha^{-1})**	**Seed sold (kg/ha^{-1})**	**As % of Output**	**per house hold /season (USD)**	**per ha/ season (USD)**
Formal system (Contract Farming)	13	1.6	174.7	172.0	98.4	587.3	907.1
Semi-formal system (QDS)	30	0.6	354.8	182.6	51.5	216.7	892.6
Informal system (Farmer saved seeds)	47	0.7	59.8	34.3	57.4	59.2	209.1
Overall	90	0.8	175.2	107.7	61.5	186.6	576.5

For this study, we have adopted the ten statements used by Hansson et al. (2012) with slight modifications to capture latent variables on the three psychological indicators. We asked respondents to evaluate their agreement with each of the 10 statements on a 5-point Likert scale, with 1 indicating strong disagreement and 5 indicating strong agreement (Table 5).

Following aggregation of the results, the Kruskal Wallis test was applied to understand the statistical significance of farmers' self-perception indicators among seed marketing channels. The results for all three statements of attitude were statistically significant among the three marketing channels. This implies that farmers' attitudes toward a new agricultural technology differs among three main identified seed marketing channels (formal, semi-formal and informal channels). Scores for social norms and perceived control did not vary statistically across the different marketing channels, except for the first statement under each perception indicator. Farmers with high scores for attitude and perceived control were not concerned about what other farmers think (social norms).

Overall, the study results suggest that attitude, social norms and perceived control differ among farmers who participated in seed marketing and distribution channels—contract farming, QDS, and informal (Table 5). Farmers from the formal and semi-formal seed sectors had better self-perception about adopting new technologies than farmers from informal seed sector. Farmers from the formal and semi-formal seed sectors had better social systems to diffuse their knowledge to neighbor farmers. These farmers also had better access to technologies due to their positive attitude toward adopting new technologies. Table 6 presents results regarding the relationship between farmers' decisions to participate in farmer-led seed enterprises and their access to certified seed, and the subsequent effect on vegetable seed income. Overall, farmers' participation in farmer-led seed enterprises and their frequent contacts with village extension agents were positively and significantly associated with accessibility of certified seed (treatment variable). Seed companies also provide extension services to their contract farmers, thereby increasing the frequency of extension and advisory services to contract seed growers.

Table 5. Surveyed Farmers' Psychological Constructs on Attitude, Social Norms and Perceived Control, by Marketing Channel.

Farmers' Self-perception Indicators	Semi-formal system (QDS)	Formal system Contract grower	Informal system Farm-saved seed	Overall
Attitude		**Average** [a]		
I consider myself as a progressive farmer	4.1	4.2	3.6	3.8*
I like to try new agricultural technologies	4.4	4.7	4.2	4.3*
I actively seek information from others	4.4	4.2	4.1	4.2**
I like new ideas in general	4.4	4.4	4.2	4.3
Average	4.3	4.4	4.0	4.2
Social Norms				
Other farmers think I am a progressive farmer	4.0	3.7	3.6	3.7***
Other farmers ask my opinion about agricultural technologies	3.9	4.0	3.8	3.8
Other farmers will not object my farming activities	3.9	3.8	3.4	3.6
Average	3.9	3.8	3.6	3.7
Perceived Control				
It is easier for me to collect information about technology	3.6	3.4	3.1	3.3**
I have good and constant contact with village extension officers	4.0	4.3	3.8	3.9
I can adopt new agricultural technology if it is profitable	4.4	4.5	4.3	4.4
Average	4.0	4.1	3.7	3.9

Note. a 5-point Likert scale: 1 = Strongly Disagree, 2 = Disagree, 3 = Neither, 4 = Agree, 5 = Strongly Agree.
* Indicates significance at 1% level; ** 5% level; *** 10% level and statistically significant difference among three marketing channels; test of equality using Kruskal Wallis test.

The accessibility of certified seeds is an endogenous treatment. Bratti and Miranda (2010) noted that if treatments are not randomized, and there are unobservable characteristics affecting the treatment variable, it will in turn affect the outcome variable (revenue generated from vegetable seed sales). Such unobservable characteristics are usually related to the individual characteristics of the household head (i.e., gender and age) and collective household characteristics such as family size. The individual characteristics of the household head significantly influences the accessibility of certified seeds but not the outcome variable, vegetable seed income. This means that female-headed households have less likelihood of having access to certified seed in comparison with male-headed households. However, vegetable seed income was not influenced by female-headed households. Similarly, age of the household head significantly affects accessibility of certified vegetable seed, which implies that older farmers have less likelihood of having better access to certified vegetable seed compared to young farmers. There are unobservable characteristics that directly influence the outcome variable rather than the treatment variable. These include access to credit and the net operated irrigated area. Farmers' vegetable seed income can be improved if farmers receive credit for their farm operations during the production season while simultaneously increasing their cultivated and irrigated land area.

In sum, based on the sign of the coefficient of access to certified vegetable seed and its standard error value, the study concludes that farmers' vegetable seed income is positively and significantly influenced by access to certified vegetable seed. The interpretation of the estimated results can be done in two ways. First, the direct interpretation of the coefficient (2.281) of accessibility of certified vegetable seed variable shows that holding all other independent variables constant, the log of revenue generated from vegetable seed sales is expected to increase by 2.3 times if farmers can increase their access to certified seed (Table 6). However, this method of interpretation has been criticized by several studies (e.g., Halvorsen and Palmquist 1980; Kennedy 1981; Giles 1982; Van Garderen and Shah 2002; Giles 2011). Therefore, this study also presented a second method of interpretation based on Kennedy (1981) approach[6], which is similar to an approach suggested by Van Garderen and Shah (2002). Based on the approach of Kennedy (1981), the coefficient of access to certified vegetable seed, the revenue generated from vegetable seed sales is expected to increase by 17.6% if farmers can increase their access to certified seed. Since the coefficient of the Inverse Mills ratio (Lambda) is significant at the 10% probability level, the treatment effect (i.e., access to certified seed) significantly impacted on farmers' vegetable seed income at the 10% probability level after correcting for endogeneity in the estimates. The results highlight that increasing access to certified vegetable seed significantly and positively affects farmers' vegetable seed income, along with improved credit access and increased net operated irrigated area.

Results from the extended Instrumental Variable (IV) model are presented in Table 7. The IV model is used to validate the results of the endogenous treatment effect model, and was estimated in two sequential steps. First, the causal relationship between accessibility of certified vegetable seeds and farmers' participation in farmer-led enterprises is measured such that access to certified vegetable seed is identified and assumed to be the most suitable instrument that has an effect on the outcome variable. Unobserved characteristics that influence this instrumental variable are designated as "excluded instruments". This study hypothesized that excluded instruments, including farmers' participation in farmer-led seed enterprises and frequency of contact with village extension agents, have positive influences on access to certified seed. The Sargan statistics are significant at the 5% probability level, indicating that the assumed excluded instruments are valid, uncorrelated with error, and correctly excluded from the equation. We also performed an endogeneity test of endogenous regressors (i.e., accessibility of certified seed), and results indicate the presence of endogeneity in the model. The IV model also provides results of an "under and weak identification test," which indicates that the excluded instruments are relevant (statistically correlated with the endogenous regressors) and implies these variables positively and significantly influence access to certified seed.

[6] Kennedy (1981) suggested the following formula for producing almost unbiased estimates and measures percentage change from the estimated coefficient in the model:100 {[exp(*b)/exp(0.5V(b))*]-1]} where *b* is the relevant parameter estimate and *V(b)* is the variance of the parameter estimate. Since in this study the estimated coefficient of access to certified seed as a dummy variable and measured in the log-linear regression framework, we used the Kennedy (1981) approach for the interpretation of the coefficient of access to certified seed.

Table 6. Linear Regression with Endogenous Treatment (Two-step Estimator)

Variables	(1) Log of Traditional African Vegetable Income	(2) Accessibility of certified seeds (Dummy) (1=No bottlenecks; 0=Otherwise)
Female (Dummy) (1=Female; 0=Otherwise)	0.472	-0.659**
	(0.407)	(0.337)
Age of Household Head (Number of Years)	0.00599	-0.0269***
	(0.0192)	(0.0133)
Family Size (Number person in the household)	0.0991	0.0914
	(0.0978)	(0.0695)
Access to Credit (Dummy) (1=received credit for agricultural activities; 0=otherwise)	0.775*	
	(0.487)	
Net Operated Irrigated Area (Ha)	0.311***	
	(0.142)	
Accessibility of Certified Seed (Dummy) (1=No bottlenecks; 0=Otherwise)	2.281**	
	(1.363)	
Farmers' Participation in Farmer-Led Enterprises (Either Contract farming and/or QDS system=1; 0=Otherwise) (Dummy)[a]		0.555**
		(0.318)
Have good contacts with village extension workers (Likert Scale 1-5) 1=Strongly Disagree; 5=Strongly Agree)		0.295**
		(0.160)
Lambda (Inverse Mills ratio)		-1.458**
		(0.844)
Constant	9.500****	-0.720
	(1.196)	(0.844)
Observations	81	81

Note. Standard error in parentheses **** p<0.01, *** p<0.05, ** p<0.10, * p<0.15; Footnote for a: base group is informal system (farm-saved seed)

Table 7. IV (2SLS) Estimation with Endogeneity Test

Variables	(1) Log of Traditional African Vegetable Income
Accessibility of Certified Seed (Dummy) (1=No bottlenecks; 0=Otherwise)	2.216**
	(1.308)
Female (Dummy) (1=Female; 0=Otherwise)	0.440
	(0.390)
Age of Household Head (Number of Years)	-0.000511
	(0.0172)
Family Size (Number person in the household)	0.106
	(0.0947)
Access to Credit (Dummy) (1=received credit for agricultural activities; 0=otherwise)	0.972*
	(0.594)
Net Operated Irrigated Area (ha)	0.528***
	(0.238)
Constant	9.587****
	(1.131)
Observations	81
Under identification test (Anderson canon. corr. LM statistic):	6.632***
Weak identification test (Cragg-Donald Wald F statistic):	3.255
Stock-Yogo weak ID test critical values:	
10% maximal IV size	19.93
15% maximal IV size	11.59
20% maximal IV size	8.75
25% maximal IV size	7.25
Sargan statistic	15.751****
Endogeneity test of endogenous regressors:	4.974***
Instrumented:	Accessibility of certified seeds (Dummy) (1=No bottlenecks; 0=Otherwise)
Excluded instruments:	Farmers' Participation in Farmer-Led Enterprises (Either Contract farming and/or QDS system)
	Have good contacts with village extension workers (Likert Scale 1-5) 1=Strongly Disagree; 5=Strongly Agree)
Duplicates	Female (Dummy) (1=Female; 0=Otherwise)
	Age of Household Head (Number of Years)
	Family Size (Number of Persons in the Household)

Note. Standard error in parentheses **** p<0.01, *** p<0.05, ** p<0.10, * p<0.15

Based on the results from the endogenous treatment effect model and extended IV model, the income of farmers from traditional vegetable seed sales is positively and significantly influenced by access to certified seed. However, access to certified seed tends to be influenced by farmers'

participation in farmer-led enterprises and through frequent contacts with village extension workers. As per any other rational behavior, a farmer decides whether or not to participate in a farmer-led seed enterprise. If the farmer makes this decision randomly, we could ignore that not all crop incomes are realized, and use an ordinary least squares regression to fit a crop income model. Such an assumption of random participation, however, is unlikely to be true; a farmer with a low crop income may be unlikely to choose to participate in farmer-led seed enterprises, and thus the sample of observed crop income is biased upward. Therefore, farmers may choose not to participate in farmer-led seed enterprises when their crop income from an informal system is greater than their income from a formal or semi-formal system. Therefore, crop income and farmers' participation have a simultaneous effect. However, this study hypothesized that if farmers participate in farmer-led enterprises, then they can have better access to certified seed, which influences revenue generated from their vegetable seed sales. This finding could be linked to consumer preference for produce attributes from diverse marketing outlets that would drive the seed supply system for farmers to demand quality certified seed for production.

Conclusion

In Tanzania, vegetable seed growers encounter three critical bottlenecks in the seed supply and distribution system: (i) seed quality, (ii) spatial and timely availability of certified seed, and (iii) affordability of certified seed. These factors directly influence the revenue generated from seed sales. Several studies have concluded that farmer-led enterprises can provide better access to certified seed to overcome these bottlenecks, while other studies indicated that farmers' participation in farmer-led seed enterprises can enhance their incomes. However, few studies have analyzed the simultaneous effect between farmers' participation in farmer-led seed enterprises, their access to certified seed, and the consequent effect on income accrued from seed production and sales. Our studies empirically quantified the effect of accessibility of certified seed on farmers' crop income among vegetable seed growers in Tanzania. Farmers' revenue generated from vegetable seed sales can be increased by 2.3 times if their access to certified seed can be increased while simultaneously improving the frequency of their contact with village extension agents. Female-headed households were found to have less access to certified seed in comparison with their male counterparts. We recommend that women's participation in farmer-led enterprises be encouraged through the formation of women's groups or by creating targeted extension programs to improve their access to certified seed. Our study results show that young farmers have a better likelihood of accessing certified seed than older farmers. Thus there is a need to encourage vulnerable youth in Tanzania to participate in farmer-led seed enterprises to generate employment while enhancing their income for improved livelihoods. The results suggest that both contract farming and QDS farmer-led seed enterprise models are effective for generating higher income for farmers in the study locale.

There is a need for government and development partners to promote and boost public-private partnerships that will ensure better access to inputs for production of certified seed, provide better access to extension services for smallholders, and increase revenues from certified seed production from farmer-led seed enterprises. The government should provide an enabling policy environment and incentives to scale up farmer-led seed enterprises, particularly for traditional African vegetables. Awareness campaigns about the nutritional benefits of these crops will further stimulate and increase demand while attracting investors and agribusiness practitioners into the sub-sector.

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Assessing the Impact of Fresh Vegetable Growers' Risk Aversion Levels and Risk Preferences on the Probability of Adopting Marketing Contracts: A Bayesian Approach

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Abstract

One of the most frequently cited theoretical statements to explain the use of contractual arrangements is that risk drives the choice of contracts. However, there is limited empirical support for this argument. A Bayesian ordered probit formulation is used in this study to determine the importance of fresh vegetable producers' and farm operation characteristics on the probability of adopting marketing contracts. The findings of the study indicate that younger farmers, with larger farm size and with the ability to expand their operations are more likely to participate in marketing contract agreements. On the other hand, the results do not support the risk shifting hypothesis.

Keywords: marketing contracts, risk management, Bayesian ordered probit

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Introduction

In the Wealth of Nations Adam Smith criticized sharecropping[1] as an unsatisfactory intermediate stage between slavery and the English fee based system (Newbery 1977). Building on Adam Smith's argument, Alfred Marshall (1920) illustrated that sharecropping leads to moral hazard and, consequently, to Pareto inefficient resource allocation. The "Marshallian inefficiency" argument remained undisputed for several decades (Allen and Lueck 1999). However, despite its theoretical shortcomings, highlighted by Marshall and the majority of classical economists, sharecropping remained a popular method of agricultural production both in the Old and the New world (Newbery 1977).

Gale Johnson (1950) tried to explain this phenomenon. As a result of his endeavors, the focus of the research on contractual arrangements shifted from the resource allocation to the factors influencing the selection of contracts. Following the seminal works of Cheung (1969), Stiglitz (1974) and Newberry and Stiglitz (1979) the principal – agent framework has been adopted by many scholars as a theoretical explanation for the farmers' decision to utilize contractual agreements. Under this approach, the rationale for contract participation is risk sharing between a risk-averse agent (the farmer), who has the ability to shrink in performing the agreed tasks, and a risk neutral principal (i.e. landlord, buyer etc.), who is not able to perfectly observe the agent's activities (Allen and Lueck 1995, 1999; Sheldon 1996).

Despite the theoretical appeal of the risk-shifting hypothesis, there is no consensus in the empirical research regarding the significance of risk-sharing in farmers' decisions to utilize contracts. For instance, Ackeberg and Botticini (2002), Dubois and Vukina (2004), Hudson and Lusk (2004) illustrate that growers' risk aversion levels play an important role in the selection of contracts. On the other hand, Allen and Lueck (1992, 1995, 1999), Hobbs (1997) and Vassalos et al. (2013) argue that it is the reduction of transaction costs rather than the risk sharing that drives the selection of contracts.

A related strand of the literature focuses on the observable characteristics of the farmers (i.e. demographic characteristics) and of their farm operations (i.e. farm size, location etc.) and how these characteristics influence the choice of contractual agreements. Similarly to the risk shifting hypothesis, the empirical evidence regarding the role of the aforementioned characteristics is mixed. For instance, Katchova and Miranda (2004) illustrate that the age and education level of the farm manager do not influence the decision to participate in contractual agreements for corn and wheat producers in the U.S.A. Paulson et al. (2010) have similar findings for corn and soybean producers in U.S.A. However, Katchova and Miranda (2004) indicate that older and more educated soybean producers are more likely to participate in contractual agreements. Other studies (i.e. Asplund et al. 1989; Musser et al. 1996; Bellemare 2012) indicate that the age of the farm manager has a negative and statistically significant effect on the decision to participate in contractual agreements. Furthermore, Musser et al. (1996) and Goodwin and Schroeder (1994) indicate that more educated farm managers are more likely to participate in contractual agreements. The aforementioned discussion indicates the need for further research regarding the

[1] Sharecropping is a form of land leasing in which a tenant and a landlord share the final output as compensation for the managerial labor supplied by the tenants and the land capital supplied by the landlord.

role that: growers' risk aversion levels, growers' demographic characteristics and farm characteristics play in the choice of contracts.

The main objective of the present study is to examine the role of: i) risk, ii) producers' characteristics and iii) farm operation characteristics on the probability of adopting marketing contracts by U.S. Mid-South fresh vegetable producers. Marketing contracts typically refer to a written or oral agreement between a grower and a buyer who sets a price and possible price adjustments as well as a market outlet. Under this type of agreement producers assume all risk related to yield, but, share the risk related to price fluctuations with the buyer (MacDonald et al. 2004).

The contribution of the study to the literature is threefold. First, the present article focuses on fresh vegetable production (tomatoes), in contrast to grain crops that have been the major interest of similar studies (Musser et al. 1996; Katchova and Miranda 2004; Paulson et al. 2010). The unique characteristics of vegetable production (i.e. perishability and seasonality of production, higher price fluctuation etc.) in conjunction with the potential heterogeneity of contract preferences across different products are the underlying reasons for examining vegetables. Second, we incorporate a broader measure of growers' risk aversion and risk perception levels. Specifically, both the expected utility framework and answers to Likert-scale questions are utilized to elicit growers risk attitudes. Third, while several studies have used binary models to examine the relationship between contract choice and the characteristics of the farm or the grower, to the best of the authors' knowledge, this is the first endeavor that uses a Bayesian approach to analyze ordered multi-level responses. The adoption of multi-level response can reveal more about the dynamics of contractual agreements compared to a simple binary model.

The main data source for the study is a survey administered via US mail to tomato growers in four states: Kentucky, Illinois, Ohio and Indiana. A Bayesian ordered probit model is utilized to analyze the dataset. Growers age (in years), education (in years), risk aversion level, risk perception, location, income, farm size and the ability to expand the farm, if required, are included as explanatory variables in the analysis. The selection of these explanatory variables is based on previous literature, indicating that personal and farm characteristics influence the probability of adopting marketing contracts (Musser et al. 1996; Katchova and Miranda 2004; Goodwin and Schroeder 1994; Pennings and Leuthold 2000) and on feedback received by industry leaders.

The findings of our study have important theoretical and practical implications. From a theoretical perspective, the results do not provide empirical support for the risk shifting hypothesis (growers' risk aversion is not a determining factor of contract choices). Regarding the latter the results provide helpful insights to the vegetable production industry and especially to retailers who use marketing contracts as a vehicle to meet the changing consumer demand and improve market efficiency (Bellemare 2012; Sykuta and Parcell 2003). For instance, retailers can use this information to more efficiently identify growers that are willing to participate in a contractual agreement. This is especially important considering that the cost of writing and enforcing the contractual arrangements. Lastly the results may be used to target specific education programs related to marketing contracts.

Data Collection

The data for the present study were obtained from a mail survey. The survey instrument was initially mailed on April 1st, 2012 to three hundred fifteen (315) tomato growers in four states: Kentucky, Illinois, Ohio and Indiana. Two reasons justify this selection. First, although the U.S. Mid-South is not a major vegetable producing area, in the last decade the importance of vegetable production in the agricultural economy of this region has been constantly increasing. This is illustrated by the substantial increase in the number of farms with some type of vegetable production between 2002 and 2012, in conjunction with the increase in the market value of vegetable production (Table 1). The aforementioned factors highlight a very dynamic and changing market. This dynamic, indicates opportunities for new marketing options in the examined area. Second, tomatoes are selected because they are among the top three vegetables cultivated in these four states.

Table 1. Importance of Vegetable Production in the Examined Region

	2012	2007	2002	% Change 2002- 2012
		A. Number of Vegetable Farms		
State				
Illinois	1,370	1,377	1,107	23.76
Indiana	1,376	1,363	1,139	20.80
Kentucky	2,222	2,123	1,424	56.04
Ohio	2,440	2,873	2,323	5.03
		B. Number of Tomato Farms[2]		
State				
Illinois	587 (573)	525 (516)	334 (347)	75.75
Indiana	687 (628)	600 (554)	511 (470)	34.44
Kentucky	1,387 (1,297)	1,142 (1,102)	659 (618)	110.47
Ohio	1,285 (1,221)	1,351 (1,272)	1,083 (995)	18.65
		C. Market Value of Vegetable Production ($1,000)		
State				
Illinois	127,592	103,914	98,067	30.11
Indiana	104,411	78,719	77,583	34.58
Kentucky	28,787	20,937	17,575	63.79
Ohio	133,796	135,355	136,884	- 2.26

Source. 2012, 2007 USDA, Census of Agriculture

Following Dillman's (1978) guidelines, in addition to the questionnaire, the survey package included a personalized cover letter and a return-postage paid envelope. The cover letter was printed with a university letter head, signed by the researchers, emphasized the importance of the study and the fact that the responses will be anonymous and confidential. A personalized reminder was emailed to the producers two weeks later. A second mailing of the survey package was distributed to the growers during the last week of April, 2012. With the aim of increasing the response rate a monetary incentive ($25) was offered to the producers if they completed the survey.

The mailing information for the growers was gathered from MarketMaker, after obtaining permission to use the database of the website. MarketMaker is a free online marketing tool

[2] The number of farms that harvested tomatoes for fresh produce is included in the parenthesis

developed by the University of Illinois Extension Service. The primary objective of MarketMaker is to facilitate buying relationships between consumers (i.e. households, wholesalers, local restaurants etc.) and producers (Zapata et al. 2013). Currently, MarketMaker operates in 19 different states and includes a database of more than 8,600 producers.

Of the 315 survey packages initially mailed, 10 were returned as undeliverable and 5 indicated that they were not farmers or had retired leaving a total population of 300 producers. From the 300 producers 55 returned completed surveys for an effective response rate of 18.3%. The response rate is higher compared to similar studies that used mail surveys to examine producers' preferences towards contractual arrangements or used MarketMaker to obtain producers information. For instance: Zapata et al. (2013), Roe et al. (2004) and Carpio et al. (2013) reported response rates of 15.7%, 12.4% and 18% respectively.

Summary statistics of the demographic variables for the sample growers are provided in Table 2. The average age of the responders is 49.8, and the majority of the responders were male producers. These compare favorably with the data from census of agriculture for vegetables, potatoes and melons, where the average age of the vegetable producers was 55.9 and 17% were female. All of the farmers who participated in the survey use some form of direct marketing for their products (i.e. farmer's market, on farm sales etc.) with the second most common marketing option being local wholesalers. This finding is not surprising, considering that the study sample included growers who participate in the MarketMaker website. The "ability to expand" variable refers to a grower's ability to expand his/hers operation if the right opportunity occurs, based on their responses to the survey instrument.

Table 2. Sample Descriptive Statistics

Variable	Average	Std.	Min.	Max.
Gender (1=female)	0.25	0.43	0	1
Age	49.8	12.95	30	70
Farm Size (Acres)	70	40.7	1	110
Ability to expand	0.8	0.37	0	1
Household size	2.4	1.28	1	6
Household income	71,480	33,169	20,000	137,500
Education	15.5	2.56	5	19
Farm income	59,722	38,089	15,000	95,000
n=55				

Source. Survey questionnaire

Survey Description

The survey questionnaire consisted of five sections. The first section included general questions to attract producers' interest. The second section contained questions regarding producers' perception and experience with marketing contracts. The third section included the risk aversion level and risk preference elicitation questions. The fourth section included a choice experiment. Demographic information (including age, gender, education, income etc.) was collected at the end of the survey. Questions that required growers to check their records were not included in the survey instrument (Pennings et al. 2002).

The survey questionnaire (clarity of questions, layout of the survey, wording of instructions etc.) was modified following the feedback from five focus group discussions as well as pilot tests of

the survey instrument. The focus group participants included vegetable growers, extension specialists and individuals involved with the marketing process of fresh vegetables. The focus group discussions took place during the 2011 Kentucky Farm Bureau Convention and the 2012 Kentucky Fruit and Vegetable Trade Show. Farmers who participated in the focus groups were not excluded from the mailing of the survey.

Risk Aversion and Risk Preferences Elicitation

A plethora of techniques has been adopted in the applied economics literature to elicit growers risk aversion levels and risk attitude. The majority of these measures can be derived from either: a) the expected utility framework, b) responses to Likert-scale questions, c) safety-first risk preference measures or d) the prospect theory (Pennings and Garcia 2001; Sartwelle et al. 2000).

For the objectives of the present study a combination of a "multiple price list" design and of Likert-scale questions was employed. The former is a modification of the design proposed by Binswanger (1980, 1981). Specifically, Binswanger's design was modified to resemble tomato growers' decisions. In detail, growers were asked to select among two hypothetical tomato varieties. The varieties had different resistance to diseases and, depending on whether or not the disease occurred, different economic returns. The probability that a disease would occur was set at 0.5. In accordance with Binswanger (1980), higher expected returns were offered at a cost of higher variance (Figure 1).

Please consider the choice you would make in the following hypothetical situation:

You will be given 150 tomato plants (in 5 bundles of 30 plants each) for free, to use in the coming season. There are two types of plants, A and B, and you can choose any combination of the two that totals 5 bundles.

The A and B plants have different levels of resistance to tomato diseases. The A plants have potentially higher harvests but are more vulnerable to disease. If disease does not occur, the A plants will produce a harvest worth $30 per bundle. However if disease occurs (50% of the time), the A plants' harvest is worthless ($0 per bundle). The B plants are disease-resistant and always produce a harvest worth $10 per bundle.

The following table illustrates the different combinations of type A and B plants that you could receive, and the value of their combined harvests based on the weather. Please **check one box** to indicate which combination of plants you would choose.

I choose: Check one of the six combinations A-F below		Bundles of 30 type A plants	Bundles of 30 type B plants	If disease does not occur (50%)	If disease occurs (50%)
o	A	0	5	$50	$50
o	B	1	4	$70	$40
o	C	2	3	$90	$30
o	D	3	2	$110	$20
o	E	4	1	$130	$10
o	F	5	0	$150	$0

Figure 1. Risk Preferences Elicitation Question

The basic advantage of this approach is that it can be used even if producers do not fully understand probabilities (Lusk and Coble, 2005). Table 3 illustrates the corresponding risk classification levels and the estimated partial risk aversion coefficient. Following Binswanger (1980), under the assumption that producers' exhibit constant partial risk aversion, the partial risk aversion coefficient can be estimated using a utility function of the following form:

$$(1)\ U = (1 - S)M^{1-s}$$

where *M* is the certainty equivalent and *S* is the approximate partial risk aversion coefficient[3]. In line with Lusk and Coble (2005), the measure used in the analysis as an individual's risk aversion coefficient (*S*) is the midpoint of the possible minimum and maximum range of *S*[4].

Table 3. The Payoffs and Corresponding Risk Classification for the Risk Game

Choice	Low Payoff (Disease occurs)	High Payoff (No disease)	Risk Aversion Class[a]	Approximate Partial Risk Aversion Coefficient (S)	Percentage of Choices in Experiment
A	50	50	Extreme	∞ to 2.48	16.3%
B	40	70	Severe	2.48 to 0.84	22.45%
C	30	90	Intermediate	0.84 to 0.5	34.69%
D	20	110	Moderate	0.5 to 0.33	18.37%
E	10	130	Slight to Neutral	0.33 to 0.19	6.12%
F	0	150	Neutral to Negative	0.19 to -∞	2.04%

Note. [a]Based on Binswanger (1980) classification

In addition to the multiple price list design, producers risk perceptions were elicited from three Likert-scale questions. The main advantage of this technique is that it is easier for the growers to answer these questions (Lusk and Coble 2005). To estimate producers' risk attitude we adopted three Likert-scale questions (Table 4) from Pennings and Garcia (2001). Following Pennings and Garcia (2001) if the sum score of the responses was negative, then, producers were classified as risk seeking. On the other hand, if the score was positive producers were classified as risk averse. Based on this scale, 59% of the producers in our sample are classified as risk averse, 25% as risk seeking and 16% as risk neutral. This finding compares favorably with results from previous research that used similar techniques to elicit growers risk aversion. For instance, Franken et al. (2014), using a sample of corn and hog producers from Illinois, estimated that 69% of the producers can be classified as risk averse, 11% as risk neutral and 20% as risk seeking. Similarly, Pennings and Garcia (2001) using a sample of Dutch hog producers estimate that 43% of them can be classified as risk averse.

[3] In order to calculate S (Table 3) we have to solve for the indifference point among two consecutive choices using equation 8. For instance, for choices A and B the S is calculated from the following equation: $50^{(1-s)} + 50^{(1-s)} = 40^{(1-s)} + 70^{(1-s)}$. This equation was solved in Excel after graphing the equations to estimate where the functions cross the x-axes.

[4] Following Binswanger (1981), for the regression analysis alternative F (Table 3) was given a value near zero (0.18) and the value for alternative A was set to 2.47

Table 4. Growers' Risk Perception: Response to Scale Questions
(-4= strongly Disagree, 4= Strongly Agree)

Question	Definition	Mean (Std. Dev.)
1	With respect to the conduct of business I avoid taking risk	0.51 (2.07)
2	With respect to the conduct of business I prefer certainty to uncertainty	1.50 (1.72)
3	I like "playing it safe"	0.81 (1.85)

Note. N=55

Econometric Procedures

After providing the definition of marketing contracts, in the second section of the survey instrument, growers were asked if they would be interested in participating in fresh produce marketing contract agreements. Producers were provided three ordinal choices to select from: i) no, I am not interested, ii) maybe, depending on the terms of the contract or iii) yes, I am willing to participate in a marketing contract agreement. This approach was preferred instead of a typical binary question (i.e. do you have a marketing contract for your fresh produce) because, currently, the use of marketing contracts for fresh vegetables is limited in the area of interest (Kentucky, Illinois, Ohio and Indiana)[5]. Given the discrete nature of the dependent variable, and the relatively small sample size of the study, we utilize a Bayesian ordered probit formulation to achieve the study objectives. The present section discusses in detail the formulation of the economic model used in this article.

Assume that a vegetable grower, indexed by i, is considering participation in a marketing contract agreement. The grower's decision, denoted Y_i, can be specified as a discrete variable with three possible values: a) the grower will not adopt the marketing contract, b) the grower may adopt the contract, depending on the terms and c) the grower will adopt the contract. In our sample 24% percent of the growers indicated that they are not interested in marketing contracts, 64% indicated that they may consider a marketing contract agreement depending on the terms and 11% indicated that they will adopt a marketing contract agreement.

Because the response variable is a non-numerical ordinal variable, an ordered probit model was implemented for the empirical estimation. Following Greene (2008), we first introduced a latent variable y* expressed as:

$$(2)\ y^* = BX + \varepsilon,$$

where B is the vector of the parameters to be estimated, X is the vector of explanatory variables and ε is a random term that follows normal distribution.

The value of the dependent variable Y_i (growers' decision) depends on the aforementioned latent variable and satisfies the following model:

[5] However, there is a great opportunity for increased use of contractual agreements considering the growth in fresh vegetable production (both in acres and farm number) in conjunction with the local food demand in the examined region.

$$(3)\ Y_i = \begin{cases} 0, \text{ if } y^* \le A_1, \\ 1, \text{ if } A1 < y^* \le A_2 \\ 2, \text{ if } y^* > A_2 \end{cases}$$

where, A_1 and A_2 are unknown cutoff values to be estimated with B.

The explanatory variables used can be broadly categorized in the following groups: i) producer characteristics (age, education, risk aversion level, risk perception), ii) farm characteristics (farm size, ability to expand, farm income), iii) location (Kentucky, Illinois, Ohio, and Indiana). Selection of these variables is based on previous literature (Musser, et al. 1996, Franken et al. 2014; Goodwin and Schroeder 1994) in conjunction with discussions with industry experts.

Empirical Estimation

Traditionally, to estimate the regression slopes and cutoff points we use maximum likelihood estimators (MLE). However, MLE is found to be unstable and easily affected by extreme cases when the sample size is small (Xie et al. 2009). Considering the small sample size of our study, in order to avoid this instability, we estimated the ordered probit model from a Bayesian perspective. This approach has a number of desirable properties. Specifically: i) when the sample size is small, the Bayesian method provides more stable parameter estimation and better model fitting compared to MLE, ii) the confidence intervals provided by the Bayesian approach are more reliable and do not depend on large sample assumptions, and iii) the Bayesian method facilitates the use of prior information or experts' belief through the specification of prior distributions.

Under the Bayesian inference, model parameters θ are considered as random. For the ordered probit model θ = (A, B). Before the data collection the researchers specify prior distributions based on findings from previous literature. Alternatively, one can adopt non-informative priors. Suppose that we denote the prior density function as π(θ). Then, according to Bayes theorem, the density of the posterior distribution can be expressed as:

$$(4)\ p(\theta|\, y) = \frac{f\,(y\,|\theta)\,\pi(\theta)}{f(y)}$$

where, f (y|θ) is the likelihood function and f(y) is the marginal likelihood.

Once the posterior density is computed we can use point estimators (i.e. posterior mean, median or mode) to estimate the model parameters. For the present study the posterior mean is used since it represents the center of the posterior distribution and can be obtained via Monte Carlo

approximation when a tractable form of p(θ|y) is unavailable. To estimate the credible intervals[6] we utilized the Highest Posterior Density (HPD) interval that has the shortest length (Hoff, 2009).

Regarding the choice of prior distribution, for the present study, the non-informative approach, suggested by Gelman et al. (2008), is implemented. Specifically, we first standardize the continuous predictors to have mean zero and standard deviation 0.5. Then, we let the coefficients B have independent Cauchy prior with scale 2.5 and intercepts (i.e. the cutoffs) A have independent Cauchy prior with scale 10.

A Markov chain Monte Carlo (MCMC) algorithm is utilized to draw samples from posterior distributions. In particular, Gibbs sampler[7] is used to generate simulations from the joint posterior distribution of the model parameters (Gelfand and Smith 1990). For the present study we generate a Markov chain of length T= 1,000,000 iterations, as a large T guarantees convergence from any starting point of the chain. However, the simulation requires a burn-in starting period to allow for the chain to converge and make accurate approximations. The first S =200,000 iterations are treated as the burn-in period and are discarded. The posterior means of A and B are approximated using sample means of the remaining MCMC samples. Similarly, posterior standard deviations are approximated by sample standard deviations. Furthermore, for each regression coefficient its 90% and 95% HPD intervals are estimated.

Estimation of Marginal Effects

In an ordered probit formulation the sign of the estimated coefficients can be easily interpreted as determining if the latent variable increases, or not, with the explanatory variables (Cameron and Trivedi, 2005). However, the interpretation of the magnitude of the coefficients is not as straightforward. To overcome this problem, the marginal effect (ME) for each of the explanatory variables is estimated to reveal the exact impact of the explanatory variables on the probability of participating in a marketing contract agreement.
The marginal effects for the maximum likelihood estimation (MLE) are calculated following Cameron and Trivedi (2005) as:

$$(5)\quad \frac{\partial P(y=k|X_i)}{\partial X_{Kj}} = [\,\varphi\,(A_{k-1} - X_i\beta) - \varphi(A_k - X_i\beta)]\beta_j$$

where, the function φ(.) is the pdf of the standard normal distribution. Since we have three categories, we estimate three marginal effects. The Monte Carlo estimate of the $ME_{y=0,j}$ is calculated by taking the average of all iterations after the burn-in:

[6] A credible interval is the Bayesian analogue of the confidence interval. In contrast to the confidence interval, it incorporates information for the prior distribution. A 90% credible interval indicates the range that the true parameter value will fall into with 90% probability.
[7] A Gibbs sampler is an MCMC approach for generating random variables from a distribution without having to calculate the density (Casela and George 1992).

$$(6)\ \widehat{ME_{y=0,j}} = \frac{1}{T-S}\sum_{t=S+1}^{T} -\varphi(A_1^{(t)} - \overline{X}'B^{(t)})B_j^{(t)}$$

where, $A^{(t)}$ and $B^{(t)}$ are the samples in the t^{th} iteration of the MCMC chain, and $\overline{X}$ is the column-wise mean of the design matrix.

Similarly, the marginal effects at y=1 and 2 are estimated using the following formulas:

$$(7)\ \widehat{ME_{y=1,j}} = \frac{1}{T-S}\sum_{t=S+1}^{T} -\varphi[\left(A_2^{(t)} - \overline{X}'B^{(t)}\right) - \Phi\left(A_1^{(t)} - \overline{X}'B^{(t)}\right)]B_j^{(t)}$$

$$(8)\ \widehat{ME_{y=2,j}} = \frac{1}{T-S}\sum_{t=S+1}^{T} -\varphi(A_2^{(t)} - \overline{X}'B^{(t)})B_j^{(t)}$$

Empirical Results

The regression results for the ordered probit and Bayesian ordered probit formulations are reported in Table 5[8]. The marginal effects for the Bayesian formulation are presented in Table 6. In a general framework, the sign of the coefficients indicates whether the latent variable y* increases or decreases with the explanatory variable. The marginal effects indicate the increase/decrease in the probability of signing a contract associated with a one unit increase in the explanatory variable. Lastly, for the ordered probit/logit models, inference regarding the threshold parameters, i.e., comparing each cutoff parameter with zero, is meaningless (Green and Hensher 2009; Dayking and Moffat 2002). However, testing whether the cutoff parameters are statistically different from each other can help us assess if the three categories should be collapsed into two (Gebrezgabher et al. 2010; Cameron and Trivedi 2005). For the present study, a chi-square statistic for the MLE approach (Williams 2015) and the HPD interval for the Bayesian approach, verify that the two cut-off points A_1 and A_2 are significantly different from each other.[9] Thus, the three categories should not be collapsed into two, and the use of an order probit model is justified.

In line with our initial hypothesis, the findings indicate that the probability of signing a marketing contract is lower for older producers (Table 5). Specifically, a one year increase in the age of the producer is associated with being 1.36% more likely not to sign a contract, 0.83% less likely to maybe sign a contract depending on the terms and 0.53% less likely to sign a contract (Table 6). A number of reasons justify this finding. First, older growers have a shorter planning

[8] In addition to the main effects estimation, models with interaction terms were also estimated. In line with the findings of Hudson and Lusk (2004), the interaction terms were not statistically significant. The only exception was the interaction term between risk perception and Kentucky that was found to have a statistically significant positive coefficient indicating that more risk averse growers in the state are more likely to participate in contractual agreements.

[9] For the MLE approach, prob > χ^2 =0.00. The Bayesian model yields an estimated value of $A_2 - A_1$ of 2.69, with a 95% HPD interval [1.87, 3.50], confirming that the difference between the two cutoff points is significant.

horizon, thus they may be less likely to participate in contractual agreements especially if they require long term commitments (Musser et al. 1996). Second, older/more experienced growers may be able to better time their production and achieve greater net returns from the cash market (Franken et al. 2014). Furthermore, older growers are less willing to diversify their practices, especially in areas where contracting is not common (Franken et al. 2014). On the other hand, younger producers may prefer contractual agreements in order to improve their financing capabilities (Davis and Gillespie 2007).

Table 5. Ordered Probit Estimation Results for the Probability of Signing Contracts[1]

	Ordered Probit (MLE)		**Bayesian Ordered Probit**	
Variables	Coefficient	Standard Error	Coefficient	Standard Error
Risk Aversion	-0.2751	0.3027	-0.3241	0.2919
Risk Perception	0.0407	0.0416	0.0354	0.0401
Age	-0.0544**	0.0166	-0.0564**	0.0171
Farm Size	0.0085*	0.0047	0.0083*	0.0047
Ability to Expand	1.1607*	0.6220	1.1007**	0.6011
Education	-0.0758	0.0739	-0.0719	0.0709
Farm Income	0.4868	0.6514	0.5010	0.6531
Kentucky	1.0929*	0.5536	1.0355**	0.5182
Indiana	0.2960	0.5378	0.2029	0.4946
Ohio	0.0458	0.5796	-0.0608	0.5475
A_1	-2.8058	1.6058	-3.0569	1.5642
A_2	-0.2397	1.5336	-0.3680	1.4776
Pseudo R^2	0.2508			
Fitting[10]	0.2642		0.2642	
Prediction[11]	0.3774		0.3774	

Note. * and ** denote significance level of 0.10 and 0.05 respectively

Moreover, the results indicate that the farm size and the ability to expand the operations, if needed, have a positive impact on the probability of adopting a marketing contract agreement (Table 5). For instance, a grower that has the potential to expand his/her operations is 10.49% more likely to participate in a marketing contract agreement, compared to a grower that does not have the ability to expand (Table 6). This finding is not unexpected considering that the majority of farmers who participate in contractual agreements are large scale producers (Franken et al. 2014; MacDonald et al. 2004, Katchova and Miranda 2004). This result is also consistent with the statement of Wang et al. (2014), who mentioned that buyers are more likely to offer contractual agreements to larger farms in order to reduce transaction costs.

Following Goodwin and Schroeder (1994) and Musser et al. (1996) our initial hypothesis was that education would have a positive impact on the probability to participate in contractual agreements, since more educated growers may be able to utilize contractual agreements more efficiently. However, in line with Goodwin and Kastens (1996), Katchova and Miranda (2004) Paulson et al. (2010), and Bellemare (2012), our results indicate that the education level of the farm manager does not have a statistically significant impact in the probability that a grower will participate in contractual agreements (Table 5).

[10] Misclassification rate in the fitted data is 0.2642 for both MLE and BOP, i.e., 14 misclassified cases out of 53 observations.

[11] Misclassification rate in out-of-sample prediction by a ten-fold cross validation is 0.3774 for both MLE and BOP, i.e., 20 misclassified cases out of 53 observations.

Two of the purported benefits of contractual agreements include a reduction in income risk and a steady cash flow that can improve growers' access to credit (Katchova and Miranda 2004; MacDonald and Korb 2011; Wang et al. 2014). Therefore, a plausible hypothesis is that producers with lower farm income may be more likely to participate in contractual agreements (Musser et al. 1996; Wang et al. 2014). Our findings indicate that farm income does not have a statistically significant impact in the probability that a grower will use marketing contracts (Table 5). Although surprising, this result is consistent with the findings of Katchova and Miranda (2004) who indicated that gross farm income does not affect the probability of participating in marketing contracts for U.S.A. soybeans and wheat producers and with Simmons et al. (2005) who indicated that credit constraints do not have a statistically significant impact in the decision to participate in contractual agreements for corn and rice producers in Indonesia. This finding may suggest to potential buyers that just designing a monetary scheme is not enough to attract producers to participate in contractual agreements

None of the explanatory variables related to risk (risk aversion levels and risk perception) have a statistically significant impact on the probability of adopting marketing contracts (Table5). Consequently, our findings, in line with Allen and Lueck (1992, 1995, 1999), do not provide support for the risk shifting hypothesis.

Regarding the location variables, producers in Kentucky are more likely to sign a marketing contract compared to growers in Illinois (the base category), while, producers in Indiana and Ohio are not significantly different from those in Illinois. For instance, the probability of a producer in Kentucky signing a marketing contract is 9.81% higher compared with a grower in Illinois (Table 6). The change in the available marketing outlets in conjunction with the rising importance of vegetable production in the economy of Kentucky provides justification for this finding. Specifically, it has been noticed in the literature that when production of a certain agricultural product in one area increases substantially, like the case of tomato production in KY, there is an expectation for increased participation in contractual agreements (Davis and Gillespie 2007). Furthermore, until 2008, fresh produce cooperatives were among the major marketing outlets (Woods et al. 2012). However, after 2008 the majority of them declined, or went out of business (Woods et al. 2012). Consequently, vegetable producers seek alternative options. Considering the increased demand for local foods in the state, and the promotion programs, such as Kentucky Proud, contractual agreements with restaurants and grocery stores is an attractive marketing alternative (Woods et al. 2012).

Table 6. Marginal Effects for the Bayesian Ordered Probit Formulation

Variable	No	Maybe	Yes
Risk Aversion	0.0783	-0.0469	-0.0314
Risk Perception	-0.0840	0.0051	0.0034
Age	0.0136**	-0.0083**	-0.0053**
Farm Size	-0.0020*	0.0012	0.0008*
Ability to Expand	-0.2675*	0.1626	0.1049*
Education	0.01740	-0.0108	-0.0067
Farm Income	-0.1218	0.0759	0.0458
Kentucky	-0.2514**	0.1533	0.0981**
Indiana	-0.0503	0.0302	0.0200
Ohio	0.0140	-0.0092	-0.0048

Note. * and ** denote significance level of 0.10 and 0.05 respectively

Conclusions

Contractual agreements account for, almost, 40% of the value of U.S. agricultural production. However, only 12% of the producers participate in any type of contractual arrangements (MacDonald and Korb 2011). Considering the low participation rate and the expenses associated with writing a contract (monetary costs, time requirements etc.) a better understanding of the factors that influence producers probability of signing a contract is especially important for reducing costs and writing contracts that can be beneficial for the buyer and the grower. Although numerous theoretical explanations for the increased use of contracts have been proposed, there is limited empirical support for them (Hudson and Lusk 2004; Paulson et al. 2010).

The present study used a Bayesian ordered probit approach to investigate how different producer and farm operation characteristics affect fresh vegetable growers' decision to sign a marketing contract. Fresh vegetable growers were selected as the sample of the present study due to the increased sources of risk they face and the limited opportunities they have to reduce this uncertainty.

The findings indicate that the producers' age, the farm size, the ability to expand and the location are factors that influence the probability of signing a marketing contract. On the other hand, farm income and education level did not have a statistically significant impact on the probability of signing a marketing contract agreement.

An important research question is whether or not growers risk aversion levels affect the probability of participating in contractual agreements. The present study used a multiple price list game and three Likert scale questions to elicit growers risk aversion and risk perception levels. The findings of the empirical analysis do not provide support for the risk shifting hypothesis.

A limitation of the present study is associated with the relatively small sample. However, the use of Bayesian analysis can help overcome this problem. Further research is needed to estimate if the results of this study are consistent across regions. Furthermore, future research may try to examine which elements of a contractual arrangement make them more attractive to producers.

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Employee Perceptions and Expectations of Online Marketing Service Quality: An Investigation of Farmers' Associations in Taiwan

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Abstract

Numerous agribusiness firms have aimed to improve their service quality to build profitable relationships with customers. Prior research has indicated that employee satisfaction could create customer loyalty, yielding favorable business results. According to previous studies, the SERVQUAL scale was used in this study to investigate the relationship between the expectations and perceptions of farmers' association employees in Taiwan. The results indicated that the largest gap between employee expectations and perceptions pertained to the tangibility of service quality, followed by reliability, empathy, responsiveness, and assurance. In addition, the results suggested that perceived responsiveness could influence expected tangibility, and that expected empathy could influence perceived assurance and empathy. To achieve higher profitability, farmers' associations should focus on low-performing areas, and the overall value of an organization should be vital to employees.

Keywords: employee; farmers' association; online marketing; service quality; SERVQUAL

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Introduction

Strengthening farmer access to market information and marketing channels by using modern information and communication technology (ICT) can create a potential market for agribusiness (Henderson et al. 2005). Market information and marketing channels can be provided using ICT tools, which have advanced with the increasing predominance and affordability of the Internet, enabling farmers to reach more informed decisions on where and when to sell their farm products; bypass or bargain with the intermediate distributor; and be aware of products that are increasingly in demand, scarce agriinputs, and available subsidies (World Bank 2011). The Food and Agriculture Organization (2014) indicated that e-agriculture is an emerging field in the intersection of agricultural informatics, development, and entrepreneurship and is intended to increase agricultural productivity.

Taiwan farming is a small-scale system in which farmers' associations are critical throughout all regions of the country, safeguarding farmer rights and interests, enhancing farmer knowledge and skills, modernizing agriculture, increasing crop yields, improving farmer livelihoods, and developing rural economies (The Farmers' Association Act 2015). Farmers' associations have the advantages of brands, capital, technology, and policy support, all of which are conducive to developing online marketing. Applying ICT to facilitate agricultural marketing could enable the agricultural industry of Taiwan to be more efficient in the current global market than those of other countries. However, when governments create promotional programs to integrate ICT into agriculture, they should disseminate information pertaining to online marketing and evaluate the outcomes (Liu 2011).

Enterprises must provide products and services that fulfill customer requirements. Agribusiness firms have aimed to improve their service quality to build and maintain profitable relationships with their customers (Langen et al. 2013; Tey et al. 2014). However, because services are intangible, inseparable, variable, and homogenous (de Jong et al. 2003), achieving a consistent service standard is difficult. Moreover, although numerous customer services are used in agriculture, they are not systematically evaluated in a manner similar to how products are assessed (Alsemgeest and Smit 2013; Gunderson et al. 2009). To date, little empirical assessment has been performed regarding coworker perceptions (Farner et al. 2001). Because service quality is primarily determined by actual experience, it results from employees and customers comparing their expected and actual service experiences.

To measure enterprise service quality, Parasuraman et al. (1985, 1988) proposed using a service quality concept model and developed the SERVQUAL scale. This scale is an effective tool that is employed by various service industries to analyze customer satisfaction, and can be applied within organizations (Ebrahimi and Imani 2014). Over 300 farmers' associations have been established throughout Taiwan, each of which possesses unique characteristics and business models. To ensure positive outcomes, the online marketing service quality of farmers' associations must be carefully examined. To determine this service quality and whether employee satisfaction could create customer loyalty, this study adopted the SERVQUAL scale, investigating the relationship between the expectations and perceptions of employees regarding online marketing in farmers' associations.

Research Context

Taiwan has a well-established infrastructure in agriculture, excellent research and development, and agricultural extension services provided by the public and private sectors (Huang and Lin 2006). Because of rapid economic development in previous decades, the gross domestic product of Taiwan has grown substantially, whereas the agricultural contribution has dropped. From 1992 to 2012, the agricultural population declined from one million to 540,000 (Council of Agriculture 2012). The agricultural management style in Taiwan is primarily that of small-scale farms; thus, accumulating capital, increasing investment, and expanding the scale of operations is difficult. Introducing mechanized cultivation methods to increase production is also challenging, and consequently, farmers lack bargaining power for their product prices (Council of Agriculture 2015a).

Recent development trends in rural villages, such as establishing farmers' markets and promoting agricultural tourism and entrepreneurial ventures, have revitalized the rustic culture of Taiwan's small towns. Under the Council of Agriculture's Small Landlords and Big Tenant-Farmers Program, younger generations have also begun to play a larger role in the national agricultural sector, marking the beginning of an era in which farming is a lifestyle (Council of Agriculture 2015b). Taiwan's agricultural environment and conditions are unlike those in countries with large agricultural sectors that operate on a vast economic scale; however, Taiwan has numerous flexible modes of operation to remedy this limitation. One method is facilitating farmer cooperation as an economic scale to compete with international agricultural products in the world market.

Farmers' associations in Taiwan are a vital agribusiness and serve as a crucial intermediary between the government and farmers. Currently, farmers' associations are organized according to three levels: national, city/county, and township. National and city/county farmers' associations mainly function to supervise and coordinate the township associations. Township farmers' associations are private corporations that employ an average of 50 employees. Each township farmers' association consists of four departments that provide marketing, credit, insurance, and extension services to their farmer members. Regarding online marketing, employees of farmers' associations not only provide joint procurement of inputs, technical support, and advisory services to their members, but also assist in product sales and market promotion, helping the members to improve their lives.

Considering that the employees of farmers' associations provide valuable agricultural extension services, their professional ability, work performance, and job satisfaction play a crucial role in farmers' well-being and influence policy making. Previous studies have indicated that employee satisfaction creates customer loyalty and favorable business results (Keiningham et al. 2005; Xu and Goedegebuure 2005); in other words, firm employee satisfaction mirrors customer satisfaction. Because of the extension of national policy on e-agriculture, nearly every employee of farmers' associations in Taiwan now has adequate knowledge or experience regarding online marketing and e-commerce. To prevent a self-evaluation bias, only employees with sufficient knowledge who were uninvolved in farmers' association online marketing were included in this study.

Online Marketing

The focus of marketing is the process created by the supplier to satisfy consumer requirements, resulting in consumer acceptance of the provided product. The Internet combines product information, promotional events, customer feedback surveys, public relations, and access to distinct marketing environments and personalized services (Chen et al. 2014a; Chou and Liang 2013). Therefore, online marketing can involve tangible products, express services, and intangible consumer experiences; satisfactory consumer experiences can be conveyed to potential customers (Bernstein and Federgruen 2007). Recently, the Taiwanese government has promoted the application of modern ICT in the agricultural industry to enhance the provision of market information as well as enable farmers and agricultural associations to develop e-commerce (Chen et al. 2014b).

The 4Ps (price, product, promotion, and place), which are traditional marketing topics, can be applied to online marketing. Using the Internet enables buyers to compare prices more easily and efficiently than in the past (Shin 2001). To survive in the Internet market, companies must develop new pricing models and offer a variety of new products that exist solely because of the Internet (Darby et al. 2003). Regarding promotion, the Internet enables firms to vary their service delivery systems, thereby increasing customer value, which can be exploited to gain a competitive advantage (Jin and Oriaku 2013). Current business promotional activities are mostly performed using Internet marketing, and small-scale businesses can promote their products in the same manner that large businesses do, creating competition in the market (Chen et al. 2014b).

The essence of online marketing strategies is the 4Cs: customer, cost, communication, and convenience. Therefore, online marketing focuses on consumer opinions when endeavoring to fulfill customer requirements, adopt the customer's point of view, and interact and communicate with customers to strengthen client relationships (Paul and Garodia 2012). Through online marketing, firms can obtain immediate feedback, enhance relationships with consumers, and increase overall efficiency and profitability (Ozituran and Roney 2004). Excellent service quality resulting in a successful online experience is the key to creating an online competitive advantage (Novak et al. 2000; Zeng et al. 2009). According to the aforementioned studies, service quality influences the success of online marketing and is derived from customer experience; however, a gap between customer perception and expectation of service quality exists. Therefore, determining the difference between customers' expected and actual experiences is crucial for developing online marketing.

Service Quality

Buttle (1996) indicated that service quality has become a crucial research topic because of its apparent relationships to cost, profitability, customer satisfaction, customer retention, and positive word of mouth. Numerous studies have confirmed that more efficient customer service leads to greater profitability (Lülfs-Baden et al. 2008; Niraj et al. 2003; Zeithaml et al. 2001). Service quality represents the quality that consumers perceive and their service expectations during the purchasing process (Grönroos 1984). Therefore, service quality should be measured using the provider's quality and the quality of the interaction between the provider and receiver (Ramseook-Munhurrun et al. 2010). Numerous farmers' associations in Taiwan provide online

marketing services for their farmer members. Awareness of the service quality that is provided and the interaction between the associations and their customers is crucial.

Service quality has been increasingly recognized as a vital aspect of e-commerce. Santos (2003) proposed that e-service quality has incubative and active dimensions that can be used to increase hit rates, stickiness, and customer retention. Landrum et al. (2009) determined that users rate information system responsiveness and reliability higher than other service quality dimensions. Roy and Butaney (2014) indicated that aesthetics, information content, navigational quality, information quality, e-satisfaction, and customer attitude positively affect customer relative loyalty (CRL). Roy and Butaney suggested that CRL provides useful insights because it may reflect the mental representations of the customers that are obtained when they engage in consumer behavior on a website.

Parasuraman et al. (1985) first conducted 12 focus group interviews with customers from four different service industries and determined that customers primarily apply similar standards when evaluating service quality. In addition, Parasuraman et al. (1988) then developed a 22-variable SERVQUAL service quality scale, revising the scale again in 1991. The 22 variables are divided into the following five categories: (1) tangibility (appearance of physical facilities, equipment, and employees); (2) reliability (ability to accurately and reliably complete promised services); (3) responsiveness (willingness to assist customers and provide timely services); (4) assurance (employee knowledge, etiquette, and ability to instill trust and confidence in customers); and (5) empathy (individual care and attentiveness provided by service personnel).

A previous study indicated that several service gaps must be filled, including those between consumer expectation and management perception, between management perception and service quality specification, between service quality specification and service delivery, between service delivery and external communication, and between expected service and experienced service (Parasuraman et al. 1991). In addition, Behe and Barton (2000) indicated that customers ranked responsiveness and assurance as the top two quality concerns during food shopping, followed by tangibility, reliability, and empathy. Eastwood et al. (2005) determined that successful food retailing depends substantially on providing a positive shopping environment for consumers. Moreover, Lülfs-Baden et al. (2008) emphasized that store atmosphere, customer service, and product quality were the main factors influencing customer satisfaction.

Previous studies have indicated that employee service, commitment, and job satisfaction are crucial for continually improving organizational performance (Farner et al. 2001; Gupta et al. 2005; Lee 2006). Hirmukhe (2012) measured employee expectation of service quality and suggested that organizational performance must be reviewed because the expectations of both internal and external customers are constantly increasing. Musaba et al. (2014) also stressed that the service gaps between employee perceptions and expectations of quality service are related to the fair treatment and care for employees by employers. Although most companies have developed strategies to improve quality and customer service, employee satisfaction is frequently neglected. Firm employee satisfaction reflects external customer satisfaction (Bellou and Andronikidis 2008; Keiningham et al. 2005). Ramseook-Munhurrun et al. (2010) confirmed that employees have a thorough understanding of the expectations of external customers; hence, employee perception of service quality reflects that of external customers.

Although the SERVQUAL scale has been applied in diverse fields (such as aviation, health care, and food retail), few studies have applied this research instrument to examine online marketing performance. The research team in the present study adjusted the SERVQUAL scale according to industrial characteristics (such as farmland potential to provide public goods, farmers' lack of market power, and unstable agricultural prices), investigating the employee assessment regarding the service quality of farmers' association online marketing in Taiwan. Based on the aforementioned studies, two hypotheses were provided: (1) There is a gap between employee expectations and perceptions; and (2) employee expectations and perceptions influence each other.

Methods

Participants and Procedure

The participants of this study comprised the employees of 302 farmers' associations in Taiwan. Although the employees are not in charge of the online marketing at their associations, they have adequate knowledge of online marketing, and their work is affected by the service quality of the online marketing division or staff. The research team sent two copies of the questionnaire and a stamped addressed envelope to each farmers' association; 604 questionnaires were mailed, followed by reminders two weeks later. The research team provided phone numbers and e-mail addresses on the questionnaires; thus, the problems participants encountered when completing the questionnaires could be resolved directly. All participation was voluntary and anonymity was guaranteed. Data were collected between March and April 2014. A total of 214 questionnaires were returned, of which 210 were valid. No particular incentives were offered for participation, accounting for the reasonable participation rate (214/604 = 35.43%).

Measures

In this study, the 44-item SERVQUAL scale refined by Parasuraman et al. (1991) was employed. The participants answered on a 6-point scale ranging from 1 (*strongly disagree*) to 6 (*strongly agree*). A total of 20 experts from the agricultural industry, government, and academia participated in a pilot study that used the questionnaire. The wordings of the questionnaire was amended according to the pilot study results and suggestions, and the final questionnaire content was developed. The questionnaire was accompanied by a participant information sheet comprising study title, invitation paragraph, study purpose, reasons for participation, possible disadvantages and benefits of participation, ensured confidentiality and anonymity, use of the study results, and contact information. This questionnaire was approved by the Research and Development Committee, Department of Bio-Industry Communication and Development, National Taiwan University.

The data were analyzed using SPSS Version 17.0 software. An exploratory factor analysis was employed to determine the factor structure of the questionnaire items. Pearson's correlation was used to analyze the linear relationship between employee expectations and perceptions of the service quality involved in online marketing. A paired sample *t* test was applied to examine the gap between expectations and perceptions. Furthermore, multiple regression analysis was used to explore whether an interactive effect existed between expectations and perceptions.

Results

Descriptive Analysis

The measured items were organized by item analysis according to the mean (*M*) ranges of employee expectations and perceptions (4.16–5.57), standard deviation (*SD*) (0.601–1.050), skewness (-1.151–-0.160), and Kurtosis (-1.727–0.114) of the data acquired during the formal survey, demonstrating that the measured items were appropriate.

The reliability of the questionnaire was evaluated according to the Cronbach's α values of each item and factor. The general standard indicated an adequate reliability of ≥ 0.7. The results demonstrated that the Cronbach's α values of each factor measuring employee expectations ranged from .847 to .915, whereas the Cronbach's α values of each factor measuring employee perceptions ranged from .891 to .948, suggesting that the questionnaire items were highly reliable. Regarding validity, first, the questionnaire was designed, and a standard SERVQUAL scale was adopted. Second, the pilot study was performed using 20 experts on agricultural marketing. Finally, the results of the follow-up factor analysis were used to explain the high total item variance. All of these measures ensured that the questionnaire employed in this study was valid.

Exploratory Factor Analysis

The Kaiser–Meyer–Olkin (KMO) measure of employee expectations determined in this study was 0.940, and the Bartlett's test of sphericity was significant (χ^2 = 3924.174, *df* = 231, *p* = 0.000). The KMO measure of employee perceptions was 0.959, and the Bartlett's test of sphericity was significant (χ^2 = 4415.349, *df* = 231, *p* = 0.000). These analyses indicated that the sampling was satisfactory and that factor analysis could be performed. Principal Axis Factoring (PAF) analysis employing promax rotation was conducted to determine the dimensionality of the scale.

On the basis of the method developed by Parasuraman et al. (1991), two sets of a five-factor solution, which explained variables of 68.512% for employee expectations and 78.509% for employee perceptions, conceptually provided the appropriate factor structure. For both employee expectations and perceptions, Factor 1 was named *Tangibility*; Factor 2 was called *Reliability*; Factor 3 was referred to as *Responsiveness*; Factor 4 was named *Assurance*; and Factor 5 was titled *Empathy*. Table 1 summarizes the detailed results of *M*, *SD*, Cronbach's α, and PAF.

In this study, a paired sample t test (95% confidence interval) was conducted to compare the differences between internal-customer expectations and perceptions (Table 2). The gaps in tangibility, reliability, responsiveness, assurance, and empathy achieved significance; hence, the first hypothesis was supported. In addition, multiple regression analysis was performed to explore the interactive effects between expectations and perceptions (Tables 3 and 4). The results indicated that perceived responsiveness influenced expected tangibility, whereas expected empathy influenced perceived assurance and empathy. Therefore, the second hypothesis was partially supported.

Table 1. Descriptive statistics of the questionnaire items (n = 210)

Factor / Item	*M*	*SD*	Cronbach's α	PAF
Employee Expectations				
Tangibility	5.36			
OM should constantly update website content and hardware equipment.	5.39	.699	.824	.713
OM websites should be visually appealing.	5.46	.620	.813	.747
OM employees should have a professional image.	5.37	.672	.768	.880
OM service documents should be visually appealing.	5.23	.762	.820	.738
Reliability	5.41			
OM promised services should be completed within a designated time.	5.49	.654	.855	.724
OM service personnel should solve all problems posed by customers.	5.48	.621	.825	.871
OM should complete all services correctly the first time.	5.46	.676	.832	.806
OM should provide services during the promised timeframe.	5.46	.653	.826	.876
OM should insist on a flawless service record.	5.16	.764	.888	.626
Responsiveness	5.40			
OM employees should be able to provide a precise service timeframe to customers.	5.42	.680	.822	.776
OM employees should be able to provide customers with immediate service.	5.34	.680	.833	.744
OM employees should enjoy helping customers.	5.51	.629	.808	.835
OM employees should respond to customer requests even if they are busy.	5.32	.699	.825	.777
Assurance	5.49			
OM employees should strengthen customer confidence through service.	5.44	.675	.796	.845
OM services should enable customers to relax during the purchasing process.	5.57	.601	.813	.803
OM employees should always respect customers.	5.46	.713	.844	.710
OM employees should possess the knowledge required to respond to customer questions.	5.47	.653	.820	.766
Empathy	5.28			
OM employees should be attentive to each customer.	5.11	.806	.903	.768
OM service times should be convenient for all customers.	5.39	.676	.887	.859
OM employees should prioritize customer care.	5.42	.710	.904	.754
OM should strive to maximize benefits for customers.	5.23	.775	.880	.862
OM employees should understand specific customer requests.	5.27	.762	.876	.889
Employee Perceptions				
Tangibility	4.34			
Our OM constantly updates website content and hardware equipment.	4.53	1.050	.898	.705
Our OM website is visually appealing.	4.30	.907	.830	.918
Our OM employees have a professional image.	4.37	.960	.857	.829
Our OM service documents are visually appealing.	4.16	.953	.830	.842
Reliability	4.68			
Our promised OM services are completed within a designated time.	4.76	.950	.911	.836
Our OM service personnel solve all problems posed by customers.	4.83	.919	.899	.902
Our OM completes all services correctly the first time.	4.80	.921	.898	.914
Our OM provides services during the promised timeframe.	4.84	.863	.904	.880
Our OM insists on a flawless service record.	4.17	.958	.933	.707
Responsiveness	4.80			
Our OM employees can provide a precise service timeframe to customers.	4.75	.952	.889	.893
Our OM employees provide customers with immediate service.	4.67	.913	.913	.808
Our OM employees enjoy helping customers.	4.96	.905	.888	.901
Our OM employees respond to customer requests even if they are busy.	4.81	.926	.901	.854
Assurance	4.93			
Our OM employees strengthen customer confidence through service.	4.90	.871	.928	.923
Our OM services enable customers to relax during the purchasing process.	4.96	.823	.929	.919
Our OM employees always respect customers.	5.01	.824	.926	.932
Our OM employees possess the knowledge required to respond to customer questions.	4.84	.880	.946	.856
Empathy	4.66			
Our OM employees are attentive to each customer.	4.48	.991	.937	.826
Our OM service times are convenient for all customers.	4.69	.966	.929	.867
Our OM employees prioritize customer care.	4.79	.955	.923	.910
Our OM strives to maximize benefits for customers.	4.71	.871	.933	.850
Our OM employees understand specific customer requests.	4.63	.928	.920	.925

Note. *M* refers to mean; *SD* refers to standard deviation, PAF refers to principal axis factoring; and OM refers to online marketing.

Table 2. Paired sample *t* test of the differences between expectations and perceptions (*n* = 210)

	Paired Differences							
				95% Confidence Interval of the Difference				
Paired Samples	**Mean**	**Std. Mean**	**Std. Error Mean**	**Lower**	**Upper**	**t**	**df**	**Sig.**
Pair 1	4.600	3.869	.292	4.023	5.177	15.730	209	.000
Pair 2	4.571	4.345	.328	3.923	5.220	13.918	209	.000
Pair 3	3.023	3.570	.270	2.490	3.556	11.201	209	.000
Pair 4	2.937	3.439	.260	2.424	3.450	11.297	209	.000
Pair 5	3.954	5.117	.387	3.191	4.718	10.223	209	.000

Note. Pair 1 refers to Expected Tangibility - Perceived Tangibility; Pair 2 refers to Expected Reliability - Perceived Reliability; Pair 3 refers to Expected Responsiveness y - Perceived Responsiveness; Pair 4 refers to Expected Assurance - Perceived Assurance; and Pair 5 refers to Expected Empathy - Perceived Empathy.

Table 3. Summary of multiple regression analysis for perceptions predicting expectations (*n* = 210)

Variables/Factors		**Expectation Tangibility**		
		Beta	***t***	***p***
Perception	Tangibility	-.093	-.827	.410
	Reliability	.043	.249	.804
	Responsiveness	.444	2.068	**.040**
	Assurance	-.360	-1.669	.097
	Empathy	-.044	-.258	.797
Summary	R^2		.033	
	F		1.150	
	P		.336	

* *p*< .05 , ** *p*< .01 , ***p*< .001

Table 4. Summary of multiple regression analysis for expectations predicting perceptions (*n* = 210)

Variables/Factors		**Perception**					
		Assurance			**Empathy**		
		Beta	***t***	***p***	**Beta**	***t***	***p***
Expectation	Tangibility	-.067	-.575	.566	-.007	-.062	.951
	Reliability	-.002	-.013	.989	-.024	-.146	.884
	Responsiveness	.205	1.282	.202	.215	1.343	.181
	Assurance	.113	.773	.441	.062	.424	.672
	Empathy	-.264	-2.039	**.043**	-.290	-2.234	**.027**
Summary	R^2		.030			.031	
	F		1.046			1.082	
	P		.393			.372	

* *p*< .05 , ** *p*< .01 , ***p*< .001

Discussion

The results indicated that assurance was rated as the highest expectation of service quality (*M* = 5.49, Table 1), indicating that professional conduct, such as possessing sufficient knowledge to respond to questions, respecting and enabling customers to relax, and building customer

confidence, were the most critical performance factors for online marketing agricultural services. In addition, the employees rated reliability (M = 5.41) and responsiveness (M = 5.40) highest, suggesting that resolving customer problems efficiently and promptly is crucial. Tangibility (M = 5.36) and empathy (M = 5.28) were rated as the least crucial expectations, probably because agricultural customers focus more on product quality than on visual appearance. In addition, the convenience and low price typically provided by e-companies have created the empathy that customers require. The rating sequence of perceptions was similar to that of expectations (Table 1). These results are consistent with those of previous studies (Behe and Barton 2000; Landrum et al. 2009; Paul and Garodia 2012; Ramseook-Munhurrun et al. 2010; Santos 2003).

The results of the paired sample t test suggested that employee expectations and perceptions differed substantially (Table 2). The largest gap occurred in the tangibility of service quality, followed by reliability, empathy, responsiveness, and assurance. Although tangibility was not ranked high according to expectations and perceptions, it could be increased if funding were available and professional staff could be hired. Reliability was ranked high according to expectations and perceptions, and the second largest gap existed in this category, indicating that the most effort should be expended in improving reliability. Behaviors such as promptly solving customer problems and providing effective services should be demanded and fostered. Consistent with the findings of previous studies (Parasuraman et al. 1988; Ramseook-Munhurrun et al. 2010), employees believed that the ability of farmers' associations to provide accurate, reliable, timely, friendly, and convenient services and instill confidence in customers requires improvement.

In addition, the results indicated that expectations may interact with perceptions. The responsiveness perceived by the employees could have influenced the tangibility they expected (Table 3), suggesting that satisfying the current responsiveness would increase future expectations of tangibility. This also implied that precise and immediate service is more essential than updating facilities and creating visually appealing exteriors. Moreover, the empathy the employees expected could have influenced the assurance and empathy they perceived (Table 4), indicating that the customers were concerned that empathy would influence their judgment regarding the current quality of assurance and empathy. This also implied that customers who demanded more personalized services cared more about the existing services, particularly with respect to assurance and empathy. Although few interactive effects were observed between expectations and perceptions in this study, the implications of the results warrant future investigation.

Although this study contributes to the relevant literature, a few limitations should be noted. First, to avoid a self-evaluation bias, only employees that were not involved in the online marketing of farmers' associations were studied. Although the respondents possessed adequate knowledge of online marketing, they may not have been able to answer all of the operational questions in detail. Marketing staff members could be included in future studies to facilitate a comparison with their counterparts. Second, the opinions of external customers were not investigated in this study. Future researchers should consider the differences resulting from internal and external perspectives regarding service quality.

In the context of agriculture, customer satisfaction and online marketing are influenced by product quality and differentiation (Cranfield et al. 2012; Wirthgen 2005), two factors that should be considered in future research. In addition, the organizational operation (farmers' associations or agricultural companies) and the surrounding socioeconomic context profoundly influence the service quality of online marketing (Carpio and Isengildina 2009; Gupta et al. 2005; Tey et al. 2014) and should be explored. Cross-industrial coordination is a beneficial strategy that is used to develop new products and enter new markets (Fritz and Canavari 2008; Hanf and Kühl 2005); employee perceptions regarding this aspect should be studied.

Conclusion

The employees rated assurance as the highest expectation (perception) in service quality, followed by reliability (responsiveness), responsiveness (reliability), tangibility (empathy), and empathy (tangibility). The correlations between expectations and perceptions were minimal, and the differences between expectations and perceptions were substantial. The two largest gaps occurred for the tangibility and reliability of service quality. In addition, the responsiveness that employees perceived influenced the tangibility that they expected, and the empathy that employees expected influenced the assurance and empathy that they perceived. In conclusion, farmers' associations should focus on the dimensions that received the highest expectation ratings and the lowest perception ratings as well as on the attributes for which gaps in the scores were found.

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Mitigating Risk in the Tuna Supply through Traceability System Development

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Abstract

This study concerns the mitigation of risk based on advances in food product traceability technology. A case study of the supply, processing and distribution of wild catch tuna on the island of Sulawesi in Indonesia provides the backdrop for describing and analyzing risk agents and how they are interrelated in the supply chain. The purpose of this study is to develop an inductive, empirically based model concerning risk mitigation in seafood supply networks. It builds upon the seminal works of Forrester's understanding of information distortion, Alderson's transvection model and Thompson's interdependency theory.

Keywords: risk management, traceability, complete supply chains, transvection, food, tuna

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Introduction

Conducting business requires an integrated network of firms competing with each other in "supply chains" (Christopher 2011). No single firm can stand as an "island" isolated from a network of business services (Richardson 1972). Scholars were seeking to conceptualize all the facets of distribution, from end to end, by the 1950s and 1960s (Forrester 1958, Alderson 1965, Thompson 1967). Their insights are still highly relevant and fundamental to the theoretical development of the management of end-to-end supply chains and provide the analytical framework for this study.

Adopting an end-to-end perspective entails strategic thinking that encompasses the flows of food from harvesting, fishing or hunting to end-use (Engelseth 2012). It also concerns the integration of marketing with logistics and SCM (Engelseth and Felzensztein 2012). While supply chain management (SCM) involves integration from an end-to-end supply chain perspective (Lambert and Cooper 2000), research has paid less attention to conceptualizing and understanding the risks from the same end-to-end perspective. The emergence of food product traceability requirements within the food industry in the past two decades has had a synergetic effect with integration (Engelseth 2013). As electronic traceability systems have evolved to address risk mitigation associated with food safety and quality concerns, the food industry has become aware that achieving supply efficiency requires the participation of all the actors involved in transforming foods in the end-to-end supply chain. Developing food product traceability is therefore not only a logistical and marketing issue, from a developmental aspect, but clearly also an SCM issue (Engelseth 2009). Integration encompasses in long-linked end-to-end supply chains an often coincidental translation through a series of markets from raw material to consumption revealing how SCM and marketing issues are intertwined from this complete perspective (Engelseth 2016). In this picture of structural complexity traceability is an information resource enabler of integration.

Developing food product traceability is a common practice that needs organization (Vanany et al. 2015). Traceability encompasses features of risk mitigation. While risk is associated with features of transformation in the supply chain, traceability concerns the potential for providing information about goods' transformation in the supply chain, that is, whether production is carried out in accordance with the food safety and quality requirements. The concept of risk management in the food industry is not new. Numerous academic publications discuss risk management in relation to food safety and contamination. Jacxsens et al. (2010), for example, discuss knowledge-based modeling systems and risk assessment to identify the impacts of anticipated climate change and globalization on the microbiological food safety of fresh produce. Gonzales-Barron and Butler (2011) consider the use of meta-analytical tools in risk assessment for food safety, and it has become generally accepted that it is possible to apply the principles and methodologies developed for the risk assessment of toxicological substances to food allergens as contaminants (Crevel et al. 2014). Other publications assess risk by focusing on just one component of the food chain, such as production, postharvest processing, distribution or consumption (Yeung and Yee 2003, Lagerkvist et al. 2013). These examples present risk management from a single-firm perspective. It is necessary, however, to develop food product traceability through an integrated and coordinated multi-organizational effort and to organize traceability systems from an end-to-end perspective, from the upstream to the downstream stages of the supply chain, since product transformation encompasses the entire flow of foods from the

raw material source to retail. A proposed notion concerns the interweaving of the development of food product traceability with the mitigation of risk: developmental efforts that are carried out at the same time. Vanany et al. (2015) describe a case study of the mango supply for exporting; the company in this case intentionally integrated the monitoring of product quality with the development of the traceability function from a multi-tier supply chain perspective. This study seeks to build on this research by elaborating further on the features of risk and risk management associated with an-end-to-end perspective. The purpose of this study is to develop an inductive, empirically based model of risk mitigation in seafood supply networks.

The study develops a concise research approach through a literature review built on the concept of risk and risk mitigation in food chains, supply chain management within the entire chain and the modeling of risk management in complete networks from a micro-level decision-making perspective in the context of an end-to-end supply chain. It applies the framework to develop a case study of the tuna supply from wild catches to exporting on the island of Sulawesi in Indonesia. Indonesia is a developing economy; Vanany et al. (2015), however, stress that the same food safety, quality and traceability requirements are required in a globalized marketplace. Indonesian fishermen, producers, distributors and exporters therefore need a clear business blueprint to trace and mitigate the risks that may hamper the achievement of food product safety, quality and traceability objectives.

Analytical Framework

The topic of risk in networked food supply chains is an emerging area within the domain of supply chain risk management. Academics' and practitioners' attention to the subject has increased during the last decade (Whipple et al. 2009, Dani and Deep 2010, Marucheck et al. 2011, Diabat et al. 2012). This networking-based approach to risk management in the food industry raises the level of complexity and dynamism of risk management. The approach is founded on business changes associated with increasing speed in new product creation to supply diversifying and globalizing markets (Christopher 2011). It has been resulting in increasingly globalized flows of food ingredients and products and the need to satisfy changing and variable consumer and governmental demands with respect to food safety, animal welfare and environmental impacts (Trienekens et al. 2012).

Risk management involves perceiving the future uncertainties of a business and dealing with these uncertainties today. A common conception of supply risk is in line with Zsidin's (2003) definition as "the probability of an incident associated with inbound supply from individual supply failures or the supply market occurring, in which its outcomes result in the inability of the purchasing firm to meet customer demand or cause threats to consumer life and safety" (Choi and Krause 2006, Cooper et al. 2006, Kull and Closs 2008, Neiger et al. 2009). Risk assessment consists of identification, assessment and evaluation. Risk is associated with a managerial approach that involves taking account of the future supply today. A range of metrics and approaches account for risk as a phenomenon by taking into consideration the attitudes and observable outcomes of a particular risk. "Risk" is, however, never straightforward. "People's perceptions and attitudes are determined not only by the sort of unidimensional statistics used in tables, but also by the variety of quantitative and qualitative characteristics ..." (Slovic 2000: 231).

Stone et al. (1994) point out that even when objective data are available to support decision-making, their interpretation may cause bias when assessing the strength of the risk. March and Shapira (1987) propose viewing risk from either a managerial or an economic perspective. The managerial perspective involves accounting for the probability of negative outcomes. The concept of risk widens from the economic perspective to encompass probabilities of both negative and positive outcomes. The economic perspective concerns the probabilities of variation regardless of the perceptions of attractiveness. Zsidisin et al. (2000) classify risk as being associated with supplier capacity constraints, product quality, product technology changes, product design changes and disasters. Juttner et al. (2003) suggest that risk sources fall into one of three categories: 1) Environmental risk sources, 2) Network-related risk sources or 3) Organizational risk sources. Risk classification in a supply chain may involve three categories, which Juttner et al. (2003) further sub-divide to produce a total of five categories: internal risk including 1) process and 2) control risk, risk that is external to the firm, consisting of 3) demand and 4) supply risks, and 5) risk that is external to the network, covering the environmental factor (Christopher and Peck 2004). Rao and Goldsby (2009) also explain five supply chain risk factors: environmental, industry, organizational, problem-specific and decision-maker factors. Tang and Nurmaya Musa (2011) classify risk into three groups: 1) material flow risk, which involves physical movement within and between supply network elements, 2) financial flow risk and 3) information flow risk. While Tang and Nurmaya Musa's classification of risk is process-oriented, Juttner et al. (2003) and Christopher and Peck's (2004) definitions are associated with the risk source and its location in the supply chain from the perspective of a single firm. Figure 1 combines these perceptions of risk to develop a comprehensive model showing the origin of risk and the type of process, information flows supporting goods flows, with which it is associated.

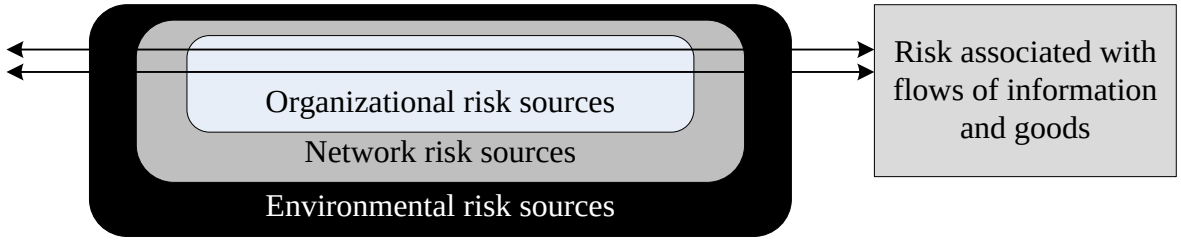

Figure 1. Process and Location Factors Associated with Risk

Food supplies have industrial particularities that also affect the types of risks and the features of these risks. Engelseth et al. (2009) assert that the food supply is necessarily ethically laden since food consumption is a vital aspect of human well-being. They therefore consider the food industry to be more strongly embedded than most other industries in a cultural context involving how food is produced, how it is distributed and how it is consumed. It is a relatively *less* modern, more "traditional" industry following Giddens's (1990) understanding of "modernity." The food industry balances food safety, a societal aim embedded in the traditions of a culture, with economic and quality product supply, representing business aims (Engelseth et al. 2009). The concept of "safety" in the food supply signifies food product features that are measurable through the supply chain in relation to human well-being dependent on the technicalities of the food supply, whilst "quality" involves product attributes measured in relation to customer value (Van Rijswijk and Frewer 2008). Food safety includes a number of procedures to be followed to avoid potentially severe health hazards. Various systems and standards, like the HACCP (Hazard Analysis Critical Control Point) system and the ISO 22000 standards, constitute the international

and local legislation enforced on this issue to avoid the consumption of contaminated food. Becker (2000) states that food product quality consists of three aspects: 1) product-oriented quality, 2) process-oriented quality and 3) consumer-oriented quality. These features entail three actors or "locations" of quality: 1) the food supplier, 2) the food product itself and 3) the consumer. It is necessary to consider three important food-industry-specific challenges in food supply chains: 1) food safety, 2) food quality and 3) sustainability (Akkerman et al. 2010). These challenges are associated with the food supply purpose, which integrates the societal, ethical and business perspectives (Engelseth et al. 2009). Safety is concerned with ethics, quality with business and sustainability with society and the environment at large. Clearly these considerations are interdependent and interwoven; it is not a clear-cut classification that is in focus here, but the consideration of what constitutes the food supply purpose, taking a wider view than simply focusing on microeconomic business objectives. Food safety, quality and sustainability emerge as prominent aggregate-level risk factors in food chains.

Risk perceptions in food chains are also associated with the way in which actors interact and are dependent on the degree of supply chain integration. "Risk" does not only emerge technically in association with an event; it is also perceived and then communicated to others. A low degree of complete supply chain flexibility and supply requirements exists in the food supply (Adebanjo 2009). Increased inter-organizational collaboration in the food supply, according to Bijman et al. (2006), is due to: 1) the rise of food safety as a prominent societal issue, 2) the raw material in food distribution often closely resembling the finished product and 3) foods to varying degrees always being perishable goods. Fresh foods, such as bananas, represent perishable products, with a limited shelf time frame. The particularities of the fresh food supply include: "… 1) fresh products are not standard and subject to quality deterioration, 2) there is a lack of clear product descriptions and coding standardization, 3) information requirements differ per customer, making standardization complex, and 4) a relatively low degree of automation of farmers" (Van der Vorst and Beulens 2002). These considerations point to a need to model risk management from a complete network perspective. Van der Vorst and Beulens (2002) as well as Taylor and Fearne (2006) in the food management literature indicate the need to model an end-to-end food supply network based on features of seasonality, perishability, safety and traceability factors. Intermediary trading organizations in the food industry face challenges in coordinating retail promotions with lead time requirements. The logistical particularities of foods are concerned with achieving an ethical and safe supply of foods.

The next step is to embed these evoked particularities of the wild-catch seafood supply in the context of supply chain management (SCM) thinking. SCM places the focus on inter- as well as intra-firm integration. It is therefore well suited to acting as a conceptual foundation for considering risk management from a network perspective. SCM thinking can trace its origins to Forrester's (1958) bullwhip effect as well as Alderson's (1965) writings on marketing channels. Especially Forrester's (1958) work is seminal as the foundation for developing the core concept of SCM thinking: "integration." Forrester notes how sales information was distorted due to weak integration when communicating stepwise through tiers of actors organized in a common supply chain. Oliver and Webber (1982) first use the term "supply chain management" to describe the management of flows of materials across organizational boundaries. The focus on SCM involves the study of the synthesis of business and resource networks, the opportunities and barriers to developing synergies between actors in supply chains and the synchronization of activities and

operations across supply chains (Bourlakis and Bourlakis 2004). The complete end-to-end modeling of a supply is still weak in SCM; the focus is mainly on immediate supplier relationships.

Alderson (1965) develops the transvection model to depict the logic of the supply from raw material to consumption from an end-user perspective. This approach, together with Thompson's (1967) interdependency theory, is applicable when considering business actor roles and business actor interaction in a complete network. This involves highlighting considerations of interdependency types explained in relation to power, legitimacy and urgency, all of which are vital when considering the mitigation of risk. Alderson (1965) models the flow of goods as a long-linked set of integrated goods-transforming processes. Transformations are directed by intermittent decision-making events termed "sorts" in this piecemeal picture. The transvection in the marketing channels literature (e.g. Rosenbloom 1995) represents an early and unique balancing of transactions with operations through enhancing the logistics side of these channels. While transactions provide a customer-oriented purpose to flows, the transvection places an increased focus on logistical descriptions of sequentially dependent decision-making events supporting value creation through goods transformations (operations). This view evokes the importance of achieving customer value through a model of physical distribution conceived in the early 1960s. In accordance with the transvection model, a sequence of utility-providing operations creates product value by transforming the time, place and form features of goods through a series of decision-making events that Alderson (1965) terms "sorts." Figure 2 models the transvection from a SCM perspective as collaboration associated with logistics.

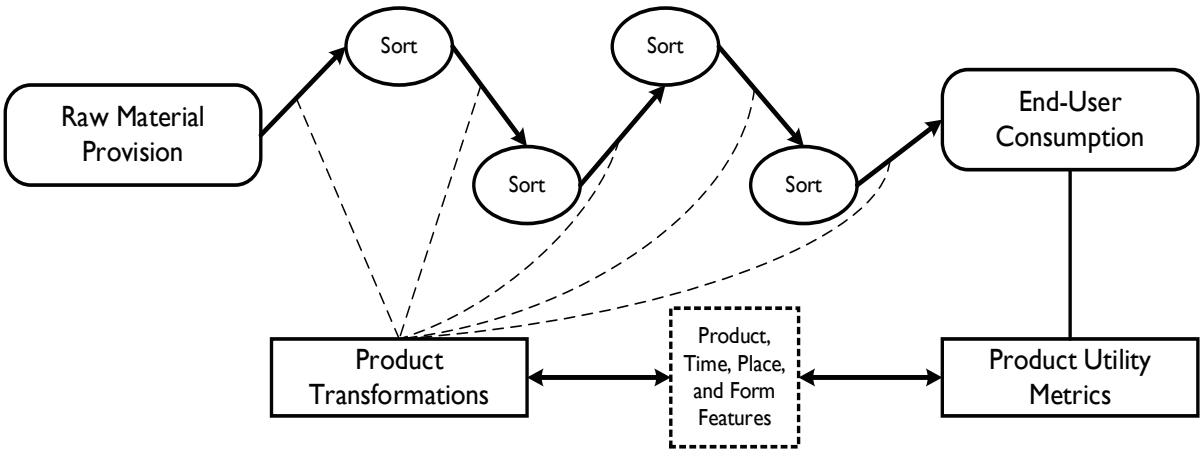

Figure 2. The transvection (the arrows between sorts indicate value-creating transformations of product features) (Engelseth and Felzensztein 2012).

The inquiry involves research following the flow upstream from the end-use state of the finished product through intermediary locations to the upstream initial "conglomerate resources" (raw materials) in accordance with the transvection approach. This indicates, in line with Richardson (1972), an organized series of complementary processes that are dependent on business relationships to facilitate food supply coordination. The transvection model exposes sequential interdependencies that are typical of the food supply. The supply is always represented by a combination of sequential, reciprocal and pooled dependencies according to Thompson (1967).

The sequential interdependencies are predominant, with pooled and reciprocal interdependencies, in the case of analyzing the food supply through the lenses of interdependency theory. The transvection model, which concerns physical distribution, and therefore at core logistics, accordingly models the technicalities of sequential interdependencies. It provides an analytical approach to the detailed operational-level modeling of physical distribution. Risks are perceptions, so in the transvection model they are associated with sorts. Using the transvection model accordingly takes risk management from the strategic to the operational level. This discussion leads to the proposal of a model of risk management with interdependencies from the perspective of the Aldersonian sort. The model follows Christopher and Peck's (2004) supply chain risk model, which accounts for actor-associated risk rather than the sequentially dependent decision-making entity as food in the food supply. Figure 3 shows how a sort as a decision-making event is embedded in a layer of contexts associated with production through a flow of foods. Given that risk is perceived at sorts, the embeddedness that Figure 3 models directs attention to what exerts an impact on risk and how it may be managed.

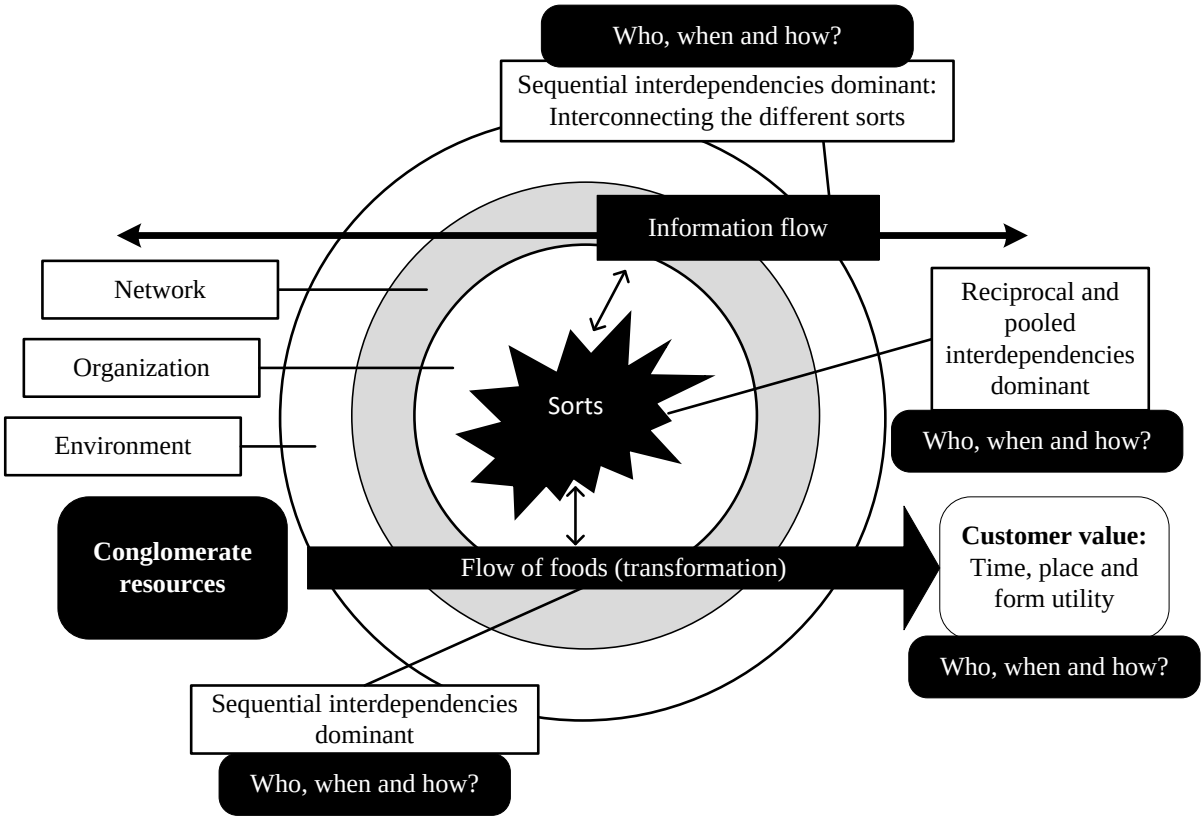

Figure 3. The Transvection Sorts Embedded in the Supply Network

The flows of both information and foods are associated with risks. This widens the concept of food safety and quality to encompass features of information about these foods: the quality of their traceability. Decision makers need to perceive these changes at sorts since risk is a perception. As sorts are predominately reciprocally interdependent and involve information pooling, risk management is thereby understood as predominately managing information. The model evokes that this communicated information is related to the interdependent flows: foods

and information. *Risk mitigation*, the purpose of risk management, in the food supply therefore involves managing the sources of risk at different locations in the flow of these goods, their severity and their probability. This entails managing risk in relation to the supply, organization and customers from a quality perspective.

Methodology

The case study involves interviews with a set of 26 informants within the tuna supply network in Bitung on Sulawesi Island, Indonesia. The interviewees consisted of 8 informants representing fisheries, 4 traders, 5 processors, 5 business owners, 3 government officials and 1 exporter. Since the study provides data from the upstream portion of the studied supply network, the authors decided to commence the study not from the end-user perspective, following the transvection principle (Alderson 1965), but rather from the raw material source. Accordingly they held interviews with the industrial food processors and finally the intermediaries.

This case study aims to study tuna product operations in a supply network context (Voss et al. 2002). The interviewers made the purpose of the interviews explicit to the informants at the outset, that is, to describe activities focusing on risks associated with their business. The interviews covered logistical factors as well as features of trading based on the analytical framework. This included evoking features of business relationships. The authors used these data to create a detailed and rich case description (Lincoln and Guba 1985) and sought the features of risk management in interviews with informants who were unfamiliar with the concept of "risk management."

These narrative descriptions are based on the informants' accounts of their past experiences or of possible risk-related futures as the primary data (Corsaro and Snehota 2012). The authors accordingly study risk management predominately retrospectively based on the informants' expressions provided in the interviews. The study elicited how the informants perceive their risk-related operations as well as the perceived likelihood and severity of each event.

The interviews lasted on average for 1 hour and included observations of on-site activities, namely fishing, delivery, market trading and fish processing. The interviewers conducted a further interview with a representative of the Bitung municipal fisheries administration to provide an overview of risk-associated issues as well as examples of the challenges and conflicts encountered in the studied supply network. The interviews themselves took place in a context of high mutual trust and resembled a conversation within an inter-subjective and mutual learning atmosphere. The researcher learned about the process to which the informant had access, and the informant learned about the concepts and theories driving the research. The researcher taped and transcribed these interviews and asked the informants brief additional questions after their interviews when clarification was needed. Although each interview produced a limited number of transcripts, these transcripts include great detail. These actual circumstances add to the credibility and accuracy of the research and enable a rich and "thick" description of the events through a mutual frame of understanding (see e.g. Lincoln and Guba 1985, Eriksson and Kovalainen 2008).

The following text narrative, based on this case study of the tuna supply from fishing at Bitung in Indonesia for exporting or domestic retail, provides a basis for analyzing this form of supply by applying the developed research model. This case narrative provides a fundamental description of the network structure and flows of goods as a foundation for more detailed descriptions of prominent risk as perceived by various supply chain actors: fishermen, seafood markets, producers and distributors/exporters.

The Tuna Supply Case

Overview

Figure 4 provides an overview of the described tuna seafood network. The left side represents the interconnected actors while the right side represents the flow of the food process, showing the sequentially interdependent upstream transformation of tuna from a complete chain perspective.

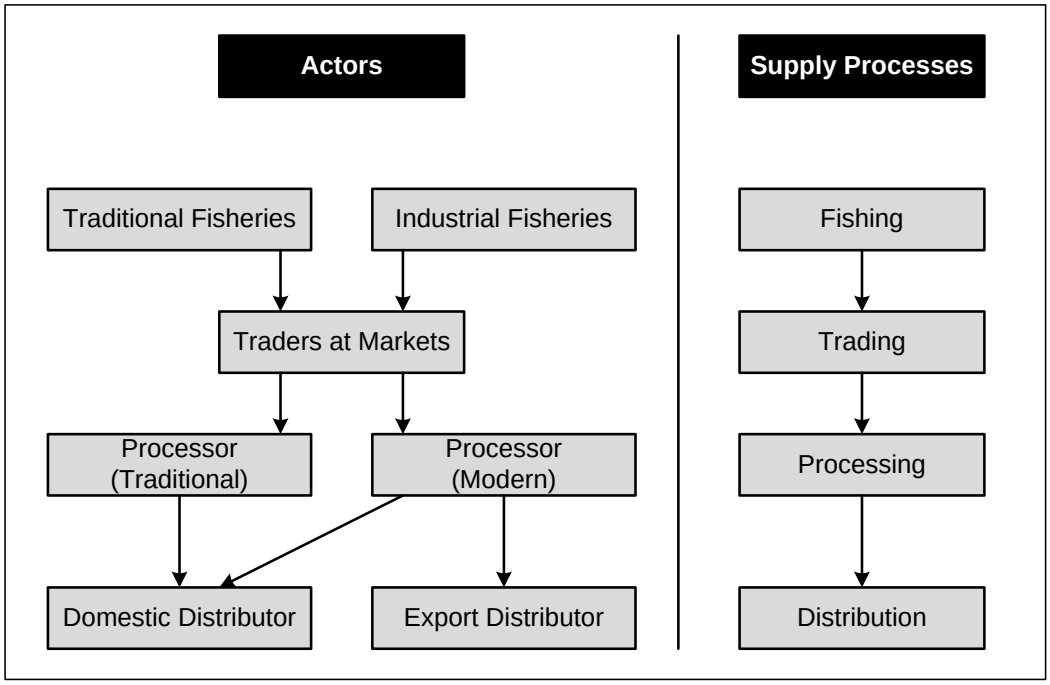

Figure 4. The Studied Tuna Supply Network

Catching and Delivering Tuna

Tuna is a saltwater finfish that belongs to the tribe Thunnini, a sub-group of the mackerel family (Scombridae). Thunnini comprises fifteen species across five genera: slender tunas, frigate tunas, little tunas, skipjack tunas and true tunas. The sizes of tuna species vary, ranging from the bullet tuna (max. length 50 cm, max. weight 1.8 kg) to the Atlantic bluefin tuna (max. length 4.6 m, max. weight 684 kg). The bluefin averages 2 m (6.6 ft.) and reputedly can live for up to 50 years. The tuna is an active and agile predator with a sleek, streamlined body and is among the fastest-swimming pelagic fish. It lives in warm seas and is extensively fished commercially. Overfishing

has reduced the stocks of some tuna species, such as the Southern bluefin tuna, to the point of extinction.

Bitung is a municipality in the northern part of Sulawesi Island in Indonesia. Bitung's fishermen catch tuna daily in the Celebes Sea. These fishermen are divided into traditional and industrial fishermen. The traditional fishermen are dominated by local residents who have tuna fisheries as their main livelihood. Hand-line as well as pole and line are the main fishing methods applied here. Hand-line is the oldest technique. It is commonly practiced in fishing in Bitung, where a fishing line is held in the hands. The hand-line fishing method uses a small vessel with a maximum tonnage of 40 gross tons (GT) when fishing for tuna. The crew of such a fishing vessel is usually made up of several people, including the captain, the fishing master and the general crew. The fishing master acts as the determiner of the fishing ground. Fishing grounds are usually closely located to a fish aggregation device (FAD) that the fishermen had previously deployed. FADs are man-made objects used to attract ocean-going pelagic fish, such as marlin, tuna and mahi-mahi (dolphin fish). They usually consist of buoys or floats tethered to the ocean floor with concrete blocks.

The majority of industrial fishermen catch tuna using the pole and line method. It consists of a bamboo rod or fishing rod, line and hook. The length of the bamboo is about 2.5 m with a diameter on the bottom of around 5 cm, smaller at the ends. The line used should be shorter than the length of the rod. This helps in the swinging process and in releasing the fish from the hook when caught. The applied hooks are different from the commonly used fishing hooks since they are not inverted, making it easy to release the fish when caught on the hook. The hook is covered with chicken feathers or an elusive rope to camouflage it and fish will attempt to bite this. Catching also uses live bait combined with water spray. Live bait will lure fish to the surface and the spray will hinder their sight so they are unable to distinguish between the bait and the hook. The type of vessel used in this form of fisheries is generally 61-120 GT with a modified bow that is used as a seat for fishing. Fishing in Bitung may also involve the use of fishing gear such as a long line, purse seine and gill net to catch tuna.

The tuna fishing process includes sequentially 1) preparation before going to sea, 2) capture, 3) treatment and handling on the vessel and 4) delivery and unloading at the port. The preparation process at the port includes preparing the fishing gear, organizing the crew, securing the food logistics for the time at sea and choosing the type of vessel. The tuna catch varies based on the type of fishing gear used. The handling on the vessel demands cold and clean storage to secure food safety. After the crew members have caught the tuna and landed it on the vessel, they clean the fish by cutting off the head and discarding the gills as well as the entrails. They then wash the fish to remove bacteria that may cause decomposition and contamination, rinse the whole fish to remove mucus and pack it in ice. Good freezing could hold tuna for up to 6 months. The crew members should provide crushed ice cubes with an equal volume ratio to the fish. The ice should be of the same size and avoid a pointed figuration. The crew members lay the ice first in the holding space, then place the fish on it and finally cover the top of the fish with more ice. They store large tunas in single layers and smaller fish in multiple layers.

Fishing vessels vary in size, holding capacity as well as the ability to freeze goods. Some of the potential problems that can emerge during fishing include a shortage of ice for freezing goods,

non-standard treatment of tuna, limited bait and insufficient capacity for cold storage. Some indirect problems also contribute to the tuna catch quality, such as handling ports that permit tuna to come into contact with direct sunlight when unloading, the use of nets for catching that results in many small tunas being caught, illegal fishing by foreigners, either using their country's flag or using the local fishermen as a way to catch fish in Indonesia, and finally unpredictable weather conditions. Some other challenges include erratic monitoring of the volume of the catch, a lack of government fisheries control officers, the complexity of vessel permit administration and a lack of seafood controllers at the port who can determine the quality of the tuna. Climate change also contributes to the tuna supply chain's problems because the available equipment still cannot detect the weather accurately. The government budget allocation to promote the tuna commodity is limited and does not allow this commodity to develop optimally.

Trading at Bitung Fishing Port

The fishing vessels land their catch at the Bitung Port for sale, at the port of Pelabuhan Perikanan Samudera (PPS)/Oceanic Fishing Port of Bitung or at the private jetty (Dermaga Untuk Kepentingan Sendiri – DUKS). The PPS is a central agency under the supervision of the Ministry of Marine Affairs and Fisheries, while DUKS is controlled by the Department of Marine Affairs and Fisheries, North Sulawesi Province. The landing of tuna at the port includes the unloading of the fish from the vessel at the port. The unloading process must take into consideration the principles of temperature, speed, cleanliness and food safety in general. The potential hazards during the unloading of the catch that could arise in the landing process, for instance, are having to wait to unload because of the limited handling capacity of the port, the tuna goods coming into contact with sand and unclear procedures for unloading the goods.

Traders purchase the catch at the port. These traders function as intermediaries connecting the fishermen with industrial processors. The intermediaries consist of three groups. One type of purchasers consists of local individuals with no formalized status who have limited skills in determining seafood safety and quality features. It is a traditional family-oriented activity handed down through generations. Their financial capacity is very limited. They deal directly with fishermen and processors based on the fluctuating market price. They do not have a permanent office and generally have no other formal occupation. This relationship represents traditional actor bonding with trust developed over time. The second group of purchasers consists of enterprises usually run by more than one person with an office location. Their management skills are still relatively weak. The owner of this kind of trading business can be a local person who has some capital or outsiders who invest in Bitung. These traders are often termed "collectors" or "middlemen." The third group contains industrial food manufacturing firms. This group has always represented the interests of the company for which it works. These purchasers have the highest degree of management skills of the purchasers, including fish quality control and assessment. Representatives of the processing firms make the purchasing decision.

The trading of tuna takes place at a local seaport auction. This auction facility is operated by the municipal government. It involves determining the quality grade of tuna, namely A, B or C to represent the best, mediocre and worst quality levels. Some tuna receive the lowest grade due to poor handling on the vessel. Lower quality entails a lower price. The limited capacity for storing

and handling tuna auctions in the ports, no cold storage and no separation between clean and dirty areas in the port can also affect the quality of the tuna. Pick-up cars then deliver the tuna to the processor for the next processing stage.

Processing

Second to fishing, the processing of tuna at a food manufacturing facility is one of critical points in the tuna supply chain. Processors are primary processing companies that produce a slightly refined tuna product. These firms are large, professional organizations. Primary tuna processing produces fresh and frozen tuna. Fresh products can be tuna GG (GG – gilled and gutted, completely cleaned, but with head on), tuna HGT (HGT – headed, gutted, tail off), tuna loins (the boneless portion cut lengthwise from either side of the backbone of a large, round-bodied fish, the back portion of the fillet having had the belly section removed), pocket hand-cut and hand-cut cubes (cubes generally, IQF individually quick frozen cubes cut into various sizes from 4 mm upwards; IQF – individually quick frozen). Frozen tuna includes tuna loins, tuna saku, tuna steaks (steak – a cross-sectional slice of a fish, usually 0.5 to 2 inches thick and containing a section of the backbone), tuna cubes, tuna kama/jaw, ground meat, tuna bellies, tuna cheek and tuna heads.

The manufacturing process is very detailed and the quality is dependent on standards. The Hazard Analysis and Critical Control Point (HACCP) is an important quality manufacturing standard used by these types of firms. The use of the HACCP standard is vital since it has an impact on the tradability and price of the finished products. Customers usually request traceability information including details of the handling process from the catching location. Failure to follow these traceability demands can lead to the rejection of tuna products and economic loss. Mistakes in the processing include such hazards as contaminated substances, human error or processing failures. These companies emphasize a strict “standard operational procedures” (SOP) system. Since the cold storage facilities and plant capacity are limited, a general aim of tuna processing is high processing speed.

Distribution

The processor or a third-party distributor may handle the distribution from the primary processor to the customers. Producers themselves distribute the products sold on the domestic market, while exports are handled by a logistics company. Bitung channels these goods through either the Bitung Oceanic Port or the Sam Ratulangi International Airport. Fresh tuna products are transported by air and frozen products by sea. The tuna from Bitung is a relatively limitedly transformed good, a primary product, which many overseas customers will further distribute through many tiers of intermediaries prior to its final consumption. In the export market this raw material may end up as a retailed fish product, on the menu of restaurants, and it may undergo further processing, such as tuna canning. One of the challenges in this transport process is that there are no direct cargo flights to international destinations from Manado Airport, even though it is classified as an international airport. All products must therefore undergo transit handling at one of the other Indonesian airports, such as Jakarta, Denpasar or Surabaya. Such limited transport and handling facilities influence the product’s freshness due to terminal procedures that are often erratic. Companies use refrigerated containers to ship by sea.

Domestic distribution involves both sea and air transport. The customers may be restaurants or traditional marketplaces that sell tuna for household consumption. There is no evidence of compliance with standards in the processing in the domestic market, but in general domestic consumers can distinguish directly between good and damaged fish. Customers will purchase fish that are of inferior quality for consumption at a very low price and can further process it into feedstuff for animals.

The decline in the overseas demand is currently affecting the distribution for the export market. Overseas customers who have received tuna have rejected it in some cases due to packaging damage, contamination or documentation errors, including missing traceability information. Another factor that causes problems for the exporter is the high quality expectations of foreign customers. This is especially true for Japanese importers. Furthermore, economic downturns in export markets lead to a lower demand. The fishermen are also unaware of these export customers' often unusually high quality concerns.

The final exported tuna product appears on supermarket shelves or in restaurants in sushi, sashimi or tuna rolls. Europe, Japan and America dominate the tuna export market. These foreign customers follow their home market's strict rules for traceability and product safety and quality. Awareness of the sustainability of tuna fishing has an impact on the demand in some foreign markets, since the media in these countries regularly report on tuna's status as an endangered species. The price of tuna on the export market is clearly differentiated from that in the domestic market. Export prices can be up to double the domestic tuna price. The Bitung processers are limited to domestic distribution if they do not follow the international standards. This includes following quality procedures involving catching, handling, washing, sorting, grading, freezing and transporting fish through the entire supply chain. An important factor causing the rejection of fish is insufficient cleaning. The rejection of tuna results in economic loss all along the flow of tuna, including the processor. The consumer for exports could be distribution centers, supermarkets or restaurants.

Analysis

The preceding case narrative concerns the flow of tuna from origin to destination through four major processes: catch, trading and processing followed by distribution to the domestic and export markets. These data provide ample grounds for analyzing the risk associated with production and thereby the supply risk. Figure 3 depicts the four main components associated with the analysis in this study: 1) customer value, 2) flows of foods, 3) flow of information and 4) sorts. The study proposes these as interdependent components with unique features that exert a combined impact on risk. The analysis will first consider each of these four components individually, thereby providing a foundation on which to consider risk mitigation in food networks.

Firstly, customer value is, in accordance with Alderson's (1965) transvection, ultimately associated with the end-user; the perception is associated with the supply purpose. The intermediaries, however, also function as customers and may therefore be associated with intermittent customer value perceptions. As perceptions are involved it is difficult to determine whether the sequence (timing), pooling or reciprocity is more important in forming customer

value perceptions. Interdependencies clearly exist, but for now the researchers consider them as balanced in relation to understanding the nature of customer value. All suppliers, furthermore, perceive customer value, since it is the purpose of supply. Fisheries only vaguely consider the requirements of the end-user (customer value) in this long-linked chain of events (sorts). The chain of actors, however, conveys the food quality requirements; there are ample grounds for information distortion following Forrester's (1958) line of thought. Fisheries experience a simple perception of tuna's physical features in the market, in which traders advocate their customers' requirements. Tuna, being a food product, is embedded in traditions of food culture. The degree to which this culture influences consumer preferences is not known. Such data, which are highly relevant to determining the nature of tuna supply, would clearly enhance this analysis. The data in this study indicate that the demand for tuna in its weakly processed state, as described in the case, is relatively stable. It is a type of food that is not subject to strong market fluctuations. This may in part be due to the fact that the study does not consider the processing of tuna into branded food products. The initial-stage processed product described, still only moderately processed, can produce a wide range of finished products. This functions as logistical buffering between market demand fluctuations and supply. It is apparent based on this understanding of the "who", "what", "when" and "where" factors related to customer value that the demand risk is relatively stable. As the data concerning customer value in this study are rather limited, this analysis needs further elaboration in other studies. As an example, further analysis can be connected to marketing, applying both a business marketing and a customer marketing approach considering the nature of customer value through tiers of intermediaries to the ultimate tuna product end-user.

The flow of tuna (goods) in the studied case represents the core feature of production leading to product realization and thereby grounds for assessing customer value. This is, following Thompson's (1967) conceptualization, a "long-linked" form of value creation that flows through different actors in the supply network: a chain of sequentially interdependent activities guided by sorts. Alderson's (1965) transvection model is clearly applicable as a conceptual research model in such supply structures. These activities are relatively simple technically speaking and involve a limited degree of pooled and reciprocal interdependencies. The safety and quality of tuna depend on transformation processes organized into what the flow metaphor can describe appropriately as production. The risk in this flow is predominately associated with the process of transforming the tuna in its movement towards the end-user. The flow of tuna is technically often only indirectly associated with sorts in practice since decision making in more modern settings takes place independently of tuna goods' physical identification and observation. Risk is therefore associated with the factors inhibiting the production, including the sustainability and safety factors associated with goods transformation. The flow of tuna is not limited to features of the network, but also involves the environment.

The flow of information is weakly studied in this case, limiting the detail in the analysis. It concerns the transfer of documents moving both upstream and downstream. These are predominantly documents about the tuna flow. This flow is clearly less sequentially interdependent than the flow of goods that it seeks to describe and thereby establish traceability. Information pooling is a core feature of this flow to create documents adapted to various uses, including product history information associated with traceability. The same information may also be duplicated, and information is created through this flow to facilitate the decision making at sorts. Risk in this flow is therefore associated with *the quality of information* provided at sorts: the degree to which the information alerts decision makers about hazards in the flow of tuna.

Traceability is the key to mitigating this form of information-related risk. The information flow encompasses more than traceability; it also includes information about customer orders and market information in general: the downstream and future perspective of the flow of goods. Risk in the information flow is associated with how information interconnects the customers and the flow of goods with sorts and with information about the future, present and past state of goods.

Traceability is as an information resource associated with that part of the information that may mitigate risk; descriptions of the product history in the upstream portion of a supply chain form the perspective of a particular sort. It is possibly a continuous effort to develop traceability that may enhance the product quality and thereby mitigate risk, in line with Vanany et al. (2015). This means that developing food product traceability, according to Engelseth (2009), encompasses features of informing about the *past, present and future states* of foods. The information flow favors risk mitigation as it supports product realization through production via the flow of goods directed by sorts. The prime question is whether the information communicated to sorts reveals the features of potential events before they take place so that actors may work to mitigate the risk. These risk events appear in the future and therefore are not directly associated with traceability. When developing and using any traceability system, however, synergies in the form of avoiding unwanted events and developing resources to handle such events if they occur may be organizationally interlinked with a traceability system. This means that not only integrating fisheries with local markets and processors with exporters will encompass informing about product history, but the action of registering production from fishing vessel to exporter is likely to have synergetic effects. Simply evoking the need for traceability in the tuna chain will stimulate the awareness of the people carrying out the production and distribution activities to be more quality and safety conscious. The act of identifying goods and controlling and registering their quality in a traceability system will promote improved quality since it functions as a control mechanism. The question remains of whether the management understands this incremental use of sorts strategically.

The transvection provides a perspective of interaction associated with production. Sorts are decision-making events (Alderson 1965) also entailing a conglomerate of actors' risk perceptions at an operational level. Not only should SCM consider how people and companies are integrated into networks, but is it also possible to suggest that the way in which events are networked is important in mitigating risk. The actors in this case network the decision-making supporting the flow of tuna to mitigate risk together as a collective. Different sorts that different actors with varying perceptions of purpose (e.g. customer value) frequently carry out are timed logically in relation to each other. The sort itself is, however, an event that implies a strong degree of pooling of information resources as well as people. The importance of reciprocal interdependencies increases with increasing uncertainty. This interdependency is found both within and between firms. As the tuna product flows towards the end-user directed by a sequence of sorts, actors make decisions to direct this flow as well as to handle unexpected challenges. It is in this flow, a dynamic system, that the authors propose risk mitigation as embedded information-supported administrative tasks.

The sort always encompasses a certain degree of reciprocally interdependent decision-making in the supply chain and is therefore clearly dependent on the human knowledge resource. People as knowledge, and the way in which people interact with other knowledge components in a network, influence the decision outcome at sorts. Decisions are not isolated to a single

"responsible" decision maker. They are nested in a system of decision makers and interests. Sorts therefore both mitigate and may even create risk. It is therefore in the interest of a supply chain actor to provide quality decision making and this may be the core to risk mitigation based on Figure 3. The quality of sorts is highly dependent on the pooling of people and information. Sorts, since they evoke the people's role and divergent perceptions, also represent the challenges of divergent interests and imbalanced power in the supply network. The decision making of actors who may be characterized as "agents" becomes evident as a supply chain role at the sort. Therefore, supply chain integration as a management principle is highly pertinent in facilitating daily operations associated with risk mitigation and this involves aligning the divergent perceptions and interests of the supply purpose. These supply agents at different locations, with different perceptions of the flow of foods and handling different aspects of information about the transformed foods need to collaborate to trace foods. The model shown in Figure 3 has guided the investigation into the tuna supply network and provided an initial analysis revealing how actors can systematically comprehend risk management from a network perspective. The study develops the following empirically based model grounded on this analysis.

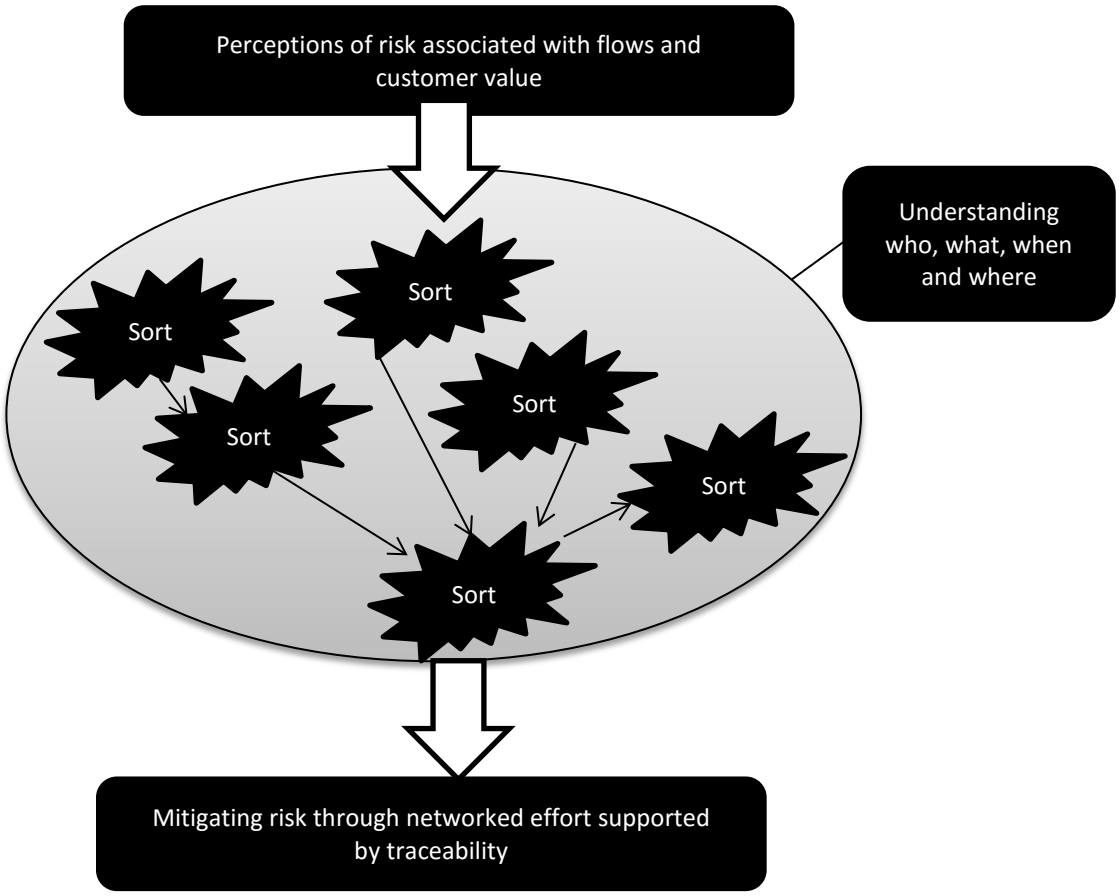

Figure 5. Risk Management in a Supply Network

Figure 5 evokes risk management as networked sorts, the vital sequentially interdependent decision-making events in the food supply network, supported by traceability (involving skills,

activities and system). However, these sorts are not purely sequentially interdependent themselves, since they involve predominately information resource pooling and reciprocal interdependencies associated with information exchange. Sorts are enabled through the strategically founded use of the traceability system, tools for problem solving and hence also risk mitigation. A network analysis provides grounds for understanding the context of this model and how actors may develop a network atmosphere (Gadde et al. 2010) that facilitates operational-level daily risk mitigation procedures. Mitigating risk from this picture is essentially associated with developing an agile supply since it enhances the data capture processes as well as thought-through multiplex information use (Engelseth 2013).

The supply chain actor seeks clarity in how risk may be mitigated from a business perspective. The preceding discussion suggests that understanding risk management is a complex concept. The discussion sheds light on managing risk in food chains. Food safety is ethically laden. The supply network being a business entity, economic concerns are also important. Risk is associated with balancing these two factors. The food supply is therefore associated not merely with network concerns, but also with environmental concerns. These involve a wide range of issues related not only to food safety concerns but also to sustainable fishing and production and human welfare in general through job creation in local environments, as some examples of a wide range of environmental issues pertinent to the tuna supply. Table 1 provides an overview of the risk agents (sources), their impact and how such risk may be mitigated.

Risk mitigation, following Table 1, is associated with first classifying the four types of processes: 1) fishing/catching, 2) trading, 3) processing and 4) distribution. Different forms of risk may be pinpointed within these types of processes. These forms of risk are associated with different metrics, termed in Table 1 as their "impacts." Finally it is essential in risk management not only to describe and understand the types of risk, but also to consider how to mitigate the risk. The treatment of a risk agent is basically preventive and associated with decision-making that may be termed as sorts. If immediate action is not taken, the potential risk would turn into a *risk event* that would result in a greater impact. Mitigation involves approaching the risk agent at its location including addressing both the people at the sorts and the production associated with transforming the tuna product. A number of methodologies to manage risks are available in the literature. Pujawan and Geraldin (2009) propose an approach called the House of Risk that the supply chain players can use to prioritize actions systematically to address the risk agents.

Risk management means avoiding reactive action after an undesirable event occurs by addressing 1) how actors may design processes from a long-term perspective because the risk has occurred and 2) how actors use the information flow from an operational perspective to support the flow of goods throughout the supply chain processes. Risk mitigation concerns both strategic and operational levels. These are quite different in practice. Table 1 focuses on the operational-level risk mitigation associated with the flow of goods. Clearly these operations that mitigate risk demand an agile supply network that is again dependent on flexible resources available at sorts. Mitigating risk at the strategic level is associated with developing an agile supply, which involves developing flexibility in resource design, interaction and use. Flexibility's criticality in a dynamic supply chain is much discussed in the recent literature. Pujawan (2004) proposes, for example, a framework to assess and improve supply chain flexibility. Angkiriwang et al. (2014) point out that companies need to have an appropriate level of flexibility to deal with uncertainty.

Uncertainty exists in supply, demand and internal processes, and depending on the uncertainty typology, companies may need different strategies to meet the required level of flexibility. This study points out traceability as an enabler of flexibility in supply chains.

Table 1. Risk Agents, their Impacts and Mitigation in the Studied Tuna Supply Network

Process	Potential Risk Agent	Potential Impact	Risk Mitigation (Agent)/Preventive
Fishing/ Catching	Lack of bites Poor treatment while in boat Bad weather Limited availability of fish Illegal fishing	Limited catch Damaged fish No fish Limited catch Low income	• Increase the fish aggregating device (FAD) units • Certify the handling process of fish on board • Apply the standard operational procedure (SOP) strictly • Complete the fishing vessels with refrigeration facilities according to the standards required • Arrest and sink the fishing vessels that operate illegally
Trading	Open port Cold storage unavailability Sand-contaminated product Unavailability of a dedicated market for the product	Damaged fish Damaged fish Low price Uncompetitive price	• Provide a landing place and auction space specifically for tuna • Provide shared ownership of cold storage
Processing	Human error in processing Limited cold storage Low-quality packaging Low market demand Product rejected by a foreign customer Electricity supply problem	Bad quality No safety stock Damaged fish Low income Loss of profit High-cost operation, quality problems	• Increase training of labor for tuna processing • Maintain adequacy and stability of the electricity supply
Distribution	Unavailability of direct flights Problems with the logistical infrastructure Unavailability of fresh product transportation	Fish products have to transit High-cost product, delayed distribution Quality problems	• Improve service quality and flight connectivity • Provide refrigerated cars

Table 1 shows that extending the use of fish aggregating devices (FADs) can mitigate risk in the process of fishing/catching to overcome the shortage of bait. FADs are temporary structures or devices made from any material and used to lure fish. Before the fishermen fish for tuna in a predetermined location, they head out to obtain bait using FADs. More FADs will increase the amount of bait and increase the chances of catching the tuna. The strict application of the standard operation procedure (SOP) can improve the lack of handling after catching the tuna and

all tuna fishing should be certified regarding how it handles tuna on board. Standard refrigeration should also be available on fishing vessels to handle tuna properly. To mitigate the risk due to illegal fishing, which results in lower earnings for the fishermen and the Government, the Indonesian authorities will arrest and then sink fishing vessels if they are not able to show an official fishing license. The Indonesian Government has lately carried out such strict measures to reduce cases of illegal fishing.

Regarding the process of landing the tuna, actors can carry out risk mitigation by designing a special port for tuna, so that they can avoid exposure to sunlight and sand contamination. Limitations in cold storage facilities degrade the quality of tuna. Fishermen collectively owning cold storage facilities can improve the quality. The fishermen can keep their catch and maintain the quality of the tuna, which affects the low purchase price received from the tuna processing plant. This shows how strategically driven investments may mitigate risk. Freezing tuna provides the option of buffering the supply since it is possible to store the frozen fish. Such investments, however, are hampered by the inadequate electricity supply, including the occurrence of power cuts. Preventive actions are possible through increasing the supply of electricity or considering power generation from other sources, such as solar or other power sources. This also implies that the Government plays a contextual role in the strategic development of risk mitigation. Investing in cold storage facilities is of little use if the operation of these facilities is prone to risk associated with an unstable and limited power supply. To mitigate the risk involved in the processing of tuna, it is also necessary to train the human resources in tuna companies and improve the quality of the product. This is associated with the decision-making at sorts and should minimize the occurrence of human errors in processing. The quality of service and flight connectivity also sets constrains on the distribution of both fresh tuna and processed tuna products. International flights are not always available, causing products to wait in the existing schedule. Providing a refrigerated vehicle that better preserves the quality of fresh tuna during transportation can improve its distribution.

Conclusion

This study considers risk management at the inter-organizational network level. It projects two levels of risk mitigation: 1) strategic and 2) operational. The preceding discussion evokes how these levels are layered and intertwined. The study proposes an approach to mitigating risk that involves the strategic use of a traceability system to mitigate risk at the operational level in line with this understanding. The analysis shows how actors may mitigate some risks through investment in better facilities used in the flow of goods. The main contribution of this study, however, lies in the provision of a foundation for further studies essentially associated with developing a traceability system as a core feature of any information system used in long-linked goods supply as pathway to risk management. This means that the way in which traceability systems are designed to accommodate information concerning the past, present and future states of goods encompasses risk mitigation. It also implies the need for case studies of the strategic development of traceability systems designed to provide food product traceability functionality and to encompass a wider range of supply chain functionalities predominately associated with the flow of foods as well as marketing. This includes further investigation directed towards evoking the nature of actors' perceptions associated with the operational-level risks related to individual sorts in the studied supply network. Sorts are sequentially organized, and studying the

potential domino effect of risk perceptions may account for how different actors more or less seamlessly communicate product information to mitigate risk or carry out some form of crisis management when product discrepancies or other problematic events occur. Studies may also consider information instruments integrating different sorts within and between firms in further detail. This implies a focus on information technology and its use to integrate the supply chain and thereby mitigate risk through the development of efficiencies at sorts.

Further studies may also elaborate on the understanding of risk management as collective action at the strategic level to determine how the supply network can better facilitate agile supply operations through the development of an enhanced traceability system. The decision-making events directing the flow of tuna, for example, the sorts in a transvection, should be focal in developing strategic risk management tools. This involves developing competence in using reciprocal interdependencies and pooling resources as well as interconnecting sorts. People must improve their ability to exchange information through an enhanced traceability system that is not limited to registering product history information. Finally, future studies should elaborate the role of risk perceptions, how actors communicate and perceive risk agents at sorts as well as how the environment and networked interests challenge this perception and influence the quality of risk mitigation. It is no longer a *true* "traceability system" but a wider supply chain management system configured upon the fundamental logic of a traceability system: that is, identifying and registering the transformation of goods. The difference is that the informational focus is not limited to the past but encompasses the present (whenever that is) and predictions about the future state of goods, in which a marketing perspective encompasses the goods to be dispatched.

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Critical Success Factors for Smallholder Inclusion in High Value-Adding Supply Chains by Food & Agribusiness Multinational Enterprises

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Abstract

Food and Agribusiness Multinational Enterprises (F&A MNEs) increasingly wish to source from smallholders to secure and stabilize the supply of agricultural commodities in high value-adding supply chains, while contributing positively to smallholder livelihood. In the literature we found that many F&A MNEs have been involved in supporting smallholder farming systems in developing countries for a long time. However, these projects have principally been driven by Corporate Social Responsibility (CSR) strategies. Moreover, despite many pilots to include smallholders in high value-adding supply chains, scaling or scaling up successful pilots has so far proven elusive. The aim of the present article is to identify the critical success factors (CSFs) that can help F&A MNEs to design and implement sourcing strategies for sustainable smallholder supply from a business perspective, and to scale up successful pilot projects from a business perspective.

Keywords: sustainable sourcing, smallholder inclusion, upgrading, supplier development, partnership, CSR, agribusiness.

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Introduction

An increasing number of Food and Agribusiness Multinational Enterprises (F&A MNEs), such as Mondelez, Nestlé and Unilever, recognize the economic potential of smallholder inclusion in Africa, Asia and Latin America and have announced extensive investment plans to source more from smallholders. Smallholder inclusion is defined as a sourcing strategy in which smallholders produce commodities for high value-adding supply chains with a business perspective. A high value-adding food supply chain is defined as a network of food-related businesses through which products move from production to consumption, while gaining incremental value in the marketplace (Stevenson and Pirog 2013).

F&A MNEs increasingly want to include smallholders in high value-adding supply chains to secure (long-term) supply of agricultural commodities, such as cocoa, coffee, vegetables, fruits, nuts, spices and cotton (World Economic Forum 2011 and 2012). The aim is to maintain their competitive advantage in a growing global food market, while contributing positively to smallholder livelihood and rural economic growth.

There are three major arguments why F&A MNEs are increasingly investing in smallholder inclusion in an era that is characterized by increasing and changing (dietary shift) food demands, on the one hand, and decreasing amounts of freely available and suitable new lands, on the other. First, according to several long-term global food security studies, the major part of the additional food needed to feed the world in 2050 should come from higher yields (Bruinsma 2009; Ittersum 2011; Tilman et al. 2011). Smallholders in developing and emerging economies have a large potential to produce much more food because they currently show on average low yields per hectare.

Second, F&A MNEs invest in high value-adding smallholder supply chains because these investments could provide simultaneously opportunities to access local markets and to advance local economic growth (Proctor and Digal 2008; Kapstein and Kim 2011). It is expected that local food consumer markets of emerging and developing economies will expand by about three billion middle-class consumers in the coming twenty years (Kharas 2010).

Finally, firms/business are increasingly called upon to play a positive role in solving global pressing problems such as combatting climate change, food insecurity and poverty, and thus to contribute to a more sustainable development as recommended in the 'Sustainable Development Goals 2015-2030' of the UN (2015). This applies most notably to F&A MNEs, because of their influence and activities in global food supply chains both at home and in host countries (Sjauw-Koen-Fa 2010). Therefore, investing in smallholder inclusion to secure a (long-term) sustainable supply of commodities provides them with an opportunity to express responsiveness and responsibility to social issues from a business perspective.

However, smallholder agriculture in developing and emerging economies faces several productivity and transactional barriers in its efforts to access high value-adding food markets, e.g., supermarkets, and regional and global markets. These include dispersed production, low productivity, variable quality, high transaction costs, poor market institutions and poor governance, and an inaccessible rural financial system (London et al. 2010; Wiggins et al. 2010;

IFAD 2012; Hazell et al. 2010; Sjauw-Koen-Fa 2012). Therefore, smallholder agriculture in developing countries must be upgraded to achieve its full potential.

Upgrading strategies demand increasing smallholder farmers' capabilities and creating new business relationships among all strategic partners within the supply chain. To achieve this, F&A MNE-smallholder farmer relationship must shift from short-term transactional (characteristic of conventional sourcing strategies) into long-term cooperative relationships (supplier development strategy), because upgrading of smallholder farming systems (the supply base) is a long-term process (Hahn et al. 1990; Spekman 1988; Humphrey 2004).

Hahn et al. (1990) introduced the concept of a supplier development for upgrading suppliers in developing economies to produce goods such as apparels, automobile and electronic parts for MNEs situated in developed countries. They defined this concept as a long-term cooperative effort between a buying firm and its suppliers to upgrade the suppliers' technical, quality, delivery, and cost capabilities. The ultimate goal of supplier development programs is to form a mutually beneficial relationship that will help the partners ('buyer and seller') of the supply chain to compete in the market place (Hahn et.al. 1990; Watts and Hahn 1992). We adapted this concept for sustainable smallholder supply.

In addition to upgrading of smallholder farming systems, long-term public and private capital investments are required to improve the infrastructure (access to water, roads, improving transport systems and creating storage facilities) of smallholder farmers to lower transaction costs and reduce post-harvest losses (Schmidhuber et al. 2009; Hallam 2011; Hebebrand 2011). The need of public and private investments to help improving smallholder farming systems in developing economies complies with the concept of smallholder supplier development.

Several F&A MNEs are already including smallholders in high value-adding supply chains and targeting the so-called 'base of the economic pyramid' (Jenkins and Ishikawa 2010; Gold et al. 2013; Hahn and Gold 2013). According to the World Business Council for Sustainable Development (2013), to scale or scaling-up (successful) pilot projects has proven elusive so far, because seen from a business perspective, the investments in scaling up might not automatically comply with corporate return on investments strategy. Even if a successful pilot project shows good potential for sustainable smallholder supply, the conditions on a large scale may differ significantly from the pilot project situation.

For example, on a larger scale the geographical and agricultural conditions might be less suitable, producers organizations prove to be weak, the physical or institutional infrastructure is not developed enough for the scaled situation, existing organizations rely on public subsidies, or the supply chain has become too long and disorganized (Shepherd 2007; Wegener 2012).

There could be also (corporate) finance challenges to address investments and the sequence in which to address them in smallholder supplier development, such as whether to make a local or centralized investment, aiming to provide an integrated solution often in partnership with other stakeholders (London et al. 2010; Hahn and Gold 2013; Dahan et al. 2010).

Moreover, there are also organizational challenges within the MNEs that might hamper the complex process of smallholder supplier development and lead the smallholder supply chain effectively into the scaled-up phase (Olsen and Boxenbaum 2009; Reficco and Rueda 2012). All these obstacles may make the move from pilot project to scale-up situation too costly and risky for private investors.

The *key question* arises: How can F&A MNEs best include smallholders in their sourcing strategy and contribute to both the MNE's business objectives and the improvement of smallholder livelihood on a large scale?

The aim of the present article is to define the critical success factors (CSFs) that can help F&A MNEs in designing and implementing sourcing strategies for sustainable smallholder supply from a business perspective.

We define CSFs for smallholder inclusion in high value-adding supply chains as the limited number of areas of activities where 'things must go right' to allow this inclusion to flourish (adapted from Rockart, 1979). These are areas/activities in which good performance is necessary to ensure that smallholder inclusion, i.e. smallholder supplier development, will become a viable and sustainable business to secure and stabilize the supply of agricultural commodities, while improving smallholders' livelihoods.

In the next section, we explain the methodological approach, followed by an analysis of arguments for smallholder inclusion in high value adding supply chains. Then the external CSFs for smallholder inclusion in high value-adding supply chains by F&A MNEs are identified. Finally, the findings of the previous two sections are integrated in a sustainable smallholder sourcing model and related CSFs and business drivers for smallholder inclusion are discussed. In this model we have combined the sourcing and CSR perspective.

Methodological Approach

To find the key activities in which good performance is necessary to achieve the goals of smallholder inclusion, we first specified the arguments and related critical questions that arise about smallholder inclusion by F&A MNEs from a business perspective. Then we explored the literature per activity in order to find the related CSFs and drivers for sustainable smallholder supply by F&A MNEs.

For our research we used the five key words in the subject: '**Sourcing Strategies** for **Sustainable Smallholder Supply,** a business perspective' to select publications in the literature. We combined the five key words and used also synonyms and closely related concepts. For example: **sourcing strategies** (procurement, purchasing), **sustainable** (CSR, certification, food standards, ethical codes), **smallholders** (upgrading, BOP, inclusive business, producers organization), **supply** chain (management, global value, governance, partnership, integration).

To collect the relevant literature, we used Google, Scopus and Web of Science, and we also explored the websites of several F&A MNEs (i.e. Unilever, Nestlé, Cargill, Mondelez, MARS, ECOM and ADM).

We first explored the elements, drivers and barriers and CSFs, and the consistency of the sourcing strategies of multinational enterprises operating in global markets. We found key articles in the global supply and value chain, international business management and business and society literature. We also searched in the literature for case studies and best practices of smallholder inclusion in high value adding supply chains by F&A MNEs to learn about their approach, structure, the process and the CSFs from a business perspective.

The result was a large number of publications about linking smallholders to regional and global food markets (Reardon et al. 2009; Genier et al. 2009; BOP Innovation Center 2012; London et al. 2010; Jenkins and Ishikawa 2010, 21; IFAMR 2014; Seas of Change 2012 (www.seas ofchange.net); Gold et al. 2013; Graf et al. 2015; Blok et al. 2013).

Many of the cases were CSR driven, or were dependent on temporary (financial) support from donor countries, public bodies, private foundations or NGOs (on project approach). These cases were excluded from our study, because they did miss the business approach or there was no F&A MNE involvement.

In the literature we also found a number of papers in which F&A MNEs are described as sourcing certified commodities produced by smallholders in developing and emerging economies such as cocoa, coffee, timber, cotton, bananas and fish (Giovannuci and Ponte (2005); Blackman and Rivera 2010; Rueda and Lambin 2013; Fayet and Vermeulen 2012), or participating in Roundtables such as in palm oil, soybean and organic cotton to promote the growth and use of sustainable certified agricultural commodities (Geibler 2013). Certification schemes have been qualified as a 'Tripartite Standards Regime (TRS) and shared between all supply chain actors (Hatanaka et al. 2012; Loconto and Busch 2010). The (new) established third party certification bodies to audit/inspect the required sustainable standards and codes to be met by producers/smallholders have become a (new) interface between F&A MNEs and all other actors of the supply chain (Afrane et al. 2013). We excluded therefore certification and roundtables cases from our research, because they have not established closer business ties with smallholders needed for smallholder supplier development. Moreover, the current widely applied sourcing strategies based on food standards and ethical codes and certification schemes are first and foremost CSR driven, i.e. designed to get a social license to operate (Howard-Greenville 2003; Gunningham et al. 2004).

For our study we searched for case studies in which F&A MNEs are involved in smallholder supplier developments from a business perspective that go beyond the pilot project phase. We found in the literature review few case studies on smallholder inclusion by F&A MNEs using a value chain approach (Hasibuan-Sedyono 2010; Sjauw-Koen-Fa 2014; Bruni and Schiff 2014; Perez-Alleman and Sandilands 2008; Graf et al. 2015).

Arguments for Smallholder Inclusion in High Value-Adding Supply Chains

From various long-term global food security studies (Bruinsma 2009; Ittersum 2011; Tilman et al. 2011; McKinsey Global Institute 2011), it can be concluded that large-scale and high-tech agriculture, particularly in developed regions (North America and the EU) alone, will not be sufficient to produce the additional food that is required to meet the world food demand in 2050.

A key constraint in meeting this demand is that the optimum theoretical crop yield ceilings of many food crops have nearly been reached (Fischer et al. 2009; Lobell et al. 2009). However, the crop yield ceilings of many food crops in developing regions have not been reached yet. As such, their average yield per hectare is at least two times lower compared to crops in developed countries, and best yields within developing regions have been also significant lower than the average (e.g. Frischer et al. 2009; Ittersum 2011; World Bank 2008). In Western Europe and North America the average annual yield of cereals is 6.5 tonnes per hectare, while in developing economies it is 2.9 tonnes per hectare. In the least developed economies, the average annual yield is even as low as 1.8 tonnes per hectare (average 2009-2011, computed from FAOSTAT). These averages show that small-scale agriculture in developing and emerging economies can be improved substantially to help meet the growing global demand for food. The critical arguments for unlocking the food potential of small-scale farming systems in developing and emerging economies seen from a macro level can be summarized as follows:

- Small-scale agriculture is the dominant agricultural system in developing regions on which local communities strongly depend for their food supply and income.
- Improving food production by smallholders in developing regions will reduce the demand for new arable land and additional clean water, which both will become scarcer in the future.
- The development of small-scale agriculture in developing regions can be a 'win-win' proposition. F&A MNEs want to secure the supply of agricultural commodities, while improving the livelihood of millions of smallholder farmers at the 'Bottom of the Pyramid' (Prahalad and Hart 2002; Karnani 2006).

These arguments on a micro level provide pros for a business case for smallholder inclusion in order to secure sustainable (long-term) supply by F&A MNEs, which is the focus of the present article. Although F&A MNEs have a dominant influence in global food supply chains both at home and in host countries, their capacity to provide smallholders with access to regional and global markets for business must be not overestimated—they can't do it alone. There are about 500 million smallholders in the world, of which 200 million are commercially oriented and 300 million are subsistent farms (Christen and Anderson 2013).

Fortunately, there are numerous initiatives by others, such as public and private foundations (including SMEs), donor related entities and NGOs, to link smallholders in developing and emerging economies to local and export markets on a short-term project base driven by CSR motives. However, we face the problem of continuity of smallholder farms. The challenge of linking smallholders to markets is to ensure that they become self-propelling businesses, which can survive in an open market place without external development support.

Critical Success Factors Regarding Smallholder Inclusion in High Value-Adding Supply Chains

F&A MNEs like Unilever, Nestlé and Mondelez recognize the strategic business and market opportunities of small-scale agriculture in developing and emerging economies (see arguments in previous sections) and have announced investment plans to develop sustainable smallholder

supply in the coming period. Seen from a business perspective, F&A MNEs need a viable business case.
To explore CSFs of smallholder inclusion in the literature we have transformed the *key question* for smallholder inclusion (see Introduction) into six critical sub questions:

i. Which smallholder segments are suitable for inclusion from a business perspective?
ii. How can smallholder productivity, product quality and delivery reliably be improved to meet the demands of high value-adding supply chains in a sustainable and competitive way?
iii. Which governance structures offer the best upgrading prospects for smallholders inclusion?
iv. How can vertical coordination in the smallholder supply chains be strengthened to effectively and efficiently upgrade interventions?
v. How can accessible and affordable rural financial systems be created to ease smallholder demand for investment, working capital and savings effectively?
vi. What are the commitments, attributes and procurement organizations needed to invest in and to govern smallholder supply chains to secure (long term) sustainable smallholder supply effectively?

Critical subquestions *i* to *v* are related to external challenges that occur outside (in the market place) of the F&A MNE, while subquestion *vi* is related to internal organizational challenges.

External CSFs

i. Which smallholder segments are most suitable for smallholder inclusion in high value-adding supply chains for building a business case?

Several criteria can be used to segment smallholders. The most obvious way to differentiate among small farms is by the size of the landholding in hectare or by the amount of livestock. The World Bank (2008) has defined a small-scale farm as a farm holding that owns or rents less than two hectares of agricultural land. According to this definition, 85 percent of the world's farms are smallholders of which most live in Africa and Asia (FAO 2010, Sjauw-Koen-Fa 2012)). Farm size is, however, highly region-specific and differs per crop and agro-ecological zone, while several factors influence a farm's output and economic viability, such as agronomical conditions, farming systems and access to farm input and credit.

Because of the disadvantages of a segmentation of smallholders based on land size, Torero (2011) differentiated smallholders using a market and institutional orientation as criteria. He divided smallholders into subsistence farmers that are marginalized even in their local economies (Rural world 3) and farmers oriented towards local, provincial, national (Rural world 2), and international markets (Rural world 1). It was noted that these strata are not static but are dynamic due to institutional and infrastructural interventions.

GIZ (2011) uses the degree of commercialization as criterion for finance and segments smallholders in subsistence-oriented farmers and market-oriented farmers for a (bank) financing approach. IFC and GPFI (2011) in contrast to GIZ uses net income generated by farming in that

country or region as a criterion and segmented smallholders into semi-commercial smallholders (< 2 hectares) and commercial smallholders size (2-20 hectares).

In their study on segmentation of smallholder households Christen and Anderson (2013) used a more comprehensive set of criteria. They used the total household income for a financing approach to divide smallholders into low and middle income countries. However, the authors stressed that these segments are not fixed but rather categories based on common traits that can begin to illuminate the financial mechanism of the smallholder business case. Based on the types of crops grown on the farm, the way smallholders are engaged with markets and the way those markets are organized, Christen and Anderson (2013) have estimated that there are globally 300 million non-commercial smallholders (Rural world 3), 165 million commercial smallholders in *loose* value chains (Rural world 2), and 35 million commercial smallholders in *tight* value chains (Rural world 1).

Non-commercial or subsistence smallholders farm not as a vocation or strategic business choice, but to contribute to their own sustenance and survival. According to Christen and Anderson (2013) contract farming is by definition unfeasible and credit from agricultural suppliers is uncommon.

Therefore we excluded non-commercial of subsistent smallholders from linking smallholder to high value-adding supply chains, because the pros for a viable business case are weak. However, according to the rural world classification of the farm sector, subsistence farmers can be linked best to local markets by improving institutional, infrastructural and market interventions.

Commercial smallholders in *loose* value chains are usually focused on staple crops and these may also include some high value crops such as coffee, cocoa, oilseeds, and corn. They sell their surplus usually on local markets and have limited access to inputs, financial services and information. They rely on unimproved seeds and traditional production methods and the land size is one to two hectares.

Commercial smallholders in *tight* value chains grow cash crops that are sold usually in regional or export markets. Reliable surplus of staple crops could also be sold through local markets. This category of smallholders have access to buyer-provided bundles of improved seeds, inputs, information and finance, and have the capacity to generate reliable high-quality output on a contract farming basis. This category of smallholder farms own according to the classification of Christen and Andersen (2013) at least two hectares.

However, Christen and Anderson (2013) stress that the segments are not meant to be fixed, iron-clad divisions, but rather categories based on common traits that can begin to illuminate the financial mechanisms that might best fit the given financial goals and cash flows. Farm sizes also differ geographically and per crop. For example, an average cocoa smallholder farm in Indonesia is 1 hectare while in Ghana it is 2.0 hectares. Coffee smallholders in Nicaragua have on average 3.5 hectares, compared to 5 hectares in Colombia. Cotton farmers in India have on average 1.4 hectares while paddy farmers in Java have an average of 0.3 hectares.

We conclude that from the perspective of F&A MNEs, the business case for smallholder inclusion should be primarily focused on commercial smallholders in *tight* value chains developed by Christen and Anderson (2013). This category of smallholders is best equipped to adapt upgrading interventions and to have experience with contract farming. However, commercial farmers in *loose* value chains may also be suitable for high value-adding supply chains if they take a business-like approach to producing a reliable surplus that can be sold through local markets/traders. CSF for a viable business case of smallholder inclusion in high value-adding supply chain is that the selected smallholders are commercial/market oriented and can adapt upgrading interventions to meet a F&A MNE's supply needs in a competitive global market environment.

ii. How can smallholder productivity, product quality and delivery reliability be improved to meet the demands of high value-adding supply chains in a sustainable and competitive way?

According the literature on competitiveness, the most viable response to this type of challenge is to upgrade (Humphrey 2004; Porter 1990). Upgrading can be defined as 'a move of firms to higher value added activities or interventions in production to improve technology, knowledge and skills, and to increase the benefits or profits deriving from participation in regional or global production networks' (Gereffi et al. 2005, 13). This assumes a regional or global value chain approach driven by a lead firm for example an F&A MNE. A value chain framework offers four types of economic upgrading (Humphrey and Schmitz 2002):

- Process upgrading*:* more efficiently transforming inputs into outputs by reorganizing the production system or by introducing superior technology.
- Product upgrading*:* moving into more sophisticated product lines, which can be defined in terms of increased added value per unit.
- Functional upgrading: acquiring new functions in the chain, such as design or marketing, or abandoning existing low added-value functions in favour of higher added-value activities.
- Chain or inter-sectoral upgrading: where firms move into new but often related sectors.

Upgrading patterns differ by both industry and country based on the input-output structure of the value chain and the institutional context of each country. The typologies of upgrading were originally studied in SMEs industrial sectors (e.g., apparel, garment, IT hardware, and footwear) in developing and emerging economies. These SMEs were led by large firms from Western countries. This phenomenon is studied in the supply chain literature as 'supplier development' (Hahn et al. 1990; Watts and Hahn 1995; Krause and Ellram 1997).

Supplier development is important from a purchasing perspective for developing effective and reliable sources of supply and from a corporate perspective for advancing competitive strategic objectives by linking suppliers' capabilities with internal requirements. However, the 'industrial' upgrading approach can also be applied to agriculture (Humphrey 2004). This will be discussed below.

In the literature several upgrading interventions for small-scale agriculture in developing and emerging economies from a business perspective have been identified (e.g. Eaton and Shepherd

2001, 11; London et al. 2010, 588). We have grouped these upgrading interventions into the first three upgrading types of Humphrey and Schmitz (2002) in the following ways:

- Process upgrading: improvement of physical infrastructure, provision of extension services and post-harvest facilities, access to finance, skill transfer and the strengthening of producer organizations.
- Product upgrading: provision of inputs such as fertilizers and seeds, and introduction of advanced farm technologies and certification.
- Functional upgrading: enhancement of farmers/smallholders to become crop specialists (specialization) or collaborate in joint efforts to process and market their products (vertical integration).
- Chain or inter-sectoral upgrading: e.g. introduction of a *new* crop including related activities (post-harvest and marketing).

In the literature the common denominator of upgrading types in global supply chains is that activities at any point in the chain are defined by the four key questions for vertical chain coordination: What is to be produced?, How it is produced?, How much is to be produced? and When and how is the flow of the product along the chain to be handled? (Humphrey and Schmitz 2002). A 5th question regarding smallholder inclusion can be added: How do smallholders benefit from upgrading interventions provided by F&A MNEs?

A critical point for upgrading smallholder farming systems is that F&A MNEs are used to sourcing from global agricultural commodity traders and large local exporters rather than purchasing directly from smallholders, because transaction costs, caused by dispersed production, small volumes and poor infrastructure, are high. Moreover, product quality is variable and delivery is uncertain. In a close relationship between supply chain partners, partners are willing to invest resources and time, share risks and rewards and maintain the relationship over a longer period of time because pay-offs may occur over a long time (Landros and Monczka 1989; Krause and Ellram 1997). Therefore, F&A MNEs have to closely collaborate on a long-term basis with their suppliers/intermediaries of the smallholder supply chain to upgrade smallholder farming systems.

It is emphasized in the literature that in order to succeed in market initiatives with the BOP, partnership is required that involves joint efforts between the F&A MNE, suppliers and non-private sector stakeholders and local government (Hahn and Gold 2013; Dahan et al. 2010; Rivera-Santos et al. 2012; London and Hart 2004; Perez-Aleman and Sandilands 2008; Dentoni et al. 2012; Bitzer 2012). This approach provides also a good opportunity to consider and to include local knowledge, networks, values and social consequences of smallholder supplier development in order to gain local legitimacy (Reimann et al. 2012; Gifford and Kestler 2008; Perez-Aleman 2012).

The aim of the partnership is to bring together public and private resources and capabilities of the partners needed for smallholder supplier development. In this way F&A MNEs can take into account smallholder supply development issues needed for upgrading. Moreover, they can deal also with a wider set of performance objectives such as securing and stabilizing their own supply of commodities while positively contributing to smallholder livelihood. The mission of the

partnership is identifying, building and maintaining partnerships, including non-business actors, for upgrading and developing viable sustainable smallholder supply by F&A MNEs. The factors associated with partnership success are described by Mohr and Spekman (1994). These are attributes of the partnership (commitment, coordination, interdependence and trust), communication behaviour (quality, information sharing and participation), and conflict resolution techniques (joint problem solving).

Once the partnership is established, a development program must ensure that the supplier (trader or producers organization) can facilitate upgrading of the smallholder farming system and is willing to develop a close, long-term working relationship with the F&A MNEs (Monczka et al. 1998).

One CSF of the partnership for smallholder supplier development is that there is an open two-way inter-organizational communication between the partners of the farmers upgrading program (Hahn et al. 1990).

iii. Which governance structure offers smallholders the best upgrading prospects?

Governance can be defined as non-market coordination (Gereffi et al. 2001). It includes issues related to capacities, information, power and decision-making. To include smallholders in high value-adding supply chains, governance functions are important since they indicate the possible leverage points to meet F&A MNE business goals.

Gereffi et al. (2005) distinguished five types of governance forms in global value chains:

1. Market chains: there are no tight relationships or asset-specific investments. Switching partners is quick, easy and not costly (typically spot markets).
2. Modular value chains: turn-key suppliers make products to the specification of the customer. The ability to codify specifications of the products is high.
3. Relational value chains: buyers and suppliers engage in complex interactions. Product specifications cannot be codified, transactions are complex, and supplier capabilities are high.
4. Captive value chains: smaller supplying firms are locked in by the lead firm. The ability to codify and the complexity of product specifications are both high, but supplier capabilities are low.
5. Hierarchy chains: classical vertical integration. Subsidiaries and affiliates are subject to a lot of managerial control from headquarters. Product specifications cannot be codified, products are complex, and highly competent suppliers cannot be found.

Gereffi et al. (2005) also postulate a framework to determine the emerging coordination or governance structure in a global value chain. This framework is based on the interplay between three independent variables or dimensions:

- The complexity of information and knowledge required to sustain a particular transaction.
- The extent to which this information and knowledge can be codified.
- The capabilities of the supply base in relation to the requirements of the transaction.

Table 1. shows the results of the combination of these three variables in a specific governance form.

Table 1. The Five Governance Types Based on Gereffi et al. (2005)

	Complexity of transactions	**Ability to codify knowledge**	**Supplier capabilities in reaching requirements**
Market value chains	low	high	high
Modular value chains	high	high	high
Relational value chains	high	low	high
Captive value chains	high	high	low
Hierarchical value chains	high	low	low

Source. Adapted from Omta and Hoenen 2012

The question arises which of the five governance types of Gereffi et al. (2005) can be used to include a smallholder in high value-adding supply chains. The answer to this question depends on how the characteristics of the market linkages of smallholders in developing and emerging economies match the three dimensions of governance structures.

Rijsgaard et al. (2010) specified the following characteristics of smallholder supply:

i. Sales of small volumes (high marketing cost per unit).
ii. High uncertainty of price, which is negotiated at each stage.
iii. Sales to many and different buyers (moral hazard problems, poor opportunities for acquiring reliable market information from buyers, poor opportunities for accessing finance and other support from buyers).
iv. Poorly specified quality and standards and a lack of quality control (moral hazard problems, no/low rewards for quality).
v. Lack of traceability, which is a requirement for certification of food safety and sustainability.

Given these characteristics of smallholder supply, the three value chain governance dimensions of Gereffi et al. (2005) can be qualified as follows:

- Complexity of information and knowledge transfer is high due to characteristics i, ii, iii and v.
- Codification of information and knowledge is high and it significantly increases with certification to meet sustainable and food safety private standards due to characteristics iv and v.
- Capabilities of supply base to adapt the requirements of the transaction are low due to characteristics i, ii and iii.

It can be concluded that the characteristics of smallholder supply chains do not comply with that of the 'Market' (the complexity of information exchanged is low, transactions are relatively simple, governance mechanism is price rather than a powerful lead firm), and 'Hierarchy' (product specification cannot be codified, products are complex, governance is characterized by vertical integration and managerial control within a lead firm) governance types. This means that

the governance of sustainable smallholder supply in high value-adding chains, in which upgrading is the central issue for smallholder supply development, encompasses the 'Modular', 'Relational' and 'Captive' governance types. Of these three governance types, the 'Captive' governance type provides the best opportunities to coordinate the smallholder supplier development programs, because the complexity of transactions as well as the ability to codify transactions are high, while the capabilities in the supply base are low. Therefore chains of smallholders-intermediary and other key partners have to be locked in by lead firm.

The CSF for the captive governance type of smallholder supply chains is that the 'buyer-seller' relationship shifts from an adversarial or transactional to a cooperative one (Spekman 1988; Watts et al. 1995; Krause and Ellram 1997). Transactional 'buyer-seller' relationships are driven by bargaining power and short-term contracts to achieve quick-wins at low cost by the buyer, while a cooperative one is based on partnership-like and long-term contracts to achieve mutual interest such as a smallholder inclusion relationship.

iv. How to strengthen vertical coordination in the smallholder supply chains to effectively and efficiently upgrade support?

A smallholder farm usually lacks the capacity to improve and influence the markets upon which its business depends. The challenge is then how to unify the hundreds or thousands of individual smallholders for effective upgrading interventions by F&A MNEs. The possible mechanism for this is horizontal integration (Riisgaard et al. 2010), i.e. producers' organisations (POs) of smallholders, particularly co-operatives. A PO is defined as a membership-based collective organisation or a federation of organisations with elected leaders accountable to their constituents (World Bank 2008). They are often seen as effective structures to link small farmers to commercial markets and to integrate them into regional and global value chains (Onumah et al. 2007; Koladay et al. 2007; Getnet and Anullo 2012; Chambo 2009; Bijman and Wollni 2008; Münkner 2012). Moreover, they can also strengthen producers' bargaining power.

A PO is based on the principle that acting collectively improves the position of its members, such as smallholders, and creates growth opportunities in farm productivity and income. A PO can fit together activities, such as upgrading, of sellers (farmers) and buyers (traders and processors) to more effectively meet market requirements than smallholders can individually. There are several areas in which POs can play a role in strengthening the coordination in smallholder supply chains in order to reduce transaction costs and market risks, enabling collective action, and redressing missing markets by applying (innovative) market institutions, such as market intelligent systems, grades and standards, forward contracts, contract discipline and warehouse receipt systems (e.g. Torero 2011; Onumah et al. 2007).

Therefore, the CSF for strengthening vertical coordination of sustainable smallholder supply chains is the emergence and/or empowerment of effective POs, i.e. horizontal integration of smallholders, to upgrade smallholder farming systems.

v. How can an accessible and affordable rural financing system be created to ease smallholder demands for investment, working capital and savings effectively?

Access to affordable financial services is essential in order for smallholders to meet investment and working capital requirements, and other financial services such as insurance to cover risk and savings, to unlock their potential (London et al. 2010; Hazell et al. 2007; Wiggins et al. 2010; IFAD 2012; Sjauw-Koen-Fa 2012).

Smallholders have to invest in new farm assets, technology and equipment to meet the requirements of high value-adding supply chains and to expand their farming business. In developing regions, however, smallholders lack collateral, credit history and access to finance/credit. Moreover, low levels of economic activity and population density result in dispersed demand for financial services, and weaknesses in the implementation of regulations. These, in turn, lead to high transaction costs, risks and information asymmetries that make rural farm financing less attractive for commercial banking (World Bank 2007; IFC 2010; Chalmers et al. 2006; Sjauw-Koen-Fa 2012 32-40). It should be noted that upcoming mobile banking can contribute to lower transactional cost of and provide access to rural financing (Asongu 2013; Maimbo et al. 2010).

Beside investment and working capital smallholders in developing and emerging economies need also savings and insurance services in order to respond to unexpected or irregular expenses and revenues, whether related to farming, festivities, sickness or burials. Smallholders in developing regions are after all risk averse, in view of their limited (financial) capabilities to absorb shocks.

Alternative sources of affordable financing for smallholders range from microfinance institutions (MFIs) to savings and credit groups (SACCOs), and more formalised savings and credit co-operatives (World Bank 2007). In some cases, traders and processors provide financing to smallholders such as pre-payment for contract farming (e.g. IFC 2010; Chalmers et al. 2006). Commercial smallholders have, however, even more difficulties when seeking medium-term and long-term financing. To ease this finance gap Doran et al. (2009), IFC (2010) and GIZ (2011) propose a revitalising of rural agricultural financing, with an emphasis on what the private sector, e.g. F&A MNEs and banks (in cooperation with public financial institutions for development), can contribute to mobilising smallholders.

Commercial banks and investment funds are used to serving the top of the farm production pyramid in developing and emerging economies. This pyramid consists of large farm enterprises and plantations.

Although F&A MNEs are not financial institutions, they can play a role in lowering financial risks for smallholders by providing prepayment before planting, by offering buying commitments of the produced crops or animal products, and by providing a price guarantee to smallholders, and financial access to producer organizations (e.g. Sjauw-Koen-Fa 2014; Vorley and Thorpe 2014).

However, lowering financial risks will increase creditworthiness of smallholders. This will attract (rural) financial institutions to provide finance to smallholders and design of a value chain finance approach for smallholders (Miller and Jones 2010; Sjauw-Koen-Fa 2012 36-38).

CSF regarding smallholder financing demands is the creation or presence of an accessible and affordable rural financing system to ease smallholder demand for investment and working capital including insurance and savings.

CSFs Within F&A MNEs

Many F&A MNEs have been supporting smallholders in developing and emerging economies in the past decades. These F&A MNEs have mostly used Corporate Social Responsibility (CSR) strategies to express corporate philanthropy or to get a social licence-to-produce. However, smallholder inclusion in high value-adding supply chains needs a special business-driven sustainable smallholder sourcing model in which sourcing and CSR perspectives are combined. This section elaborates on the transition of F&A MNEs from a CRS strategy to a sourcing strategy and the internal organizational challenges that dedicated Procurement and Operation departments face when they engage in these transitions.

From CSR Strategy to Smallholder Sourcing Strategy

The reason why firms should care about smallholders in developing and emerging economies is rooted in the debate on the role of business in society. This debate focuses on the corporate social responsibility (CSR) of firms. The dominant trends in CSR thinking evolved from ethics and the social obligation of business in the 1950s and 1960s to a stakeholder approach and strategic management in the 1990s (Lee 2008; Guinipero et al. 2012); Caroll and Shabana 2010) defined social responsibility of firms in the following way: "The social responsibility of business encompasses the economic, legal, ethical, and discretionary expectations that society has of organizations at a given point in time".

Gradually, the motivation for CSR evolved from corporate philanthropy to CSR as a business opportunity (Prahalad and Hart 2002; Karnani 2006; Porter and Kramer 2005; Carroll and Shabana 2010; Singh et al. 2014). Smallholder inclusion in high value-adding supply chains by F&A MNEs has followed a similar path. It has evolved from a CSR-driven smallholder support strategy to acquire a social licence-to-operate into a business-driven smallholder sourcing strategy that secures supply and creates access to local markets (Perrot 2013).

However, firms have different responses to social responsibility and social issues such as smallholder inclusion. This refers to a firm's corporate commitment and capacity, such as mechanisms, procedures, arrangements, behavioral patterns, sustainability codes and standards to anticipate on social issues (Gold et al. 2012; Tilburg van et al. 2012). Social responsiveness of firms can range from 'doing nothing' to 'doing much' regarding CSR (Caroll 1979; Maignan et al. 2002; Tilburg van et al. 2012). In the supply chain literature, the involvement and commitment of the top management has been emphasized, because they understand best the needs of supply chain management as they have the most knowledge of the firm's strategic imperatives to remain competitive in the market place (Hahn et al. 1990; Monczka et al. 1998). We concluded that to include smallholders in high value-adding supply chains, F&A MNEs best need a proactive CSR strategy combined with a clear smallholder sourcing strategy.

CSF is that the top-management is involved and committed, because sustainable smallholder supplier development programs are a long-term investment which is subjected to market risks.

Internal Organizational Challenges for Smallholder Inclusion

The internal organizational challenge to guide and to govern supplier development programs in global value chains was highlighted in the purchasing and supply chain literature (Watts and Hahn 1995; Trent and Monczka 1994 and 2002; Krause and Ellram 1997). The problem is that supplier development programs demand a procurement organization with a long-term approach and resources. This is in contrast to conventional procurement organizations that are short-term profit-driven on a transactional basing.

The challenge is how to integrate Procurement and CSR (regarding strategy, organization and capabilities) in order to govern long-term smallholder supplier development programs.

Three categories of internal organizational challenges regarding the implementation of ventures in developing and emerging economies have been identified (Olsen and Boxenbaum 2009; Reficco and Rueda 2012). These internal organizational challenges have been adapted for smallholder inclusion in high value-adding supply chains:

- Process-related challenges: To unfold coalitions for smallholder inclusion both horizontally and vertically. Horizontally: by linking functional areas within and across departments such as CSR and Procurement and Operation departments within F&A MNEs. Vertically: by linking corporate management level (headquarters) with the management at country level.
- Structural and incentives-related challenges: To allocate and refine resources and capabilities for smallholder supplier development, to tune evaluation and performance criteria, and mandate an incentive structure between departments within an F&A MNE that are involved in sustainable smallholder supplier development.
- Cognitive challenge: to harmonize conflicting mind-sets between key actors/middle management/departments involved in smallholder inclusion.
- One of the most critical points is the refining of the traditional role and capabilities of CSR and Procurement within F&A MNEs. CSR focuses on supporting smallholder farming systems, while Procurement is concerned with supplying raw materials from multiple suppliers and spot markets at low cost on a transactional base. Therefore, sourcing from smallholders means a shift from corporate philanthropy (competence of CSR) to sustainable sourcing strategy (competence of Procurement).

In the supply chain literature, the use of cross-functional sourcing teams led by Procurement dedicated to strategic purposes organized around supply has been identified as an effective internal firm structure (Trent and Monczka 1994 and 2002; Mohamed et al. 2009; Driedonks et al. 2014). Cross-functional sourcing teams consist of personnel from at least three areas of a firm. The aim of these teams is to combine different internal organizational capabilities, networks and resources to develop smallholder supply from a strategic business perspective. Cross-functional teams can effectively and efficiently interact with supplier counterparts (cf.

Hahn et al. 1990; Trent and Monczka 1994 and 2002; Krause and Ellram 1997; Driedonks et al. 2014).

CSF regarding internal organizational challenges is the use of cross-functional teams led by Procurement and Operation and including CSR to integrate an organization's values, processes and routines, and to effectively interact with supplier counterparts.

Discussion and Conclusions

F&A MNEs increasingly wish to source from smallholders to secure and stabilize supply in high value-adding supply chains while contributing positively to smallholder livelihood. The key question we try to answer in this article is: How?

We first adapted the concept of upgrading from Humphrey and Schmitz (2002) to improve smallholder farming systems in their effort in accessing regional and global value chains. Second, we adapted the concept of supplier development program from Hahn et al. (1990) to create a supplier development program for smallholder inclusion led by the F&A MNE. The ultimate goal of this concept is to form a mutually long-term beneficial relationship that will help the partners (both F&A MNE and smallholders) of the smallholder supply chain to compete in the market place. Third, we adapted the captive governance type from Gereffi et al. (2005) based on a cooperative relationship between buyers and suppliers to govern smallholder inclusion, because the complexity of transactions as well as the ability to codify transactions are high, while the capabilities in the supply base are low.

In the present literature study, we found that many F&A MNEs have been involved in supporting smallholder farming systems in developing economies to express corporate philanthropy or to get a social license to operate. They are purchasing sustainable certified commodities produced by smallholders from suppliers to comply with consumer concerns regarding environmental and social issues. We have excluded this category of smallholder (out-)sourcing strategies from our study, because they don't fit into the concept of supplier development program. This requires closer business ties with smallholders in order to build a viable sustainable smallholder supply base. This is the approach of our study.

In the literature we found also that despite many successful pilot projects aiming to include smallholders in high value-adding supply chains, scaling up of these pilots has been proven elusive so far. They might be too costly or risky to achieve corporate returns on invest strategies, or there are persistent organizational barriers that might hamper the complex process of smallholder supplier development in partnership.

The aim of the present article is to identify the critical success factors (CSFs) that can help F&A MNEs to design and implement sourcing strategies for sustainable smallholder supply and to scale up successful pilot projects. To achieve this goal, F&A MNEs have to collaborate in partnership with selected intermediaries (traders and POs) and other private (input suppliers) and public parties (NGOs, public bodies and government).

The result of our study of the sustainable smallholder sourcing model is presented in Figure 1 as the 3S-model. In this business-driven model the sourcing and CSR perspectives are combined.

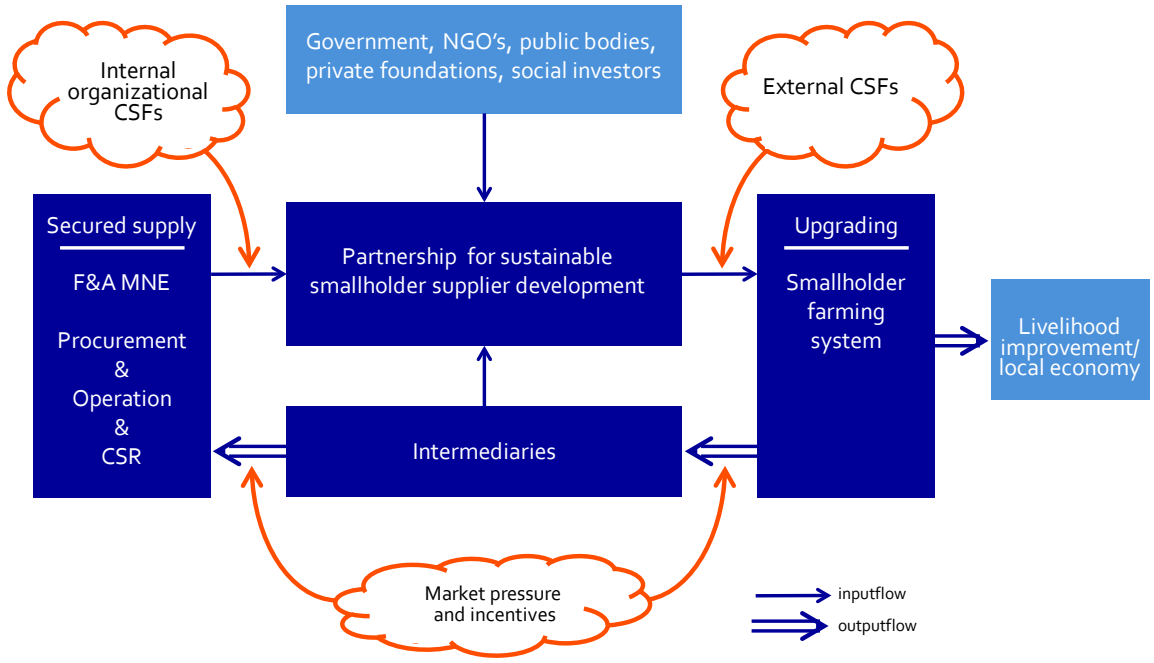

Figure 1. Sustainable Smallholder Sourcing Model (3S Model)

The sourcing process to secure smallholder sustainable supply while improving smallholder livelihood consists of two activities and corresponding structures: the buying process through the supply chain (the axis 'F&A MNE - Intermediaries – Smallholders'), and the upgrading process through the partnership consisting of the F&A MNE, intermediaries, and public and private stakeholders. Both supply chain activities are led by the F&A MNE.

The single arrows in the figure represent the input flow of upgrading support and services to smallholders, while the double arrows represent the output flow of products (and livelihood improvement) resulting from the upgraded smallholder farming system.

External CSFs and the internal organizational challenges of sustainable smallholder inclusion are located at the conjunctions of the elements 'Partnership – Smallholder farming system' and 'Partnership - F&A MNEs' respectively. Drivers of the output flow are open market pressure and incentives.

The CSFs found in the literature review are:

External CSFs (in the market place)

i. *Selection of smallholders suitable for a viable business case to secure (long-term) sustainable supply:* Smallholders that can be included in high value-adding supply chains are commercially oriented and are willing and able to adapt to the upgrading interventions needed to meet F&A MNEs' supply needs.

ii. *Building partnerships for upgrading*: To bring public and private resources and capabilities, business and CSR/philanthropy, and short and long-term interests together needed to upgrade smallholder farming systems. F&A MNEs have to collaborate with suppliers/intermediaries and government, public and private sectors in order to facilitate the upgrading of smallholder farming systems.

iii. *Building a captive governance structure based on cooperative 'buyer-seller' relationship*: The governance of smallholder supplier development should be of a captive type because the ability to codify knowledge and the complexity of product specification are high, while the 'supplier' capabilities are low. The relationship between supply chain actors should be a cooperative 'buyer-seller' relationship aiming to improve 'supplier' capabilities instead of a short-term transactional relationship. This is a precondition for achieving long-run and shared benefits between 'buyer and seller'.

iv. *Building effective producers organizations*: Building and/or empowerment of producer organizations to strengthen vertical coordination.

This is a precondition for overcoming the barriers of dispersed production and high transaction costs, and for enabling smallholders to respond to emerging opportunities in the global marketplace.

v. *Providing access to farm finance*: Building an accessible and affordable rural financing system to ease smallholder investments and savings demands.

This is a precondition for easing the demand for investment and working capital and savings of smallholders effectively. F&A MNEs can play a crucial role in lowering the financial risks of smallholders, i.e. increasing smallholder creditworthiness for rural financial institutions by providing prepayments before planting, price and buying guaranties.

Internal Organizational CSFs (within F&A MNEs)

i. *Presence of a proactive CSR strategy supported by a committed top management.* This is a precondition for long-term investment in smallholder supplier development programs in order to secure a (long-term) sustainable commodity supply. Therefore, F&A MNEs have to transform their CSR driven outsourcing strategy into a sustainable (direct) sourcing strategy in which sourcing and CSR perspectives are combined.

ii. *Use of cross-functional sourcing teams led by Procurement including CSR.*

CSR competence traditionally supports smallholder farming systems (expressing corporate philanthropy and to get social license to operate), while competence of Procurement supports sourcing raw materials from multiple suppliers at low cost on a transactional short-term base. Sustainable sourcing from smallholders from a business perspective means a shift from corporate philanthropy (competence of CSR) to a sustainable sourcing strategy (competence of Procurement). The aim of cross-functional teams with F&A MNEs is to integrate organizational values, routines and resources, and

to interact effectively with supplier counterparts in order to refining of the role and capabilities of CSR and Procurement.

The importance of the elements of the 3S-model and the CSFs can be expected to differ, given the different characteristics of particular business cases, such as crop, geographical area, smallholder and supplier types and capabilities. Moreover, F&A MNEs (processors, wholesalers or retailers) can apply different sourcing and CSR strategies.

We believe that identifying and understanding these CSFs is crucial for successfully implementing and governing smallholder supply chains. In future research, the applicability of the 3S-model should be explored in different smallholder food supply chains and related CSFs and drivers in different geographical contexts by in-depth case studies, because our present paper is explorative and conceptual in nature. This may confirm, modify or specify the 3S-model and related CSFs and drivers. It may turn out that also other CSFs are important for smallholder inclusion in high value adding supply chains by F&A MNEs, too.

The foregoing analysis of sustainable smallholder sourcing strategies leaves unaddressed a number of questions that represent avenues for future research.

First, how to measure and to monitor smallholder livelihood improvement of sustainable smallholder sourcing models? Measuring and monitoring the impact is not only a matter of defining inclusive indicators, but also of how to make the indicators applicable at low cost and widely acceptable. Second, how to harmonize the sustainable sourcing strategies from a business perspective between headquarter and subsidiaries (active in different developing and emerging economies) of F&A MNEs? Sustainable smallholder supply takes place far from global companies' headquarters.

Our research work can help to gain a deeper understanding of the concept of sustainable smallholder supply from a business perspective.

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Willingness-to-Pay for an Educational Label: The Zamorano University Brand

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Abstract

Using a discrete choice experiment, we analyze consumer preferences and willingness-to-pay (WTP) for milk products with differing quality attributes. In doing so, in-person surveys were administered in three retail stores located in Honduras. The main attribute analyzed was the "educational component", which was used to indicate the participation of Zamorano University students in milk production and processing, where the revenue from the commercialization of the products is reinvested in the education of future low-income students with strong academic and professional potential. In general, consumers are willing to pay a price premium for milk products carrying the education label. Moreover, respondents preferred natural milk with low-fat content. Consumers also expressed price premiums for bottled milk products and a medium shelf life compared to milk packaged in plastic bags or shelf life longer than sixteen days, perhaps because of a perception of lack of freshness.

Keywords: choice experiment, Latin America, lognormal price, milk, willingness-to-pay

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Introduction

Due to technological innovations in the agricultural sector, the productivity and quality of food has significantly increased. As a result, consumer's attention towards specialty food products, which provide an extensive array of physical and credence attributes, has increased. The growing interest of consumers in particular food attributes has driven farmers to target specific production lines in order to supply various differentiated products (Canavari, Nocella and Scarpa 2005). Organic and locally grown products and those with health and quality claims are among the most influential in individual's purchasing decisions (Lusk and Briggeman 2009).

Many developing nations, particularly in Latin America, lag behind in the supply of these specialty foods mainly due to infrastructural challenges and institutional constraints in the value chain (Trienekens 2011). However, the increasing number of supermarkets in the 1990's has caused consumer preferences towards specialty food products to evolve in Latin America (Reardon et al. 2003). Retail food companies have shifted their marketing and promotional campaigns towards differentiated attributes, brand recognition, and positioning of food products in general.

Since the mid-1980s, Zamorano, a private international University located in Honduras and a leader in the agricultural sector in Latin America, has produced and commercialized a wide variety of food products including dairy, horticultural, and meat products. Unlike other agricultural universities, this institution is characterized by the methodology of "learning by doing". Under this methodology students participate directly in every step of the value chain from inputs to product distribution and commercialization in real markets. In order to gather a better understanding of the motivation behind this study, it is appropriate to give a brief overview of Zamorano University and its educational mission and contribution to society.

Zamorano University

The Pan-American School of Agriculture, Zamorano, is a private university located in the Yeguare Valley, about 30 kilometers from the capital of Honduras, Tegucigalpa. Since its foundation in 1942, Zamorano has been characterized for its multicultural student body population, which represents twenty-one Latin American countries and various social strata. Offering four agriculture-related majors, Zamorano is mainly focused on agricultural education. Zamorano offers specializations in four majors: 1) Agribusiness Management; 2) Food Science and Technology; 3) Agricultural Sciences and Production; and 4) Environment and Development. The campus is home to more than 1000 resident students for eleven months of the year. An area of 200,000 m^2 is set aside for student dormitories. The daily routines for students attending Zamorano, including a requirement to wear uniforms—to signal equality among all students, daily responsibilities, discipline, and academic requirements, are designed to encourage hard work and a leadership attitude that characterizes the institution.

The university's mission is based on four pillars: Academic Excellence, Learning by Doing, Pan Americanism, and Values and Character. However, the "learning by doing" philosophy is what fundamentally differentiates Zamorano from other universities. The "learning by doing" methodology consists of participation in practical work in the sense that students implement their scientific and business knowledge in a real world context. Zamorano's campus consists of

agricultural fields, agro-industrial plants, specialized laboratories, and research centers where students do their field work. The university enterprises, where students learn by doing, are classified into three main areas: *agriculture* (horticulture, orchards, forestry, grains and seed), *animal science* (beef cattle, swine production, agricultural machinery, and irrigation), and *food processing plants* (dairy and meat products, animal feeds, seed production, fruit and horticultural products, and sawmill). Moreover, a *marketing and sales* unit is available on-site, in which students actively interact with customers in a real market setting.

As a result of the learning by doing methodology, a significant portion of agribusiness products are manufactured by students under the supervision of faculty and staff. The educational value chain process describes the full range of activities which are required to bring a product or service from conception, through the different phases of production, delivery to consumers, and disposal after use.

Zamorano offers a wide variety of food products, available in the university's retail store and in twenty-four grocery stores located around the country. The University's enterprises price their products independently using mainly costs of production and a markup system. The markup is intended to cover production costs and to guarantee a revenue target set by the enterprise. Furthermore, the markup varies depending on the type of product. For example, in the case of white, fluid milk (which is sold in bulk) the markup ranges from 5% to 10% depending on its standardization level. The University does not suggest a retail price, but rather sets a wholesale price to retailers, who determine the final store prices for each product.

The dairy industry constitutes one of the most successful units among all production enterprises. On average, this unit generates over $1.3 million of revenue annually. The dairy enterprise sells approximately fifteen dairy products to retailers including, but not limited to, cheese, ice cream, yogurt, and milk (with white, fluid milk holding the highest sales volume). In addition, five of those products have been recently developed (chocolate milk in half-liter bags, 2% fat milk in half liter bags, basil zamodelfia cheese, garlic zamodelfia cheese, curd). The profits generated by the university enterprises are designated to provide scholarships for economically disadvantaged students with strong academic and professional potential. Around 68% of Zamorano students receive financial assistance. This, in turn, serves the noble purpose of training future agricultural leaders who contribute to the development of their home countries. This fact raises an interesting question as to whether consumers are willing to support food produced by students with the knowledge that the revenues generated from such products will be reinvested in the education of low-income students from all over Latin America.

The main objective of this study is to analyze the effect of an educational component on willingness-to-pay for Zamorano food products. The term "educational component" is used to indicate the students' direct participation in the production, manufacturing, and processing of food. Specific objectives include: 1) evaluating willingness-to-pay (WTP) for milk products containing the educational component (Zamorano brand), and 2) analyzing sociodemographic characteristics of target markets. To achieve this purpose, in-person surveys were administered at three retail stores in Tegucigalpa, Honduras. White pasteurized milk was used as the reference product since fluid milk presents the highest sale's volume among all dairy products commercialized by Zamorano.

Methodology

Data and Experimental Design

The data were collected using in-person surveys administered in three retail grocery stores located in Tegucigalpa, Honduras. A total of 200 responses were collected in June and July 2014. Subjects were randomly selected among primary shoppers who were present in the market at the time of the study. Since Zamorano students are not allowed to leave the campus on weekdays, participants were regular shoppers (students in the sample are not Zamorano students). Table 1 shows some demographic characteristics of the sample and the Honduran population according to the Honduran National Statistics Institute (INE 2012). The sample is somewhat different from the general Honduran population, since the target population was primary grocery shoppers. The grocery stores where the study was conducted were selected based on the availability of products manufactured by Zamorano University and locations with high diversity of sociodemographic characteristics of grocery shoppers.

Grocery shoppers were approached randomly (every certain number of pass-byers) and asked if they were willing to participate in the study. In total, 10% of consumers refused to participate mainly due to time constraints. No personal identifiers were used, and participation was voluntary. The average time to complete the survey was 12 minutes.

The experiment had two stages. In the first stage, participants were asked to provide general information regarding their demographic and behavioral characteristics (Table 1). In the second stage, a discrete choice experiment (DCE) was conducted to elicit consumer preferences for milk attributes. The DCE consisted of 12 choice sets. In each choice set, subjects were asked to choose between two alternatives and an opt-out no purchase option. A sample choice set is presented in Figure 1. The alternatives in each choice set represent a combination of milk attributes, closely resembling a real-life purchasing condition. Moreover, the opt-out option was included to mimic a more realistic shopping situation.

Product Attributes Description and Hypotheses

The first step in designing the DCE was the selection of the most relevant milk attributes and attribute levels. The attribute levels were then combined to form realistic milk products. The milk attributes selected for the DCE were: 1) educational component, which indicates the student's participation in milk production and processing; 2) packaging, which refers to the type of package in which the product is presented to consumers; 3) natural, which refers to milk that has not been altered with artificial ingredients or additives; 4) fat content, which indicates the fat content of milk after pasteurization and standardization; 5) shelf life, which indicates the optimal period of consumption after processing as indicated by the expiration date; and 6) price, in the local currency (Lempiras) per one-liter of milk. The price ranged from $0.75 to $1.25; although the price may seem low, it is significant for the study population since average monthly income in Honduras is about $210 per household. A detailed description of the milk attributes and corresponding attribute levels is presented in Table 1. The definitions presented in Table 1 were included in the survey to ensure participants were familiar with each attribute definition.

The price coefficient was restricted to be negative indicating that consumers prefer low prices. The coefficients for natural and low-fat content are expected to be positive due to a general perception of the products being healthier with those attributes. It is also hypothesized that the coefficients for bottled milk and longer shelf-life would be positive due to consumer preferences towards more convenient and functional products. A positive effect is also expected for the educational component attribute.

Suppose that options A and B are available for sale in this store today. Which one would you choose?

1	Option A	Option B	Option C
Educational Component	No	Yes	None of the products
Packaging	Plastic bag	Bottle	
Natural	Yes	No	
Fat content	Whole	Skimmed	
Shelf life	10 - 16 days	>16 days	
Price ($)	1.25	0.75	
I would choose (please mark only one option)	☐	☐	☐

Figure 1. A Choice Set Sample

With a total of six product attributes, three with two levels (2^3) and three with three levels (3^3), there are 216 possible product feature combinations. In order to reduce the number of choices respondents have to make, an orthogonal fractional factorial design was generated using the %ChoicEff macro in SAS 9.3 with a modified Fedorov algorithm similar to the Optex procedure (Kuhfeld 2013). The resulting design consisted of 12 choice sets or scenarios with a relative D-efficiency of 87.69%. The order of the choice sets was randomized to account for potential ordering effects. The complete choice experiment is available upon request.

The choice experiment conducted in this study was hypothetical since there were no economic consequences to respondents and the exchange of money for actual products was not feasible (Harrison 2006). This could have induced "hypothetical bias". Hypothetical bias is the difference between hypothetical and non-hypothetical WTP estimates (List and Gallet 2001; Murphy et al. 2005). A number of methods have been suggested to reduce or mitigate the presence of hypothetical bias (Lusk and Schroeder 2004). A commonly used method is employing a cheap talk script, in which participants are informed about the hypothetical bias problem prior to the experiment (Lusk 2003). The implementation of cheap talk was useful in this study since all surveys were administered in-person at retail stores and the experimenter had the opportunity to interact directly with participants. In order to reduce hypothetical bias, the following cheap talk statement was included in the instructions prior to the DCE: "*It is important that you make your selections as if you were actually facing these choices in your retail purchase decisions.*" A hypothetical DCE was used in the study for two main reasons. First, some of the product feature combinations were not currently available in retail markets. Second, due to budget and time constraints, a hypothetical method was the most feasible approach.

Table 1. Milk Attributes and Attribute Levels Evaluated in Choice Experiment

Attributes	Description	Attribute Levels
Educational Component	Students were involved in milk processing as part of their learning process, where the main objective is to obtain technical knowledge. This process was made under the proper professional supervision. The revenue generated by the commercialization of this product will be reinvested in college education of low-income students with strong academic potential.	Yes No
Packaging	Package in which the product is presented to consumers.	Bottle Plastic bag
Natural	Milk is 100% natural if it does not contain artificial flavors, added color, or synthetic substances[a].	Yes No
Fat content	Natural milk fat after pasteurization and standardization.	Whole (2% fat) Low-fat (1% fat) Skimmed milk (<1% fat)
Shelf life	Period that the milk is available for sale after the processing. No health problems caused by the milk consumption are guaranteed during this period.	<10 days 10 - 16 days >16 days
Price	Amount of money a person is willing to pay for a liter of milk.	L. 15 ($0.75)[b] L. 20 ($1.00) L. 25 ($1.25)

Source. [a] FDA, 2015.
[b] Currency used in the CE was lempiras. Prices converted to U.S. dollars are shown in parenthesis.

Econometric Model

The theoretical framework of the choice experiment is given by the Random Utility Theory (RUT) (McFadden 1974) and the Characteristics Valuation Theory (Lancaster 1966). The RUT assumes that the decision maker behaves rationally and has perfect discrimination capabilities. In this context, the analyst has incomplete information and, therefore, uncertainty must be taken into consideration. On the other hand, Lancaster's theory posed that products are not the direct object that provide utility to the decision maker. Instead, it is the characteristics and attributes of the products that give real value to consumers making them ultimately responsible for determining the final purchase decision. In each choice set, respondents had to choose between two milk products and a "none of the products" option included to account for cases in which the

subject was not interested in either product. Let the i^{th} individual's utility of choosing alternative *j* in choice set *t* be given by

$$(1) \qquad U_{ijt} = V(x_{ijt}) + \varepsilon_{ijt}$$

where $V(x_{ij})$ is the systematic part of the utility function determined by the milk attributes, and ε_{ij} is the stochastic unobserved part that captures the uncertainty (McFadden 1974). The stochastic error, ε_{ijt}, is assumed to be independent and identically distributed (i.i.d.) over all individuals, alternatives, and choice sets (Revelt and Train 1998). Assuming a density function f_ε for the error term induces a density function for *U* (Hanemann 1984). Since each individual faces twelve choice sets *t*, each consisting of three alternatives, equation (1) describes a panel data model where the cross-sectional element is individual *i* and the time-series element is the *t* choice sets. A respondent will choose alternative *j*, if that alternative maximizes the utility among all available alternatives in the choice set C_j.

Previous experimental studies have found that individuals often exhibit heterogeneous preferences and that choices made by the same respondent are likely to be correlated (Train 2009). Preference heterogeneity and within-cluster correlations can be addressed by estimating a Random Parameters or Mixed Logit model (RPL). The RPL model accounts for unobserved individual heterogeneity in tastes and preferences by allowing the parameters to vary across respondents, following a specified distribution (Revelt and Train 1998). The functional form of the utility function for alternative *j* can be specified as

$$(2) \qquad U_{ijt} = \alpha' P_{ijt} + \beta_i' x_{ijt} + \delta_{i4t} + \varepsilon_{ijt}$$

where P_{ijt} is the price of alternative *j* for individual *i*, and β_i is an unobserved vector of individual-specific coefficients to be estimated. β_i varies within the population with density $f(\beta|\theta)$, in which θ represents the mean and standard deviation of all the βs determined by the survey sample. Also, x_{ijt} refers to a vector of observed milk attributes of alternative *j* in choice set *t*, and δ represents a no-purchase alternative specific constant. In this model, price constitutes a random parameter restricted to be negative. There are usually convergence issues when trying to restrict the price parameter to be negative; however, the approach proposed by Hensher and Greene (2003) facilitates convergence by specifying the distribution of the negative of price into a lognormal distribution. The intuitive reasoning is that the positive (lognormal) coefficient of a negative variable is indeed negative.

To use Maximum Likelihood Estimation, the probability of each individual's sequence of selections must be specified. Let the subscript *j(i,t)* indicate the alternative chosen by individual *i* in choice set *t*. The unconditional probability of a subject's observed series of choices is the conditional probability integrated over the distribution of β, given by

$$(3) \qquad \mathrm{P}_i(\theta^*) = \int \prod_{t=1}^{T} \left(\frac{\exp(\beta_i' x_{ij(i,t)t}}{\sum_{j=j}^{J} \exp(\beta_i' x_{ijt})} \right) f(\beta_i|\theta^*) d\beta_i$$
$$= \int S_i(\beta_i)\, f(\beta_i|\theta^*) d\beta_i$$

where θ^* are the true parameters of the distribution of β_i. The unconditional probability is then a weighted average of a product of logit models evaluated at different values of β, with the weights given by the density of f. The log-likelihood for the model can be written as

$$(4) \quad \mathrm{LL}(\theta^*) = \sum_{i=1}^{N} ln\mathrm{P}_i(\theta^*)$$

Since equation 4 cannot be solved analytically, it must be approximated numerically using simulated Maximum Likelihood methods. The simulated log-likelihood is then given by

$$(5) \quad \mathrm{SLL}(\theta^*) = \sum_{i=1}^{N} \ln\left\{\frac{1}{D}\sum_{d=1}^{D} S_i(\beta^d)\right\}$$

where d refers to the number of replications used in the simulation and β^d is the d^{th} draw from $f(\beta_i|\theta^*)$. In this application, the Random Parameters model was estimated using 500 Halton draws (Greene 2012).

Willingness-to-Pay Estimates

The marginal rate of substitution between price and other attributes was calculated in order to estimate willingness-to-pay for each attribute. That is, how much would the price have to change for respondents to be indifferent between qualitative variables (Lusk, Roosen, and Fox 2003), which is denoted as $WTP = -2\left(\frac{\beta_k}{\beta_p}\right)$. β_k is the coefficient for each attribute k determined in the regression model and β_p is the coefficient on price or the marginal utility of money. The ratio is multiplied by 2 because of the use of effects coding. Effects coding consists of using a -1 for the base category to avoid confounding effects with the opt-out no-product alternative. Since price and all the other milk attributes are not a single coefficient estimate, but each one represents a distribution of coefficients, the range of willingness-to-pay values was calculated using the delta method for a 95% upper and lower bound intervals. The Delta method uses a Taylor's approximation series to calculate the variance and standard errors of the ratio of parameter estimates. In this method, β represents a probability distribution in which the parameters are estimated with some uncertainty level. Please refer to Bliemer and Rose (2013) for a complete mathematical derivation of the ratios using the Delta method.

Results and Discussion

In analyzing the demographics of the survey sample (Table 2), over 65% of participants were females, and around 78% were aged 24-years or older. The sample was composed mostly of individuals with at least some college education (84%). Additionally, about 74% of participants reported a monthly household income of more than $750.

The random parameter logit estimates are presented in Table 3. The data consists of 12 choice sets × 3 alternatives × 200 participants for a total of 7,200 observations. The opt-out no-product constant is negative and significant, indicating respondents were more inclined to choose one of the milk products over the option of not making a purchase.

Table 2. Demographic Characteristics of Experiment Participants (n=200)

Variable	Category	Sample		Honduran[a] Population	
		Mean	**Percent**	**Mean**	**Percent**
Age (years)	Under 18		0.0		43.7
	18 - 24		22.0		12.1
	Above 24		78.0		44.2
Education	Elementary Diploma or Less		2.5		71.6
	High School Diploma		14.0		23.2
	Bachelor's Degree or some College		83.5		5.2
Gender	Female		64.5		51.2
	Male		35.5		48.8
Monthly Household Income ($)		$825.70		$210[b]	
	250 or less		6.0		
	250 - 750		20.0		
	More than 750		74.0		

Source. [a] Honduran National Statistics Institute (INE), 2012.
[b] Monthly household income at Distrito Central has been converted to U.S. dollars.

The educational component shows a positive and statistically significant effect. Recall that the educational component was defined as students participating directly in the milk production and manufacturing process under professional supervision, and that the income generated from the product sales would be reinvested in the education of low-income students. The positive effect of the educational component indicates that consumers are willing to support education by purchasing products manufactured by students and intended to enhance learning opportunities. Moreover, milk packaged in a bottle was preferred over milk packaged in a plastic bag. This effect can be explained by consumer concern for more convenient and ergonomic food packaging (Schifferstein 2010).

Additionally, results show a preference for natural, low fat, and skimmed milk. These results can be explained by increased consumer interest in healthy food products and quality. Regarding product durability, respondents show a preference for milk with a medium shelf-life (10–16 days) compared to a low shelf-life (less than 10 days). However, the higher shelf-life (more than 16 days) coefficient was not statistically significant. It is important to note that over one–fifth of the participants reported food poisoning from consuming fluid milk at least once in their lives. Thus, a possible explanation is that subjects perceive milk as a fresh but highly perishable product. Therefore, they exercise caution and a lack of trust when it comes to extended shelf-lives beyond 16 days. Furthermore, results indicate that most of the standard deviations of the random parameters were statistically significant, meaning that there exists heterogeneity in consumers' tastes and preferences for each product attribute.

Table 3. Random Parameters Logit Estimation Results

Variable	Parameter		Standard Error
	Means of Random Parameters		
No product [a]	-0.7191	***	0.2031
Education			
Educational component	0.8493	***	0.0879
Packaging			
Bottle	0.9535	***	0.1009
Natural	1.5423	***	0.1196
Fat content			
Whole	-0.8748	***	0.1525
Low-fat	0.3875	***	0.0971
Shelf life			
High	0.1071		0.0757
Medium	0.4185	***	0.0789
Price	-2.2180	***	0.1152
Education	**Standard Deviations of Random Parameters**		
Educational component	0.9467	***	0.0998
Packaging			
Bottle	1.2179	***	0.1015
Natural	1.2841	***	0.1100
Fat content			
Whole	2.0933	***	0.1770
Low-fat	0.917	***	0.1332
Shelf life			
High	0.0997		0.1601
Medium	0.1847		0.1425
Price	0.7027	***	0.0668
NOBS	7200		
Log-Likelihood	-1881.643		

Note. [a] The No product coefficient refers to Option C, "None of the products", in the CE.
Single (*), double (**), and triple (***) asterisks are used to denote significance at the 0.10, 0.05, and 0.01, respectively.

Willingness-to-Pay Estimates

The coefficients of the milk attributes of the choice model were used to estimate mean willingness-to-pay values (MWTP). Table 4 shows the MWTP values for each milk attribute. For reference, the average milk market price at the time of the experiment was $1.0 per liter.

On average, consumers are willing to pay a price premium of $0.04 for milk products containing the educational component. The range of the distribution of WTP for the educational component was between $0.03 and $0.05, which indicates that consumers are willing to support education by consuming products where students are part of the production and manufacturing process. Also, respondents expressed price premiums of $0.07 and $0.02 for the natural and low-fat milk products, respectively.

There were price premiums of $0.04 and $0.02 associated with bottled and medium shelf-life milk products, respectively. As discussed before, this aversion may be due to a perception of lack of freshness and general distrust of milk with expiration dates beyond 16 days and possibly an association with potential food poisoning. At this point it is important to note that those price premiums, although relatively low, are quite significant considering the generally low average monthly income of participants.

Table 4. Willingness-to-Pay Estimates for Milk Product Attributes in Honduras

Variable	Mean WTP ($)	Range WTP ($)
Educational Component	0.04	[0.03 , 0.05]
Bottle	0.04	[0.03 , 0.05]
Natural	0.07	[0.06 , 0.08]
Whole	–0.04	[–0.05 , –0.02]
Low-Fat	0.02	[0.01 , 0.03]
High Shelf Life	0.01	[0.00 , 0.01]
Medium Shelf Life	0.02	[0.01 , 0.02]

Summary and Conclusions

A discrete choice experiment was conducted to evaluate consumer preferences and willingness-to-pay for milk products with varying quality attributes. The main attribute evaluated was an "educational component" of milk products processed by Zamorano University students. The term educational component was used to indicate students' participation in milk production and processing under the supervision of faculty and staff. The revenue generated by the commercialization of such products is reinvested into the education of low-income students with strong academic and professional potential. In doing so, 200 in-person surveys were administered in three retail stores located in Tegucigalpa, Honduras. Results from the study show that consumers are willing to pay a price premium of $0.04 for milk products with the educational label. This result carries some potential implications for agribusinesses seeking to differentiate their products by supporting educational efforts not only at the elementary level but also at advanced levels.

Participants had price premiums of $0.07 and $0.02 for natural and low fat milk respectively. They also preferred bottled milk products with a medium shelf life. Although the willingness-to-pay estimates may seem low when converted to U.S. dollars, the percentage increase in willingness-to-pay is within the range of similar studies, and perhaps constitutes a reflection of the particular market environment in the study.

In conclusion, the results show that there exists a potential to provide products that go beyond satisfying basic nutritional needs by adding social value and that consumers are willing to pay price premiums for such products. However, it is important to note that other physical and credence attributes also played an important role in the perception and acceptance of such products.

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