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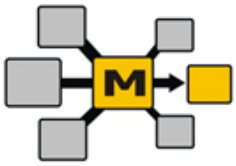

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EDITOR'S NOTE

We are very excited to release our final quarterly issue for 2011, which is the *Symposium Special Edition.*

In this edition we will highlight a few of the great papers that emerged from IFAMA's Best Paper Competition held during the 21st Annual World Forum and Symposium in Frankfurt, Germany. The competition yielded a fantastic paper by folks from Purdue University, USA, who took first place for their research looking at sustainability strategies.

This issue of the journal is remarkable for several reasons. Please notice the strong international mix of our contributing authors who represent many different universities on several different continents. We have also set a record of publishing 13 articles in one issue (while simultaneously increasing our selectivity!). Kudos to our Administrative Editor, Kathryn White, our reviewers, and our Managing Editors as this is our 12th straight on-time issue. The sole goal of the team at the IFAMR is to provide authors around the world with a high quality international publication outlet. We do this by increasing our selectivity, achieving high impact through the major cataloging services, realizing over 7,000 articles downloads every month, and having a world-wide readership of 8,500 academics, policymakers, and managers.

In 2012, the conference will be in Shanghai, China. Authors who have been selected to present a paper during the Shanghai Symposium, may also choose to enter the Best Paper Competition. Full manuscripts (only) that are submitted to the Best Paper Competition receive a full double-blind review by the IFAMR. The top 10 entries are invited to compete in a final judging which occurs during the conference. These manuscripts also have an opportunity to publish in our *Symposium Special Edition* on November 1, 2012.

Finally, we are always looking to help thought leaders publish special issues on important topics. In publication now is a special issue on *"The Scientific Pluralism of Agribusiness."* Additionally, we have two new special issues underway with open calls to authors. Visit our website to get the complete details on *"Managing Wicked Problems: The Role of Multi-Stakeholder Engagement, Resources and Value Creation"* due January 5, 2012 and *"Essays on Human Capital Development,"* due January 15, 2012. If your affiliate associations host a conference and would like to work with the IFAMR to produce a special issue, maybe we can help. Give us a shout.

***Peter Goldsmith*, Executive Editor, IFAMR**

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Sustainability Strategies in U.S. Agribusiness: Understanding Key Drivers, Objectives, and Actions

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Abstract

This study explores the domain of sustainability from the agribusiness perspective by establishing levels or stages of sustainability in terms of views, actions and performance measures. In addition, it analyzes factors including firm characteristics and internal and external stakeholders that influence a company's sustainability initiatives. In a sample of U.S. agribusiness managers, results indicate that strong management pressures have a positive and highly significant relationship with the level of a firm's sustainability initiatives. Other pressures including competition, government regulations, and the media have little or no effect. The size of the company also has minimal influence on a company's level of sustainability, whereas a company's primary function plays a more significant role.

Keywords: sustainability, triple bottom line, strategy, stakeholders, supply chain

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Background

In 1987 the World Commission on Environment and Development (WCED) officially defined sustainable development as the ability to meet present needs without compromising the needs of future generations. The WCED recognized that there were three interlaced principles at the core of sustainability: environmental integrity, social justice, and economic prosperity. In addition, it acknowledged that both industry and government had significant roles to play in sustainable development that included achieving food security, protecting species and natural resources, and attaining connectedness among societies (Brundtland 1987). However, the WCED provided little guidance beyond this definition for identifying future and present needs, determining appropriate technologies and resources to use, and understanding how to balance various responsibilities and demands (Carter and Rogers 2008). Today's definition of sustainability continues to remain vague as it encompasses a variety of issues over time and space and accommodates the values and goals of a diverse group of organizations and individuals (Gasparatos, El-Haram, and Horner 2007; Goldin and Winters 1995; Peterson 2009; Rigby and Caceres 2001).

Sustainability is often referred to as the 'triple bottom line' because it involves the integration of environmental and social responsibilities with economic goals to create value for the company as well as for society (Elkington 2004). The topic of sustainability has become increasingly important in the agricultural sector due to the sector's large environmental and social impacts: agriculture is the main user of land, water, and resources in many countries, and its products reach consumers around the world (Aigner, Hopkins, and Johansson 2003). The agribusiness sector, comprised of companies involved in the food production supply chain, faces a unique set of challenges and opportunities associated with sustainability that revolve around ensuring a secure food supply, addressing the environmental impacts of agriculture, practicing fair labor standards, and providing safe and healthy products (IMAP 2010; Murray 2010).

Incentives as well as pressures and challenges for agribusiness companies pursuing sustainable practices are present in both the marketplace where consumers demand agricultural goods and in the supply chain where organizations demand efficiency and communication. On the consumption side of the sustainable food system, consumers demand quality, nutrition, and environmental and social considerations (IMAP 2010). In addition, communities on a global scale demand technology, innovation, and efficiency to meet the needs of a growing population (Jansen and Vellema 2004). On the production side, upstream members of the supply chain such as input suppliers and producers bear the costs of innovation and environmental damage while downstream supply chain members such as processors and retailers often receive the economic benefits and value added from sustainability (Clift 2003; Heller and Keoleian 2003; Vorley 2001).

Studies on the sustainability of agricultural systems have explored the farmer perspective of sustainable agricultural practices (Giovannucci 2001; Jordan 2005), consumer perceptions of the food market (Kriflik and Yeatman 2005), drivers of sustainability strategies in food companies (Grolleau et al. 2007; Marcus and Anderson 2006), and the necessary components of a sustainable supply chain (Fritz and Schiefer 2008; Heller and Keoleian 2003). However, no studies have specifically categorized the sustainability programs of agribusiness firms based on their levels or stages within the domain of sustainability efforts. This study aims to fill this gap in order to enable the agribusiness sector to gauge its progress with respect to sustainability.

Corporate Sustainability Strategies

The topic of sustainability is relatively new and difficult to document, so studies analyzing how companies incorporate sustainability into their business strategies have only emerged in the last few decades. In the 1960s and 1970s environmental awareness and social responsibility were still periphery issues on corporate agendas (Walton, Handfield, and Melnyk 1998), and it was not until the late 1980s and early 1990s that "sustainable businesses" emerged recognizing society and the environment as legitimate stakeholders (Carroll 1991; Kirchoff 2000). In addition, only since the late 1990s have companies considered sustainability as an integral part of corporate strategy and a basis for technological development (Hart 1996).

The existing literature on sustainability strategies can be separated into two categories: the measurement-based literature and the theoretical literature. In the measurement-based literature, researchers have focused on quantifying sustainability and analyzing the resource-based and institutional factors influencing company strategies. Studies such as Grolleau, Mzoughi, and Thomas (2007) and Henriques and Sadorsky (1996) focused on quantifying specific observable activities associated with sustainability while Bansal (2005), Arragon-Correa (1998), and Buysse and Verbeke (2003) among others attempted to measure sustainability by establishing a set of indicators and frameworks.

Studies in the measurement-based literature have found that many factors influence the sustainability strategies of companies including customers (Giovannucci 2001; Grolleau et al. 2007; Henriques and Sadorsky 1996), government (Grolleau et al. 2007; Henriques and Sadorsky 1996; Porter and van der Linde 1995), the media and competitors (Bansal 2005), shareholders and the community (Henriques and Sadorsky 1996), management (Grolleau et al. 2007), size of the company (Ambec and Lanoie 2008; Arragon-Correa 1998), and position in the supply chain (Vorley 2001). A number of quantitative techniques have been employed to determine these relationships including logit regression (Buysse and Verbeke 2003; Grolleau et al. 2007; Henriques and Sadorsky 1996; Marcus and Anderson 2006), factor analysis (Arragon-Correa 1998; Buysse and Verbeke 2003; Judge and Douglas 1998; Marcus and Anderson 2006), and cluster analysis (Arragon-Correa 1998; Arragon-Correa et al. 2008; Buysse and Verbeke 2003).

The second body of literature on sustainability strategies is the theoretical literature which attempts to characterize sustainability strategies as a series of levels or stages rather than as a set of quantifiable measurements. Levels are distinguished based on factors such as the degree of balance achieved among the three aspects of sustainability (Elkington 2004; van Marrewijck and Werre 2003), the complexity of sustainability definitions (Mirvis and Googins 2006), and the sophistication of sustainability actions taken (Markevich 2009; Willard 2002). There are five main levels of sustainability that are repeated throughout the theoretical literature: *Sustainability for Regulatory Compliance, Profit-Driven Sustainability, Innovative Sustainability, Organizational Sustainability,* and *Societal Sustainability.*

Level 1: Regulatory Compliance. The first stage of corporate sustainable development is generally characterized as 'Compliance-Driven' (van Marrewijk and Werre 2003) sustainability because such companies only pursue environmental and social actions that conform to established laws and industry standards (Markevich 2009).

Level 2: Profit-Driven. In the second stage of sustainability, companies are considered 'Profit-Driven' (van Marrewijk and Werre 2003) because they predominantly focus on economic goals and only address social and environmental aspects when actions are profitable, improve reputation and brand image, or preserve the company's license to operate (Elkington 2004; Mirvis and Googins 2006; van Marrewijk and Werre 2003). Changes at this stage typically target low-hanging fruit such as sustainability 'add-ons' to normal business operations that achieve cost reductions and increase efficiency without requiring long-term investments (Markvich 2009; Porter and van der Linde 1995).

Level 3: Innovative. In the third stage of sustainability are 'Innovative' (Mirvis and Googins 2006) companies that recognize environmental, social, and economic concerns as equally important. Companies in this stage broaden and deepen their sustainability involvement through increased efficiency and innovation, formalization of sustainability criteria and metrics, and increased communication with stakeholders (Mirvis and Googins 2006). Markevich (2009) indicated that company objectives at this stage focus on aligning the values of the company with the personal values of all its employees to develop a more flexible and productive organization.

Level 4: Organizational. The fourth stage, termed 'Whole System' (Markevich 2009) sustainability, is comprised of companies that integrate sustainability throughout the business, optimize organizational designs and business models, and view sustainability as necessary for long-term survival. Sustainability efforts extend beyond the immediate impacts of the company to coordinate efforts within the supply chain and across networks (Carter and Rogers 2008; Elkington 2004; Mirvis and Googins 2006).

Level 5: Societal. In the final and most advanced stage of sustainability, 'Transformative' (Mirvis and Googins 2006) companies address sustainability as part of their core business. They are motivated by a sense of corporate purpose to serve society, and they are able to re-define and change the nature of business and the competitive landscape by merging sustainability with the business agenda (Markevich 2009). Companies at this level model sustainability on long-term global issues that reach beyond the company and its consumers such as creating new markets and developing local economies, partnering with social and environmental organizations, and becoming spokesmen for industry (Mirvis and Googins 2006; Willard 2002).

The five levels of sustainability presented in the theoretical literature provide a framework for evaluating where a company's views, actions, and performance measures are on the sustainability spectrum. Conversely, the measurement-based literature utilizes quantitative methods for establishing relationships between strategy, company characteristics, and influences. A combination of the qualitative and quantitative methods used in the literature is necessary to fully analyze the sustainability strategies in agribusiness.

Methodology

This study combines the analytical methods employed in the measurement-based literature with the sustainability framework described in the theoretical literature to better understand the domain of sustainability from the agribusiness perspective and to examine the factors influencing company strategies. The focus of the study is to establish levels of sustainability in agribusiness

companies in terms of sustainability views, actions, and performance measures as suggested by Epstein and Roy (2001). By defining a company's sustainability strategy in terms of these three dimensions, companies can be categorized into levels of sustainability based on how they view sustainability and on the scope and maturity of their initiatives.

Data Collection

Limited secondary data exists to satisfy this objective, thus, primary data collection was necessary. The survey for this study was designed in a similar fashion to other academic surveys conducted in the green business and sustainability literatures (Arragon-Correa, 1998; Bansal, 2005; Marcus & Anderson, 2006). Questions were formulated based on a review of the existing literature on the sustainability strategies of companies to align the survey with theory.

The survey listed a series of statements with Likert scale responses concerning the sustainability views, actions, and performance measures of companies. There were 16 statements on sustainability views with response choices *of Strongly Agree, Somewhat Agree, Somewhat Disagree, Strongly Disagree*, and *Do Not Know* for each view. There were 12 statements on sustainability actions and eight statements on performance *measures with responses of Using, Developing, Considering, Not Applicable,* and *Do Not Know* for each action and measure. Responses to these questions on sustainability views, actions, and performance measures were used to determine how many levels of sustainability were present in the sample and how respondents were grouped according to these levels. Additionally, it was possible to identify any relationship between the level of a company's sustainability views and its actions and performance measures.

The survey also collected responses on the presence of internal influences (including shareholders/owners, management, and employees), external influences (including customers, suppliers, competitors, government, community, and the media), and certain company characteristics (including revenue level, position in the supply chain, and primary function). This data was used to determine whether these factors impact a company's level of sustainability.

The survey instrument was pretested with graduate students and agribusiness professionals in January 2010. The final survey was then administered in person to agribusiness professionals in February and March 2010. Both an oral and written overview of the survey and its purpose were given to participants, and responses were guaranteed to be voluntary and anonymous. To encourage participation and provide some benefit to respondents, a summary of responses was delivered at the conclusion of the survey.

Sample Selection

Participants at three management seminars held at Purdue University in West Lafayette, IN and administered by the Center for Food and Agricultural Business were given the opportunity to participate in the sustainability survey. The three groups were the Agricultural Retailers Association Management Academy (ARA), American Seed Trade Association Management Academy (ASTA), and the Midwest Food and Agribusiness Executive Seminar (MFAES). These groups were chosen as the sample population because participants in the seminars were agribusiness professionals training for leadership roles within their respective companies. According to Ar-

ragon-Correa (1998), individuals in high level or executive positions tend to be the ones most familiar with company strategy and practices. In addition, making direct contact with respondents allowed for discussions which provided context for the results. Although the chosen seminars were a sample of convenience rather than a random sample, companies and individuals present were random in the sense that attendance was voluntary and open to agribusiness professionals in leadership roles.

A total of 165 agribusiness professionals representing U.S. firms participated in one of the three seminars included in the study. The number of participants to complete the survey totaled 114 for a response rate of 69.1%. Response rates were similar for all three programs. Surveyed agribusiness professionals represented companies that were diverse in terms of size, function, and legal organization. The annual revenue of companies ranged from less than $100 million to more than $10 billion. All levels of the supply chain were represented including input supply, production, grain handling, food processing, retail, and other services, although input and production companies had the largest representation. Over half of the respondents were employed by privately held companies while one third by publicly traded companies and the rest by cooperatives. Respondents were primarily in positions of executive management, other levels of management, or sales, marketing, and communications.

Empirical Analysis

Similar to previous studies on the environmental strategies of companies, analysis of the survey data involved a combination of principal component analysis, cluster analysis, and logit regression analysis (Arragon-Correa 1998; Arragon-Correa et al. 2008; Buysse and Verbeke 2003; Judge and Douglas 1998; Marcus and Anderson 2006). The sets of questions on sustainability views and actions from the survey were first subject to principal component analysis by creating standardized scores for the Likert scale responses to each question. This was done to group highly correlated variables into factors for data reduction purposes and to systematically determine the number of sustainability levels present in the data. Next, cluster analysis on the established factors grouped respondents according to their scores for each sustainability level. A two step process of Ward's hierarchical clustering algorithm and the K-means iterative partitioning process was used (Punj and Stewart 1983). Finally, logit regression analysis identified significant relationships between a company's sustainability cluster and characteristics including internal and external influences, firm size, position in the supply chain, and primary function. Other control variables included whether a company was public, private, or a cooperative, the respondent's position in the company, and which leadership program the respondent attended.

Unlike the analysis for sustainability views and actions, analysis of sustainability performance measures was performed using cross tabulations. Responses of "do not know" were common for this set of questions, and they were recorded as missing values rather than as scores on the Likert scale because they did not follow the logical sequence of the responses. Only 76 observations were available after adjusting for "do not know" responses, which were not enough observations for principal component analysis or cluster analysis (Hatcher 1994; Nargundkar and Olzer 1998) Instead, chi-square test statistics were calculated to determine the probability of association between how a respondent answered each question on performance measures and the company characteristics described previously.

Sustainability Views

Table 1 defines the 16 sustainability views included in the study and shows the factor loadings from the principal component analysis for each view using varimax rotation. Principal component analysis for the set of statements on sustainability views resulted in three significant factors (with eigenvalues greater than one) that explained 57.2% of the total variance. Fifteen of the variables had high loadings (greater than or equal to 0.50, shown in bold) for at least one factor.

Table 1. Factor Loadings of Sustainability Views

View of Sustainability	**Factor 1: Organizational and Societal** (Levels 4 and 5)	**Factor 2: Profit-Driven and Innovative** (Levels 2 and 3)	**Factor 3: Compliant** (Level 1)
Complying with laws and standard	-.04	.15	**.83**
Responding to external pressures	.40	.35	.41
A way to strengthen image	.30	**.55**	.34
A strategy for cost savings	-.08	**.69**	.21
A function of management beliefs	.37	**.62**	.04
A source of competitive advantage	.20	**.67**	.35
A way to impact employee satisfaction	.35	**.57**	.41
An opportunity for new revenue	.12	**.71**	.01
A function of aligning values	.32	**.62**	.08
Dedication to long-run development	**.52**	**.52**	-.23
A method of risk management	**.50**	.38	-.03
A value integrated into the business	**.65**	.42	.01
Collaboration with other groups	**.74**	.19	-.08
Addressing hunger and societal welfare	**.68**	.03	.42
Reducing impact on the environment to preserve it for the future	**.81**	-.01	.16
An integral part of the core business	**.74**	.35	.18
Eigenvalue	6.380	1.620	1.150
Alpha	.836	.834	

Total N = 109 observations

The first factor was comprised of variables associated with Levels 4 and 5 in the literature, namely views related to Organizational and Societal Sustainability. The second factor was comprised of Level 2 and 3 statements related to Profit-Driven and Innovative Sustainability. The third factor included the statement on regulatory compliance which was associated with Level 1, but this factor was dropped from the analysis because it was only explained by one variable (Hatcher 1994). The individual statement about responding to external pressures was not included in the subsequent cluster analysis because it did not have any high factor loadings, and the statement on long-run business development was also removed because it had high loadings for more than one factor. The Cronbach's alpha coefficients for internal consistency and reliability were high for both factors (0.836 and 0.834 respectively). The alpha coefficient can take on values from 0 to 1 with a threshold of 0.70 as an acceptable value (Hatcher 1994), indicating that variables with high factor loadings in this analysis were highly correlated within factors.

Cluster analysis on the two retained factors from the principal component analysis established two clusters of companies for sustainability views based on three goodness-of-fit measures: the Pseudo F, Cubic Clustering Criterion, and R-square values (Nargundkar and Olzer 1998; Punj and Stewart, 1983). The clusters are summarized in Table 2. Cluster 1, labeled "Broad Sustainability," was comprised of companies with high mean values of 3.28 and 3.21 for Factors 1 and 2, respectively. On the Likert scale, a score of 3 corresponded to "somewhat agree" while a 4 corresponded to "strongly agree." Therefore, companies in this cluster agreed with the majority of both types of sustainability views: organizational/societal as well as profit-driven/innovative. Cluster 2, labeled "Narrow Sustainability," was made up of companies with lower mean values of 2.5 and 2.42 for Factors 1 and 2, respectively. On the Likert scale, a score of 2 corresponded to "somewhat disagree" while a score of 3 corresponded to "somewhat agree." Consequently, this cluster was fairly neutral with respect to both types of sustainability views. If respondents agreed with some sustainability views, they disagreed with others so that their overall positions in terms of organizational/societal sustainability and profit-driven/innovative sustainability were neutral. Over half of the respondents were in the "Broad Sustainability" cluster while the remainder was in the "Narrow Sustainability" cluster.

Table 2. Cluster Means for Views of Sustainability

Cluster	**Factor 1:** Organizational and Societal Sustainability	**Factor 2:** Profit-Driven and Innovative Sustainability
1. Broad Sustainability (n=64)	3.28	3.31
2. Narrow Sustainability (n=45)	2.50	2.42

A logit regression model was used to test the significance of a number of characteristics hypothesized to explain the probability of a company being associated with either the Broad or Narrow Sustainability cluster. Table 3 shows a summary of the regression results. Reported marginal effects are interpreted as the discrete change in the expected value of the dependent variable as the explanatory variable changes from zero to one or from Narrow to Broad Sustainability (Greene 2000).

Results showed that significant explanatory characteristics for the clusters on sustainability views were management pressures, input and production positions in the supply chain, retail and wholesale as the primary firm functions, revenue between $1 and $10 billion, and being a member of the ARA sample group. Management pressure had the highest magnitude effect. The presence of strong or very strong management pressure was associated with a positive and highly significant coefficient indicating that companies with pressure from management were 70.9% more likely to be in the Broad Sustainability cluster, or at a higher level of sustainability, than companies without similar pressures. Companies in the input and production sectors of the supply chain were also 47.8% and 27.3% more likely to be in the Broad Sustainability cluster, respectively, than companies that were not in the same supply chain position. In terms of primary company functions, companies that focused on retail or wholesale were less likely to be in the Broad Sustainability cluster. To clarify, retailers and wholesalers can be at any position in the supply chain including inputs, production, food processing, and food retail.

Table 3. Logit Regression Results on Clusters of Sustainability Views

	Variable	Marginal Effect	
Internal Pressures	Shareholders/Owners	0.011 (0.187)	
	Management	0.709 (0.097)	***
	Employees	0.194 (0.159)	
External Pressures	Customers	0.107 (0.165)	
	Suppliers	0.211 (0.169)	
	Competitors	0.105 (0.155)	
	Government Regulators	-0.215 (0.173)	
	Community	0.105 (0.155)	
	Media	0.187 (0.166)	
Position in the Supply Chain	Inputs	0.478 (0.197)	**
	Production	0.273 (0.155)	*
Primary Function	Production	-0.210 (0.189)	
	Retail	-0.518 (0.155)	***
	Wholesale	-0.363 (0.162)	**
Type of Company	Publicly Traded	0.265 (0.231)	
	Cooperative Retailer	-0.065 (0.290)	
Annual Revenue	$100-499 million	-0.021 (0.205)	
	$500-999 million	0.083 (0.309)	
	$1-10 billion	0.336 (0.180)	*
	Over $10 billion	0.282 (0.232)	
Group	ARA	0.348 (0.173)	**
	ASTA	0.106 (0.226)	
Job Title	Executive Management	-0.038 (0.265)	
	Management	0.043 (0.284)	
	Sales, Marketing, or Communications	0.101 (0.260)	
Log Likelihood		-41.718	***

Total N = 109 observations.
Notes: *p < 0.10 **p<0.05 ***p<0.01 (Wald test using Chi-square distribution).
Marginal effects are computed at the sample means. Standard deviations are in parentheses.

Being a member of the ARA sample was associated with a positive significant coefficient, implying that respondents in this group were more likely to be in the Broad Sustainability cluster than respondents of the MFAES group which served as the base group. The ARA sample was primarily comprised of input and production companies whose main functions were retail and wholesale. While this appears to be counterintuitive to the previous results, the ARA variable may be significant because the MFAES group was exposed to more information before filling out the survey. The MFAES group read a case study on sustainability and strategy prior to attending the program, so these respondents may have had a more uniform understanding of sustainability and of the questions asked in the survey.

Sustainability Actions

Table 4 defines the 12 sustainability actions included in the study and shows the factor loadings from the principal component analysis for each statement using varimax rotation. Principal component analysis for the statements on sustainability actions resulted in two factors that explained 59.9% of the total variance, and all twelve of the variables had high loadings for at least one factor. The first factor included statements expected to be associated with Levels 2, 3, and 4 in the literature and was labeled as "Internal Sustainability" because actions in this factor had a

direct impact on internal operations. The second factor primarily included Level 5 statements and was labeled as "Outward Sustainability" because actions involved extending sustainability beyond the company in ways that impacted more than internal operations. The individual statement on revising the business model was dropped from the analysis because it had a high loading for both factors. Alpha coefficients were high for both factors (0.854 and 0.864 respectively) indicating that variables with high factor loadings were highly correlated within factors.

Table 4. Factor Loadings of Sustainability Actions

Sustainability Action	**Factor 1: Internal Sustainability** (Levels 2, 3, and 4)	**Factor 2: Outward Sustainability** (Level 5)
Sustainable product features	**.61**	.18
Sustainable processes	**.82**	.01
Marketing/public relations campaigns	**.55**	.38
A task force or employee position	**.53**	.49
Environmental management system	**.74**	.34
Substantially re-developed products and processes	**.65**	.39
Sustainable supply chain management	**.60**	.48
Revised business model	**.52**	**.54**
Formal business partnerships	.36	**.78**
Multi-organizational alliances	.40	**.66**
Initiatives that address human welfare	.28	**.80**
New markets created for poor and under-served communities	.05	**.83**
Eigenvalue	6.075	1.117
Alpha	.854	.864

Total N = 92 observations

Cluster analysis on the two factors for sustainability actions established three clusters of companies: "Active," "Planning," and "Inactive." Table 5 presents a summary of the three clusters. The Active Sustainability cluster was comprised of companies with high mean values of 3.47 and 3.51 for Factors 1 and 2, respectively. Participants in this group represented companies that were, on average, using or developing sustainability actions that represented both Internal and Outward sustainability. The Planning cluster was made up of companies with mean scores of 2.72 and 2.33 for Factors 1 and 2 respectively, implying that companies in this group were in the process of becoming sustainable. The score for Internal Sustainability actions was higher indicating that companies considering or developing sustainability strategies typically began with lower level actions before developing broader programs. Finally, the Inactive cluster included companies with low means indicating that they were not considering or using most of the sustainability actions represented in the survey.

Table 5. Cluster Means for Sustainability Actions

Cluster	Factor 1: Internal Sustainability	Factor 2: Outward Sustainability
1. Active Sustainability (n=26)	3.47	3.51
2. Planning (n=37)	2.72	2.33
3. Inactive (n=29)	1.89	1.22

The three clusters were fairly evenly populated, with the largest number of companies in the Planning cluster and the fewest number in the Active cluster. This is consistent with the literature which suggests that while many companies claim to be sustainable, they have not yet formulated initiatives to turn views into actions (Berns et al. 2009; Markevich 2009).

A multinomial logit model was used to test the significance of a number of variables in explaining a company's association with the Active, Planning, and Inactive clusters for sustainability actions. Table 6 presents a summary of the regression results where the marginal effects are interpreted by analyzing each cluster or dependent variable separately.

The only significant explanatory variables for describing the Inactive cluster were strong influence from shareholders or owners and the job title of Sales, Marketing, or Communications. Companies with strong or very strong influences from owners were 25.7% more likely to be a member of the lowest cluster for sustainability actions. This may be because owners usually want to see payoffs in the short run while many sustainability strategies aim to create value in the long run (Esty and Winston 2009). Respondents with a job title of Sales, Marketing, or Communications were 46.4% less likely to represent a company associated with the Inactive cluster. It is top management that typically provides the momentum for, and has the most knowledge of, the sustainability strategies of the company (Grolleau et al. 2007). As such, people in positions such as Sales, Marketing, or Communications may have personal perceptions of sustainability that are different from the senior management, and thus, the company's, perceptions of sustainability.

The significant explanatory variables for describing the Planning cluster were customer, supplier, and media influences, retail as a primary function, and ARA group membership. Companies fell into this middle cluster because they responded to the questions on sustainability actions in one of two ways: either they were developing or considering most of the actions, or they were using some of the actions but not others. Companies with strong sustainability influences from customers and the media were more likely to be in the Planning cluster, indicating that these stakeholders may be enticing companies to develop actions. Companies with strong supplier influences were less likely to be in the Planning cluster suggesting that suppliers, more so than other stakeholders, may demand practices that address a broader range of topics. Additionally, companies with retail as the primary function were more likely to be associated with the Planning cluster, and companies in the ARA group were less likely to be in this cluster.

The significant explanatory variables for the Active cluster were management pressures, retail as a primary function, and Sales, Marketing, or Communications as a job title. Companies with strong management pressures were 17.7% more likely to be in the Active cluster. Although

Table 6. Multinomial Logit Regression Results on Clusters of Sustainability Actions

Variable		Marginal Effects					
		Inactive		*Planning*		*Active*	
Internal Pressures	Owners	0.257 (0.149)	*	-0.052 (0.215)		-0.205 (0.198)	
	Mgmt.	-0.261 (0.232)		0.084 (0.231)		0.177 (0.107)	*
	Employees	0.151 (0.168)		-0.087 (0.181)		-0.064 (0.149)	
External Pressures	Customers	-0.118 (0.155)		0.300 (0.162)	*	-0.181 (0.163)	
	Suppliers	0.260 (0.229)		-0.400 (0.181)	**	0.139 (0.230)	
	Competitors	-0.094 (0.153)		0.081 (0.192)		0.014 (0.168)	
	Government	-0.233 (0.179)		0.180 (0.178)		0.054 (0.143)	
	Community	-0.095 (0.167)		-0.166 (0.199)		0.261 (0.218)	
	Media	-0.160 (0.169)		0.353 (0.182)	*	-0.194 (0.122)	
Supply Chain Position	Inputs	0.075 (0.198)		-0.199 (0.208)		0.124 (0.128)	
	Production	-0.102 (0.181)		0.097 (0.201)		0.005 (0.184)	
Primary	Production	0.052 (0.184)		0.048 (0.203)		-0.100 (0.140)	
	Wholesale	-0.056 (0.163)		-0.021 (0.191)		0.077 (0.184)	
Type of Company	Public	-0.210 (0.216)		-0.196 (0.307)		0.406 (0.362)	
	Cooperative	-0.080 (0.243)		0.243 (0.258)		-0.163 (0.112)	
Annual Revenue	$100-499m	-0.158 (0.172)		-0.217 (0.241)		0.375 (0.311)	
	$500-999m	-0.112 (0.232)		0.097 (0.305)		0.015 (0.283)	
	$1-10 bil	-0.070 (0.262)		-0.051 (0.273)		-0.019 (0.234)	
	Over $10b	0.026 (0.399)		-0.298 (0.323)		0.272 (0.475)	
Group	ARA	0.168 (0.262)		-0.405 (0.225)	*	0.238 (0.283)	
	ASTA	0.204 (0.277)		-0.184 (0.265)		-0.020 (0.247)	
Job Title	Exec Mgmt.	0.047 (0.270)		0.068 (0.305)		-0.116 (0.293)	
	Mgmt.	-0.299 (0.198)		0.252 (0.287)		0.047 (0.255)	
	Sales	-0.464 (0.125)	***	-0.170 (0.274)		0.634 (0.281)	**
Log Likelihood		-61.320	***				

Total N = 92 observations.
Notes: *p < 0.10 *p < 0.05 ***p < 0.01 (two-tailed tests).
Marginal effects are computed at the sample means. Standard deviations are in parentheses.

this result aligns with the effect of management pressure in the model on sustainability views, the effect is much smaller. Companies with retail as the primary function were less likely to be in the Active Sustainability cluster. This result is also in agreement with the previous model on sustainability views which showed that companies with retail as a primary function were less likely to be associated with the Broad Sustainability group. Finally, respondents with the job title of Sales, Marketing, and Communications were more likely to represent companies that were in the Active cluster.

A final multinomial logit model tested whether sustainability views explained company actions or deliverables. The dependent variable in the model was the categorical variable for the three sustainability action clusters: Inactive, Planning, and Active. The explanatory variables were the scores for the two factors on sustainability views: Profit-Driven and Innovative Sustainability (representing Levels 2 and 3 in the literature) as well as Organizational and Societal Sustainability (representing Levels 4 and 5). Table 7 presents the marginal effects of the multinomial logit model.

For a one unit increase in the factor score for Profit-Driven and Innovative Sustainability, a company was 14.7% less likely to be in the Active Sustainability cluster. For a one unit increase in the factor score for Organizational and Societal Sustainability, a company was 41.8% less likely to be in the Inactive cluster and 53.4% more likely to be in the Active cluster. As a result, companies that agreed with views representing the lower levels of sustainability were less likely to have active sustainability strategies. Companies that agreed with views representing the higher sustainability levels were more likely to have active sustainability strategies.

Table 7. Results of the Multinomial Logit Regression on Clusters of Sustainability Actions and Factors of Sustainability Views

Levels of Sustainability Views	**Clusters of Sustainability Actions**				
	Inactive		*Planning*	*Active*	
Profit-Driven and Innovative Sustainability	0.157 (0.110)		-0.010 (0.112)	-0.147 (0.087)	*
Organizational and Societal Sustainability	-0.418 (0.117)	***	-0.116 (0.123)	0.534 (0.110)	***
Log Likelihood	-83.911	***			

Total N = 92 observations.
Notes: *p < 0.10 *p < 0.05 ***p < 0.01 (two-tailed tests).
Marginal effects are computed at the sample means. Standard deviations are in parentheses.

Sustainability Performance Measures

When analyzing the questions on sustainability performance measures, principal component analysis retained only 76 observations because of a large number of "do not know" responses, and results indicated that only one factor was present in the data. In addition, cluster analysis determined that there were too many clusters present for meaningful interpretation. As a result, cross tabulations were calculated to determine the distribution of responses to the questions with respect to company characteristics. Table 8 provides a summary of the eight performance measures tested as well as p-values for the Chi-square test statistics for the cross tabulations. The test statistic is interpreted as the probability that there is no association between how a respondent answered a given question and the company characteristic under consideration.

The characteristics that had consistently significant associations with responses to the eight questions on performance measures were company type, revenue level, and job title. In general, publicly traded companies were more likely than privately held companies or cooperatives to be associated with using and developing performance measures, possibly as a way to convey information to stakeholders. Companies with the highest revenue (over $1 billion) were more likely than small and medium-sized firms to have responses of "do not know," possibly because they have more obstacles in communicating goals across their companies. Finally, respondents with the job title of Sales, Marketing, or Communications were also more likely than other respondents to answer "do not know" to the questions on performance measures, indicating that they may not be as well-informed as employees in management positions.

Discussion of Sustainability Levels

The principal component analysis performed on sustainability views and actions in this study indicates there are similarities between the levels of sustainability in agribusiness companies and the five levels characterized in the sustainability literature. In terms of views, two levels of sustainability are identified in agribusiness companies. The first level of sustainability is a combination of Levels 2 and 3 found in the theoretical literature which focuses on profit-driven and innovative sustainability. Companies associated with this level of sustainability focus on strategies that have a direct economic impact on the company including improved reputation, brand image, efficiency, and employee productivity. The second level of sustainability corresponds to Levels 4 and 5 in the theoretical literature which focus on the broader topics of organizational and societal sustainability. Companies associated with this level of sustainability focus on efforts beyond the normal scope of operations including sustainable business organization, supply chain management, and societal welfare.

There are also two levels of sustainability identified in terms of actions. The first level of sustainability actions include Levels 2, 3, and 4 from the literature which represent actions that align with normal business operations including investment in sustainable products and processes, marketing and public relations campaigns, sustainability incorporated into employee positions, environmental management systems, and supply chain management practices. The second level of sustainability actions is similar to Level 5 in the literature which is focused on actions that extend beyond the normal scope of the company such as the formalization of alliances, addressing human welfare issues, and creating new markets.

When assigning companies to levels of sustainability using cluster analysis, companies do not strictly align with a single level of sustainability. The Broad and Narrow Sustainability groups that emerged from the cluster analysis of sustainability views are characterized as having either high or neutral factor scores for both sustainability levels. Analysis of sustainability actions produced similar results: the Active Sustainability group has consistently high factor scores across both sustainability levels, the Planning group has mid-level scores, and the Inactive group has low scores. These results conform with the argument of Mirvis and Googins (2006) that while there may be distinct patterns of activity at each sustainability level, an individual company is rarely at only one stage of sustainable development.

The size of each cluster conveyed information about the companies represented in the survey. In terms of sustainability views, the majority of companies are associated with the Broad Sustainability group, indicating that the majority of agricultural companies recognize the importance and diversity of the roles of agribusinesses in the sustainability debate. For sustainability actions, the largest group is the Planning group and the smallest is the Active group. When comparing the group sizes for views and actions, it is apparent that there are a high percentage of companies claiming to be in the Broad Sustainability group with respect to views, but a much smaller percentage claiming to be active in their sustainability strategies. This may indicate that while companies tend to adopt sophisticated views of sustainability, their programs are more likely to involve actions at the lower levels of sustainability.

There is also a different combination of factors influencing sustainability views as opposed to actions. Involvement in inputs and production in the supply chain are significant for explaining a company's level of sustainability views, but not its actions. On the other hand, customer, supplier, media, and shareholder and owner pressures impact a company's level of sustainability activities, but not its views. The most significant factor affecting both sustainability views and actions is the influence of management. Companies with strong or very strong management influences are more likely than other companies to be associated with broad sustainability views and active sustainability programs. Conversely, size of the company has minimal effect on a company's level of sustainability views or its actions. It is also noteworthy that influences from competition and government regulations have no significant effects. Other significant variables of interest are association with the ARA group and a job title of Sales, Marketing, or Communications. The significance of these variables indicates that a respondent's personal knowledge of sustainability may influence his or her responses for the company.

After filtering the 114 original observations to eliminate those answering "do not know," 109 were retained for analysis of sustainability views, 92 for actions, and only 76 for performance measures. This is an indication that respondents are most familiar with their companies' views of sustainability, less familiar with their specific actions, and even less familiar with performance measures. It may also indicate that deliverable actions and measures are not as common as adopting views, and that implementing any type of performance measures may already be considered a high level of sustainability. While it was not possible in this study to analyze the performance measures of agribusiness companies in a similar manner as views and actions, it is still possible to conclude that the way in which a respondent answered each of the questions on performance measures was associated with whether the company was public, private, or a cooperative, its revenue level, and the respondent's job title. This suggests that there are differences in the flow of information within a company that depend heavily on these factors.

Further Research

This research has provided an introduction to the sustainability initiatives of agribusinesses in terms of views, actions, and performance measures. Similar to the previous literature which suggests that the majority of companies operate at the lower levels of sustainability (Markevich 2009), results from this research indicate that although U.S. agribusiness companies tend to adopt broad sustainability views which are driven by management pressures, they primarily develop actions at the lower sustainability levels which are driven by external pressures such as customers, suppliers, and the media. Further research is needed to fully understand the range and depth of sustainability present in the food and agricultural industry. This includes research to determine which companies embrace the full spectrum of sustainability views and actions, and which companies are more concerned with developing sustainability 'add-ons' as a way to appease stakeholders.

Further research depends primarily on additional data collection. Findings from this study are based on a small (n=114) sample size which mostly consists of input and production companies that view producers as their primary customers. A larger and more balanced sample is necessary for results to be generalized to the entire industry and to make strong comparisons within the supply chain. It would be critical to include more agribusiness companies that focus on the end

consumer as a vital driver of business. The large number of "do not know" responses is also an indication that data should be gathered from executives, rather than managers, to gain deeper insight into sustainability programs. Data collection could also be expanded to include executives in other countries as a way to compare sustainability practices on a global scale.

An additional topic to explore is whether sustainability is a brand issue as well as an issue that depends upon a company's position in the value chain. For example, companies with a cohesive brand name may be more likely to develop sophisticated sustainability programs than companies that deal with a variety of brands. In addition, a more in-depth survey with additional questions on sustainability views, actions, and performance measures would allow for clearer distinctions between levels of sustainability, and possibly even more levels than the ones found. Finally, care should be taken to control for the differences between the views of the respondent completing the survey and the views of the company that he or she represents because individual interpretations can influence how a company is portrayed.

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Attitudes of Maltese Consumers Towards Quality in Fruit and Vegetables in Relation to Their Food-Related Lifestyles[1]

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Abstract

Consumers' interest in quality aspects of food products has significantly increased. The objective of this study is to examine the influence that Maltese consumers' lifestyles have on their attitudes towards quality features of fruit and vegetables. To achieve our objective we used the Food-Related Lifestyle approach and carried out a telephone survey during February 2010 in Malta. Consumer profiles were identified through segmentation analysis, taking into account five aspects: (i) subjectivity of quality; (ii) consumer difference; (iii) intangible dimensions; (iv) information environment; (v) and price.

Keywords: food-related lifestyles approach, fruits and vegetables, consumers' attitudes, food quality, Maltese consumers

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Introduction

The European Union promotes consumption of fresh fruit and vegetables because of their healthy properties (CBI 2009). One example of this is the European Commission's recent White Paper on Nutrition, overweightness, and obesity-related health issues, which seeks to promote greater fruit and vegetable consumption as one of a number of initiatives aimed at improving public health, particularly the prevention of chronic diseases such as heart disease, cancer, type 2 diabetes and obesity (Eurostat 2008). Thus, fruit and vegetable consumption is encouraged as part of a healthy diet that will result in lower personal and social health costs (Gao et al. 2011). This trend has led to fruit and vegetable growers having to to deal with increasing demand for their products and demands on their production system (EU Report 2006), which has been met by intensifying production, improving logistical techniques, and increasing imports. Moreover, they have also been obliged to allay consumers' concerns regarding quality and safety aspects in the fruit and vegetable sectors, which go hand in hand with consumers' awareness of the relationship between production practices and quality (Kuhar and Juvančič 2010). Thus, quality and quantity features are the two factors driving the current European market supply of fruit and vegetables. Currently, the demand for traceable products and reliable suppliers is growing and the need for food safety and product quality is widely acknowledged by the European Union, the food industry and consumers. In this context, the European Union has introduced a series of quality requirements aimed at regulating the production of fruit and vegetables and protecting the consumer. However, the capacity of the food industry to translate these needs into practical and controllable measures is a critical factor in achieving success in a competitive agricultural sector. Finally, consumers, with their preference for quality attributes and differentiated food products, have become key players.

The main motivation of this study is to promote fruit and vegetable consumption in Malta and the need to develop a strategy for the value-enhancement of local fruit and vegetable production in the Maltese market.

The Maltese market absorbs, on average, 100,000 tonnes per year of fresh fruit and vegetables, with a per capita consumption of 375 grams/day of fruit and 600 grams/day of vegetables. In 2008 Maltese farmers produced 80,000 tonnes of fruit and vegetables, covering 80% of the total supply; the rest was imported from the European Union Single Market and from third countries. Maltese farmers produce fruit and vegetables which are then sold in Malta and which, therefore, do not travel long distances to get 'from farm to table'. This means that nowadays the product purchased by consumers is usually fresh and there is a minimal loss of vitamins through lengthy storage or exposure to heat. Shorter distances also result in less energy use and less pollution created due to transportation. No need for storage means that chemicals for keeping the produce fresh for weeks or months are not used. However, with the increase in imports of price-competitive and service-richer produce, the advantage enjoyed by small-scale farmers is disappearing and problems of sustainability are increasing. Although fiercer international competition has resulted in a loss of market share, it may also represent a value-enhancement opportunity for local producers who are struggling to compete in the global marketplace. Local food supply to the Maltese fruit and vegetable market may represent an alternative to a globalized system and may provide a number of benefits which could prove relevant to consumers, such as a reduction in transportation, energy use and carbon emissions, as well as enhanced local rural development.

Thus, local production is associated to a mix of private and public benefits that in most cases refer to credence attributes. In a competitive market, goods with credence attributes are affected by the well-known problems of asymmetric information and moral hazard. One way to tackle this problem is with the creation of a certification scheme which guarantees the quality level of credence attributes to those consumers who are willing to pay a premium for these attributes. Identifying groups of consumers who would be more oriented towards purchasing local produce, when it is identified as such, is one of the first steps towards value-enhancing the localness attribute and the benefits it provides. Thus, analysis of Maltese consumers' attitudes towards quality in fruit and vegetables may play a crucial role in determining strategies for enhancing the particular features of the local Maltese market. Adopting a marketing-oriented approach may be a useful competitive strategy, one which is necessary in most of today's consumer goods markets. At the same time, in a highly competitive global marketplace an increasingly driving customer demand for quality is being encountered (Kontogeorgos and Semos 2008). In this context, the importance of these studies in guiding the development of consumer-oriented strategies is paramount (Karagianni, et al. 2003).

Over the last few decades, a large number of consumer studies have been conducted which have revealed and measured consumers' preferences, perceptions and attitudes towards such quality aspects of food products as origin, production method, traceability, etc. Regarding fruit and vegetables as products of interest, most of the research done in this area has aimed at investigating consumers' purchasing behavior and their perception of quality in fruit and vegetables. For example, Kuhar and Juvančič (2010), conducted a country-wide survey to investigate consumer purchasing behavior regarding organic and integrated fruit and vegetable products in Slovenia. Using an ordered probit model, they showed that the purchase of the analyzed categories is mainly influenced in a significant way by their availability on the retail market, this is followed by income, health, environmental considerations and the produce's visual attractiveness. While, Poole and Martinez-Carrasco (2007), employing a second price Vickrey experimental auction method, tested consumer perceptions of fruit quality by evaluating consumers' willingness to pay (WTP) for five different varieties of soft citrus fruit under three different information conditions: visual inspection of the fruit before peeling; visual inspection after peeling; and after consumption. They found significant differences in consumers' valuation of the different varieties as they gained more information. Juiciness, sweetness and acidity were the attributes most closely correlated with WTP when the information was most complete, and also in the overall evaluation of the different varieties. Peneau et al (2009), using direct elicitation by means of an open-ended questionnaire, asked respondents in Switzerland to write down what they understood by "freshness" in general, and for fruits and vegetables in particular. Their results suggest that freshness signifies a degree of closeness to the origin of the product, in terms of distance, time and processing.

Several studies have also investigated how consumers' willingness to purchase and to pay for fruit and vegetables are influenced by attributes such as (a) visual, smell and taste qualities (Ernst et al. 2006); (b) health related components (Moser et al. 2011; Onozaka et al. 2006; Boccaletti and Nardella 2000); (c) environmental attributes (Caputo et al. 2012; Mordeza et al. 2009); origin, local and farmers' support (Darby et al. 2008; Thilmany et al. 2008; Rodriguez-Ibeas 2007); (d) labels and certification (Caputo et al. 2012). Finally, in addition to these studies, there have been others which have focused on heterogeneity issues among consumers of fruit and

vegetables, pointing out that factors such as socio–demographic (Gao et al. 2011; Schafer et al. 1999), household (Macario and Sorenson 1998), psychological (Trudeau et al. 1998), and attitudinal (Gao et al., 2011; Moser et al. 2011) considerations all affect fruit and vegetable consumption.

While all of these studies have investigated either how consumers' preferences and perception of quality features of fruit and vegetable products impact on their purchasing behavior or on how socio–economic and behavioral factors affect fruit and vegetable consumption, only a few studies have examined the influence of consumers' lifestyles on their attitudes towards quality aspects of fruits and vegetables. The food-related lifestyle (FRL) approach was first developed by Grunert et al. (1993) and Brunsø and Grunert (1995). Then, it was applied in different cultural contexts (Wycherley et al. 2008; de Boer et al. 2004; Brunsø et al. 1995) and tested for cross-cultural validity (Scholderer et al. 2004). Applications of the FRL model aimed at describing people according to the role that food plays in their lives (Pérez-Cueto et al. 2010), linking generic food-related attitudes to the achievement of desired consequences (Brunsø et al. 2004). With regard to vegetable consumption a first application of this approach is reported in Nijmeijer et al. (2004), who investigated to what extent the food-related lifestyle model, adapted to include personal values (Schwartz 1992), predicts differences in the consumption of 24 vegetables among a sample of 276 South Australian consumers. Results confirm that vegetable consumption is linked to a number of contextual and cognitive factors such as personal values, perceived food attributes and cooking skills.

Although the FRL approach appears to be a very useful way of segmenting food consumers, to the best of our knowledge, no other published studies have used the FRL model for both fruit and vegetable consumption across adult food shoppers. Thus, the objective of our study is aimed at segmenting the Maltese consumers according to the FRL approach and at evaluating their attitudes toward quality features of fruit and vegetables, and investigating whether the segments identified have different attitudes in this respect. The main hypothesis of our study is that on the basis of their FRL, significantly different groups exist among Maltese consumers In addition, we hypothesize that these FRL-based clusters also differ in regard to the following characteristics: (i) quality perception for fruit and vegetables; (ii) awareness of quality marks; (iii) preferences regarding the origin of the product (local and foreign products); and geographical and socio demographic characteristics.

Data and Methods

To achieve our objective we designed a survey instrument which was partly derived from the Food Related Lifestyle (FRL) approach. Since the administration method of choice was the telephone survey, we needed to simplify the original instrument developed by Grunert (1993).
In our application, aspects such as (i) subjectivity of quality, (ii) consumer difference, (iii) intangible dimensions, (iv) information environment, and (v) price were identified and considered to be consistent in assessing Maltese consumers' perception of fresh fruit and vegetables, These aspects were translated into 18 variables that were selected from the 27 items identified by De Boer et al. (2004) in her research and which reflected all the elements identified by Grunert (1993). The choice of these variables was also validated by subsequent consultations with various stakeholders in the local food industry.

Finally, a technical committee was set up to discuss extra questions to be included in the questionnaire in order to fully describe the attitudes and perceptions of Maltese consumers towards fruit and vegetables. The final version of the questionnaire is divided into three sections, and consists of a total of 36 items. The first section includes a series of 11 questions that aim to analyze different aspects of consumers' purchasing behaviour, attitudes toward fruit and vegetables, consumer perception towards quality in fruit and vegetables, quality certification schemes and perception of Maltese products versus foreign products. The second section includes the FRL items. The third section includes questions on socio-demographic characteristics of the respondent such as gender, age, education level, locality of residence, household size.

The data was processed in two phases. First, we conducted a descriptive analysis to evaluate the Maltese consumers' purchasing behaviour and their attitudes toward fruit and vegetables, using questions asked in the first part of the questionnaire. Then, consumer groups were identified using the classical segmentation approach, i.e. factor analysis aimed at defining specific useful ways to describe consumers, and cluster analysis, aimed at grouping the individuals according to these specifications. Finally, we evaluated the resulting clusters according to socio-demographic and consumption habit variables and tested the clusters for differences in attitudes towards Maltese fresh fruit and vegetables.

Results

Sample Characteristics

The FRL study was conducted during February 2010 in Malta. Data was collected from 881 responses to a questionnaire administered by telephone interviewing. The sample was drawn from the dwellings registered by the National Statistics Office, the records of which are regularly updated through auxiliary sources. Households were selected so as to obtain a representative sample according to the locality of residence. Summary descriptive statistics for the characteristics of the full sample are presented in Table 1.

Purchasing and Consumption Habits

Results from a descriptive analysis suggest that more than 50% of respondents buy fresh fruit and vegetables from hawkers, 32% buy them from supermarkets whilst 8% buy their fruit and vegetables from Wet Markets. The remaining 6% buy their fresh fruit and vegetables either directly from the farmer or consume their home-grown products.

When asked about "quality" in association with fruit and vegetables, consumers identified product safety as the most important quality characteristic (43.2%), followed by taste (35.6%); while the use of environmentally-sound techniques was considered to be the most important quality attribute by a smaller group of respondents (20.5%).

More than 75% of the interviewees perceive "fresh-looking product" as an aspect that characterized superior quality fruit and vegetable products, followed by product presentation (8.6%), brand (6.4%), and higher price (3.6%), etc. In addition, a high percentage of the respondents

Table 1. Demographic Characteristics of the Sample

Socio-Demographic Characteristics		Socio-Demographic Characteristics	
Gender		*Weekly expenditure on food*	
Male	18.8%	Less than €51	7.6%
Female	81.2%	€51 - €100	41.2%
Education level		€101 - €150	25%
No formal education	1.5%	€151 - €200	9.2%
Pre-Primary/Primary	30.9%	€201 - €250	2.8%
Secondary	43.5%	more than €250	1.2%
Post-Secondary	12.5%	No Response	12.9%
Tertiary	11.0%	*District*	
No Response	0.7%	Southern Harbour	20.8%
Household size		Northern Harbour	30.4%
1 members	10.9%	South Eastern	15.1%
2 members	27.3%	Western	13.1%
3 members	23.8%	Northern	13.8%
4 members	27%	Gozo and Comino	6.8%
5 member	8.5%	*Age*	
6 members	1.9%	Minimum	18
7 members	0.2%	Maximum	90
8 or more members	0.3%	Mean	53.5
		St. deviation	14.58
Total	881	Total	881

state that they are willing to pay up to 10% more for products with higher quality attributes, such as fruit being tastier (64%), healthier (63.1%), local (58.7%) or grown using environmentally-friendly techniques (57.5%). Finally, a lower percentage (from 9 to16%) of the respondents are willing to pay up to 30% more for quality products, with taste being the attribute that consumers would be most willing to pay for.

Perception of Maltese Products vs Foreign Products

Our questionnaire also included a series of questions aimed at assessing consumers' perception of Maltese products versus foreign products. In our sample, 90% of the respondents stated that Maltese products differ from foreign products. In particular, the respondents who believed that Maltese fruit and vegetables are different, were asked whether this difference meant that fruit and vegetables of Maltese origin where better or worse than foreign ones in terms of authenticity, freshness, healthiness, environmental safeguards, and taste. For authenticity, freshness and taste, more than 90% believed that Maltese fruit and vegetables are superior regarding these characteristics, with less than 5% stating that the products are worse. However, regarding healthiness and safety characteristics, a lower percentage of the respondents believed that Maltese products are better than the foreign ones, especially with regard to safety. Finally, when asked to explain what the difference was due to, most of the respondents stated that it was due to the sun (84.9%) and soil (79.9%). Fewer believed that the difference was due to the minimal use of machinery in crop management (54.1%).

Attitudes Towards Labels

Most of the Maltese consumers in the survey considered safety as the most important quality aspect in fruit and vegetables. This aspect, however, is a credence attribute since it can only be claimed by the producer and cannot be checked by the consumer, either before or after purchasing. As earlier mentioned, consumers in our sample interpreted quality according to how the fruit and vegetables are presented and whether they look fresh. However, according to a wide body of literature, in a purchasing context where a product is characterized mostly by credence attributes, specific information provided by labeling schemes and brands might increase consumers' awareness of the presence of quality characteristics. However, in our study we found that 66% of respondents were not aware of the existence of quality marks; this explains why a high percentage of the consumers base quality perception on their sensory capacities.

The actual level of awareness of quality marks is even lower than the 34% derived from respondents' self-assessment since most of the consumers who believe that they are aware of these marks confuse private brands with public/collective quality marks (82%).

Finally, the questionnaire included a question concerning the amount of trust that consumers place in certification bodies. The results showed that producer organisations would be the most trusted to certify quality characteristics (43%) whilst 23% trust governmental departments with quality assurance. This came as quite a surprise since a producer making claims about his own product might be considered to be in conflict of interest and at risk of opportunistic behaviour. Akerlof (1970), highlights the problem of information asymmetry, which occurs when the seller knows more about the product than the consumer. The high percentage of consumers buying their fruit and vegetables predominantly from hawkers may explain a lot about the perception of the quality of fruit and vegetables in Malta. Hawkers in Malta are closely linked to producers. It is common for hawkers to market their own produce or that of their relatives. The result is usually that bad products are driving out the good ones. Even though locally-grown fruit and vegetables are preferred to foreign products due to the belief that they are superior in all regards, most of this perception may be attributed to the hawker's selling pitch.

Segmentation Analysis and Profiles: Food-Related Lifestyle Approach

In order to analyze Maltese consumers' attitudes towards quality in fruit and vegetables in relation to their Food-Related Lifestyles, we first investigated the relationship among the 18 FRL items using Principal Component Analysis (PCA) with Varimax rotation. Prior to performing PCA, the suitability of data for factor analysis was assessed. Even though inspection of the correlation matrix revealed the presence of few coefficients of 0.3 and above, the Kaiser-Meyer-Olkin KMO statistics were 0.677, exceeding the recommended value of 0.6 (Kaiser, 1974) and Bartlett's Test of Sphericity (Bartlett 1954) reached statistical significance, supporting the factorability of the correlation matrix.

Results from the PCA suggest that in this dataset the 18 variables used to analyze consumers' FRL may be grouped into six significantly different factors, thus explaining 51.67% of the variance. Analyzing factor loading of each variable among the factors extracted, we observe that they may be associated with: (i) the role of food in the consumer's social life, (ii) information on the products purchased, (iii) interest in experimenting with food, (iv) the practicality of buying

and consuming food, (v) the need to plan using a shopping list or a weekly menu, and the perception of food as a (vi) serious commitment for the household keeper. Table 2 shows the factors obtained from the PCA.

Table 2. Factors from Principal Components Analysis*

Variables[1]	Fact1	Fact2	Fact3	Fact4	Fact5	Fact6
Going out for dinner is a regular part of our eating habits.	**0.696**	-0.103	0.108	0.068	0.005	0.182
Dining with friends is an important part of my social life	**0.683**	0.004	0.201	-0.069	0.105	0.144
When I do not really feel like cooking, I get one of the other members of my family to do it.	**0.595**	0.025	-0.053	-0.121	-0.044	0.095
To me product information is of high importance. I need to know what the product contains.	0.037	**0.699**	0.027	-0.096	-0.035	0.219
I try to plan the amounts and types of food that the family consumes.	-0.107	**0.667**	0.042	0.049	0.147	-0.053
I like to buy food products in specialty stores where I can get expert advice.	0.162	**0.469**	0.186	0.309	-0.077	0.019
I make a point of using natural or ecological food products	-0.066	**0.637**	-0.049	-0.041	0.121	-0.052
Recipes and magazines articles from other cooking traditions make me experiment in the kitchen.	0.49	0.077	**0.799**	-0.021	0.142	0.014
I like to try new foods that I have never tasted before.	0.175	0.047	**0.771**	0.045	0.065	0.071
I only buy and eat foods which are familiar to me.	0.036	0.098	**-0.473**	0.466	0.211	0.204
I always check prices, even on small items.	-0.271	0.067	-0.021	**0.459**	0.174	*0.328*
I consider the kitchen to be the woman's domain.	-0.263	-0.090	-0.079	**0.714**	0.180	-0.124
In our house, nibbling has taken over and replaced set eating hours	*0.342*	0.007	0.142	**0.553**	-0.358	-0.072
Before I go shopping for food, I make a list of everything I need.	0.021	0.184	0.185	-0.008	**0.599**	0.201
I always plan what we are going to eat a couple of days in advance.	0.003	0.014	0.005	0.167	**0.758**	-0.12
Eating is to me a matter of touching, smelling, tasting and seeing; all the senses are involved.	0.127	0.114	0.052	-0.021	*0.336*	**0.496**
Cooking is a task that is best over and done with.	-0.191	0.127	0.059	0.247	0.039	**0.616**
Shopping for food is like a game to me	0.102	0.183	0.072	0.242	0.201	**-0.618**
Eigenvalue	2.290	2.179	1.468	1.231	1.097	1.039
Variance explained (% of total)	12.722	12.106	8.153	6.837	6.092	5.772
Cumulative variance explained (% of total)	12.722	24.828	32.981	39.818	45.911	51.682

* Bold values indicate higher correlation between variables and factors.
[1] Variables included in the PCA are expressed using 5-point scales.

The first component, labelled *social life* explains 12.72% of the total variance. It is characterized by variables indicating that the persons interviewed view food as having an important role in social life, i.e. entertainment gatherings of friends and family. The second factor is called *information* and accounts for 12.11% of the total variance. This factor collects variables showing consumers' interest in getting information on the characteristics of the food that they are consuming or buying. The third factor, labelled *experimentation*, explains 8.15% of the total variance. This factor is linked to variables showing neophilia or consumers' interest in trying out different things when they cook, whether it be food, ingredients or recipes. The fourth factor, labelled *practicality*, explains 6.84% of the total variance and is related to those variables indicating households which are dominated by women and which will buy food as long as it is convenient and familiar, even if this means that the food bought will take over mealtimes. The fifth factor, called *planning*, which helps to explain 6.09% of the total variance, collects variables indicating the degree to which planning is important for the household when it comes to the buying of food and the planning of the food that will be cooked for the set meals. Finally, the sixth factor, which explains 5.77% of the total variance, is labelled *serious commitment*. This is linked to variables

that can be associated with involvement of the interviewee with food as a compelling task. This factor showed a lack of enthusiasm for cooking and rigour and seriousness in shopping but, on the other hand, acknowledgement of the relevance of eating as an involving experience.

Based on the six factors obtained from the the PCA, we performed a cluster analysis, using a K-means clustering technique (Malhotra, 1993), to verify the presence of different food-related life-style segments in Malta. First, a Hierarchical Cluster Analysis was performed to get an indication of the most appropriate number of clusters, which was calculated by plotting the coefficients logged on the Agglomeration schedule against the stage number. This gave rise to a Scree plot, whose elbow indicated that the ideal number of clusters would be either 4 or 5. Finally, using the K-means clustering method, four clusters were identified. Relationships between identified clusters and socio-demographic variables were also analyzed. Results from the cluster analysis are shown in Table 3.

Table 3. Categories of Final Clusters

	Cluster 1 *Hedonistic*	Cluster 2 *Adventurous*	Cluster 3 *Bargain Seeker*	Cluster 4 *Traditional*
1 Social	.606	-.525	-.657	.436
2 Information	.765	-.417	.703	-.530
3 Experiment	.070	.767	-.227	-.688
4 Practical	.045	-.003	.520	-.313
5 Planning	-.071	-.122	.043	.149
6 Serious commitment	-.906	-.153	1.043	.247

The first segment is described as *hedonistic households***.** Hedonistic households are the most common type found on the Maltese islands, making up 31% of the entire sample. They have the lowest average number of members residing permanently in the household and consider food as an important social tool. This was seen from the high score in the item highlighting the importance of food as a social factor. They are not particularly aware of quality marks; on the other hand they are interested in knowing the characteristics of the food they usually buy and eat, showing particular preferences for products bearing quality labels or products sold by specialty stores. Their interest in the characteristics of food products leads them to experiment with new recipes, prepare unusual meals, and try out different culinary traditions. For these reasons, people in this segment are willing to pay extra for products when they satisfy their curiosity and gratify their senses.

The second segment is *adventurous households*, which accounts for 30% of the sample. As shown (Table 3) "experimentation" accounts for the highest single score of all the clusters, suggesting that consumers in this segment are interested in trying new food, new recipes and new ways of cooking, In addition, they are not particularly aware of quality products, allowing their senses to inspire and guide their shopping decisions, and the "information" score is quite low, indicating that when buying, adventurous households are driven mostly by their gut feeling, rather than by cognitive aspects. Finally, the low score attached to the social factor suggests that consumption of novelty foods takes place in private or with other members of the family rather than outside the household.

The third segment accounts for 20% of the sample and is classified as the *bargain seeker household*. This segment is different from the others in terms of the consumer's vision of food consumption and its demographic characteristics. In particular, the lower score in the social section suggests that unlike the others these households do not consider food to be important for their social life, viewing it as a means to satisfy their hunger. Unlike all the other segments, the higher score for "serious commitment" suggests that consumers in this segment prefer to dedicate shopping time to looking for products that offer good value for money rather than to cooking. These types of households might try to experiment with different foods but will only do so if the product is not extremely exotic and is cheaper than the food they are used to. Finally, with regard to demographic characteristics, responsibility for the acquisition of food in this household is not entirely attributed to the women, with 25% of the respondents being male. This segment has the lowest level of education and the highest average age amongst the clusters.

The fourth segment accounts for 19% of the sample. Consumers in this group agree that food favours socializing. They have the highest level of education and the highest average number of people residing permanently in the household. The average age of the person responsible for food shopping is the youngest amongst the clusters. This household is very reluctant to try out new recipes or experiment with other types of food, preferring only food that seems familiar to them. Since they base their food choice on what they are used to eating, product information is of little importance to them. On the other hand, consumers in these households are willing to pay a premium price for fruit and vegetables that guarantee quality. Even though we can see that they scored lowest in the "information" factor, these households are better informed on quality marks than the rest. Thus the label *traditional household***.**

Testing for Heterogeneity across Maltese Consumer Segments

To increase the usefulness of our segmentation results, we widened our analysis by testing whether belonging to an FRL consumer segment makes the respondent show different attitudes towards Maltese fresh fruit and vegetables. We did this by estimating a probit model, using as a dependent variable an attitudinal question indicating positive attitudes of Maltese consumers towards Maltese fruit and vegetables, while as a co-variate the cluster membership of the respondent. This model is not suitable for predicting consumer attitudes towards Maltese fresh fruit and vegetables, since a number of omitted variables, not available in our dataset, may be anticipated. However, given a statistically significant estimate, the cluster parameters are useful for evaluating whether; compared to Cluster 1 (which is the baseline) the respondent's belonging to a different cluster makes it more or less probable that they will declare a positive attitude towards local fruit and vegetables.

The model's specifications are reported in the following formula; the empirical model was estimated using the Maximum likelihood (ML) estimation method:

$$F\&V = \beta_0 + \beta_1 Cluster\,2 + \beta_2 Cluster\,3 + \beta_3 Cluster\,4$$

where the variables are as defined in Table 4.

Table 4. Description of Variables used in the Probit Models

Variables	
Dependent Variable	
F&V	1 if respondents have positive attitudes towards fresh fruit and vegetables from Malta; 0 otherwise.
Covariates	
Cluster1	1 if the respondent belongs to the *Hedonistic* cluster; 0 otherwise (Baseline).
Cluster2	1 if the respondent belongs to the *Adventurous* cluster; 0 otherwise.
Cluster3	1 if the respondent belongs to the *Bargain Seeker* cluster; 0 otherwise.
Cluster4	1 if the respondent belongs to the *Traditional* cluster; 0 otherwise.

Source: Survey data.

In the estimation procedure, Cluster 1 was chosen as the baseline scenario. Socio-demographic variables were also considered, but they have not been included in the final model since none of them were found to be statistically significant. Table 5 presents probit estimates and supporting statistics for each variable considered.

Table 5. Estimates of the probit models

Variables	Coeff.	T-Stat	
Constant	0.46	5.88	***
(Cluster2) *Adventurous*	0.21	1.81	*
(Cluster3) *Bargain Seeker*	0.40	3.09	***
(Cluster4) *Traditional*	-0.14	1.03	
LL	-515.5617		
Pseudo_R-squared	0.0224		

Source: Survey data. *** Significant at the 1% level; ** Significant at the 5% level

Since the parameters of all the variables but Cluster 4 are statistically significant, results suggest that Clusters 2 and 3 are different from Cluster 1 in terms of the likelihood of individuals belonging to the cluster having positive attitudes towards fruit and vegetables from Malta.

In order to investigate more deeply into whether all the clusters differ from each other in terms of fruit and vegetable attitudes, we performed three Wald tests to test for equality of the parameters for each pair of clusters. In accordance with the results shown in Table 6, we reject the hypothesis of equality at the 1% or 5% level for all clusters, except in the case of the comparison between clusters 2 and 3.

Table 6. Wald Tests across Clusters

Hypothesis	Wald Test	P-Value	Significance
H_0 = *Cluster 2=Cluster3*	2.09	0.1483	
H_0 = *Cluster 2=Cluster4*	6.46	0.0110	**
H_0 = *Cluster 3=Cluster4*	13.08	0.0003	***

Source: Survey data. *** Significant at the 1% level; ** Significant at the 5% level

In conclusion, probit estimates show that no significant difference exists between hedonistic and traditional consumer groups with regard to their positive attitudes towards Maltese fruit and vegetables, while the Wald tests suggest no significant difference exists between the adventurous and bargain seeker consumer groups in terms of the probability of its members having a positive attitude towards fruit and vegetables from Malta. In addition, the adventurous and bargain seeker Maltese consumer segments seem to be currently more positively oriented towards local fruit and vegetables.

Conclusions

In an attempt to support the establishment of a marketing strategy for fruit and vegetables based on quality, a survey was conducted to identify to what extent quality aspects are valued by local consumers. A market segmentation was performed using a questionnaire focusing on quality perception of fruit and vegetables and containing a reduced version of the FRL instrument. The results obtained were helpful in developing an understanding of Maltese consumers' general perceptions and also in suggesting which segments specific marketing strategies might be aimed at. Analysis of the first part of the questionnaire clearly shows that the market is still new to quality marks. This may be interpreted as an opportunity to design a quality scheme that caters specifically for Maltese consumers by involving producer organisations in the management of the system and promoting safety as the main quality feature. The challenge lies in getting the consumer to trust the quality attributes highlighted in the scheme more than the hawker's sales pitch. Analysis of the second part of the questionnaire sets out six components of FRL, defined as social life, information, experimentation, practicality, planning, and serious commitment. Using these six factors, we also identified four clusters: hedonistic, bargain seeker, adventurous, and traditional households. The four clusters identified can be used for the marketing of the product once the quality scheme is put in place. In addition, we also found that the clusters identified using the FRL differ also in terms of attitudes towards fruit and vegetable quality. In particular, we tested whether differences between the segments exist in the interest towards local Maltese fruit and vegetables. A relevant finding is that currently, while a quality mark for Maltese produce is not available on the market, the adventurous and bargain seeker consumer segments show a more positive attitude towards Maltese fruit and vegetables than the hedonistic and traditional segments.

This study thus provides relevant insights in terms of managerial implications. Our results indicate the importance of implementing appropriate marketing strategies in order to communicate the quality aspects of food in general and of fruit and vegetables in particular. In this situation, the adoption of diversified communication tools seems to be the most appropriate strategy, since consumers' attitudes toward quality aspects of fruit and vegetable products differ across the consumers groups identified. In fact, our findings suggest that a communication strategy for the introduction of a labelling program could be more effective if it is addressed to the adventurous and bargain seeker segments. However, it is worth noting that the results of our analysis do not exclude that a positive response may come also from the other segments, especially if it is supported by appropriate communication.

However, the study shows some limitations. Since we conducted this study using a reduced version of the FRL instrument proposed by Grunert, which has been cross-culturally validated, its

comparability with other studies that used the instrument in its complete form are questionable. Future research should analyze the FRL using the full version of the instrument and compare the results of the two studies. It would also be interesting to monitor the changes in FRL, conducting the survey in 10 years time to see whether there will be any changes in the segment size and whether new segments will appear.

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Effective Marketing of Hass Avocados: The Impacts of Changing Trade Policy and Promotion/Information Programs

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Abstract

U.S. avocado producers faced major economic challenges in 1996, when opening of the U.S. market to Mexican avocados was approved. Fearing introduction of new pests and diseases as well as severe economic impacts, U.S producers were able to gain a phased opening of regional markets and legislation authorizing an assessment of 2.5 cents per pound on all Hass avocados sold in the U.S. to support promotion programs. Promotion programs expanded demand sufficiently to maintain real producer prices even though Mexican imports exceeded USDA forecasts by a factor of three.

Keywords: avocado, promotion, Mexico

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Problem Statement

U.S. avocado producers faced a growing economic crisis during the late 1990s. Consumer demand was increasing slowly, imports of avocados from Chile, The Dominican Republic and New Zealand were increasing as bearing acreage increased and Mexico, the world's largest avocado producer, was gaining entry to the U.S. market for the first time in nearly a century. Rapidly increasing supplies in the face of inelastic demand at the producer level would place serious downward pressure on prices and had the potential to result in a much smaller domestic industry. In addition, imports were free riding on the California Avocado Commission's (CAC) well-established and effective promotional programs. Leadership of the California avocado industry, which had been fighting a delaying action against Mexican fresh avocado imports, decided to pursue several proactive initiatives and programs while continuing the fight. These forward-looking actions included increased expenditures on a well-organized political effort to include funds from imported avocados in the industry's advertising and promotion programs, expansion of a data-base program to include imports combined with internet technology to improve the timeliness and dissemination of marketing information to all market participants, and increased attention to the nutritional characteristics of avocados.

Objectives

The objectives of this study are to:

1. Describe the phased entry of Mexican Hass avocados into the U.S. market.
2. Outline the features and summarize the impacts of the Hass Avocado Promotion, Research and Information Order (HAPRIO) on U.S. avocado demand and producer returns.
3. Evaluate the impact of avocado industry information programs.
4. Outline avocado nutrition research and the nutrition message to consumers.

Procedures

This paper combines a description of marketing Hass avocados with analysis of the U.S. demand for fresh avocados and producer returns from marketing programs and expenditures. [1] The opening of the U.S. market to imports of Mexican avocados together with implementation of the HAPRIO will be described and discussed. Changes in avocado imports and U.S. per capita consumption will be outlined and U.S. demand for avocados will be estimated using econometric methods. Factors affecting avocado demand will be discussed and the contributions of advertising and promotion to growth in demand will be analyzed. Previous research has found that transmission of farm-level (f.o.b.) price changes to retail is asymmetric for avocados. These results will be used together with information on price variability to assess the results of HAPRIO information programs on avocado producers and consumers. Simulation of weekly changes in marketing margins resulting from f.o.b. price changes will be used for the assessment of information programs. Information on nutrition research, use of this research in promotional programs, and anecdotal results are outlined.

[1] This analysis is for fresh avocados as HAPRIO and CAC assessments and promotion programs are only for the fresh fruit.

The Phased Opening of U.S. Markets to Mexican Avocados

Mexico, the world's largest avocado producer, was unable to export fresh avocados to the U.S. prior to 1997 because of pest and disease problems. The USDA's Animal and Plant Inspection Service (APHIS), after studies extending over six years, announced that it would allow avocados from Mexico to be sold in 19 Northeastern and Midwestern states and the District of Columbia from November through February beginning in 1997. The States eligible for Mexican imports are shown in Table 1. The timing of shipments and the selection of states eligible to receive Mexican avocados were chosen to minimize the probability of a fruit fly infestation and the probability that avocados infested with stem weevil, seed weevils and seed moth would be re-shipped to avocado producing areas. To minimize the risk of introducing pests to the conterminous United States, APHIS used a systems approach to establish redundant safeguards in Michoacán, Mexico avocado orchards and packing facilities. Risk mitigation measures included pest field surveys; orchard certification; and packinghouse, packaging, and shipping requirements, including cutting and inspection of samples from all shipments.

Table 1. Phased Reduction of Shipping Restrictions for Mexican Avocados to the U.S. Market, 1997 –2007.

Phase and Dates	States Eligible for Mexican Avocado Shipments	Cumulative Share California's U.S. Shipments 1995-2005
I – November through February each marketing year beginning in November 1997 and through February 2001	Connecticut, Delaware, Illinois, Indiana, Kentucky, Maine, Maryland, Massachusetts, Michigan, New Hampshire, New Jersey, New York, Ohio, Pennsylvania, Rhode Island, Vermont, Virginia, West Virginia, Wisconsin and Washington, D.C.	16.1 percent
II –November 1, 2001 to April 15, 2002, and October 15 to April 15 each marketing year beginning in 2002 through January 31, 2005.	Colorado, Idaho, Iowa, Kansas, Minnesota, Missouri, Montana, Nebraska, North Dakota, South Dakota, Utah, and Wyoming	22.9 percent
III – January 31, 2005 to January 31, 2007	Mexican avocado shipments permitted year-round in all states except California and Florida	60.8 percent
IV – After January 31, 2007	Mexican avocado shipments permitted year-round in all U.S. states	100.0 percent

Sources: U.S. Department of Agriculture, 1997, 2001, 2003 and 2004.

Responding to persistent Mexican requests and the apparent success of the systems approach, APHIS in 2001 increased the number of states allowed to import Mexican avocados from 19 to 31 and increased the shipping season to six months. The 12 additional states are shown in Table 1. The initial shipping season extended from November 1, 2001 to April 15, 2002, with subsequent seasons extending from October 15 through April 15. Finally, beginning on January 31, 2005, Mexican imports were allowed to enter all U.S. states except California and Florida year-round. California and Florida markets were opened to Mexican imports after January 31, 2007. The last column of Table 1 shows that the states included in phases 1 and 2 received less than a quarter of California avocado shipments during 1995 through 2005. California is the most im-

portant market for California-produced avocados, accounting for almost 38 percent of total shipments.

An empirical analysis of U/S. demand for avocados conducted before the entry of avocados from Mexico found that demand is seasonal, with the highest monthly demand occurring in August and the lowest demand occurring in December (Carman and Craft). The lowest demand months were October through March, with demand increasing steadily from March through August and then decreasing in September to a level comparable to May.

California avocado production is seasonal with the largest weekly shipments typically occurring from April through August and the lowest weekly shipments occurring from November through February. A monthly index of California avocado shipments for four marketing years is shown in Figure 1.[2] An index value of 1.0 is average monthly sales for the year being considered. The 1989 marketing year illustrates the shipping pattern before avocado imports began increasing—total imports were only 10 million pounds. As imports have increased the seasonal pattern of California avocado shipments has shifted substantially.

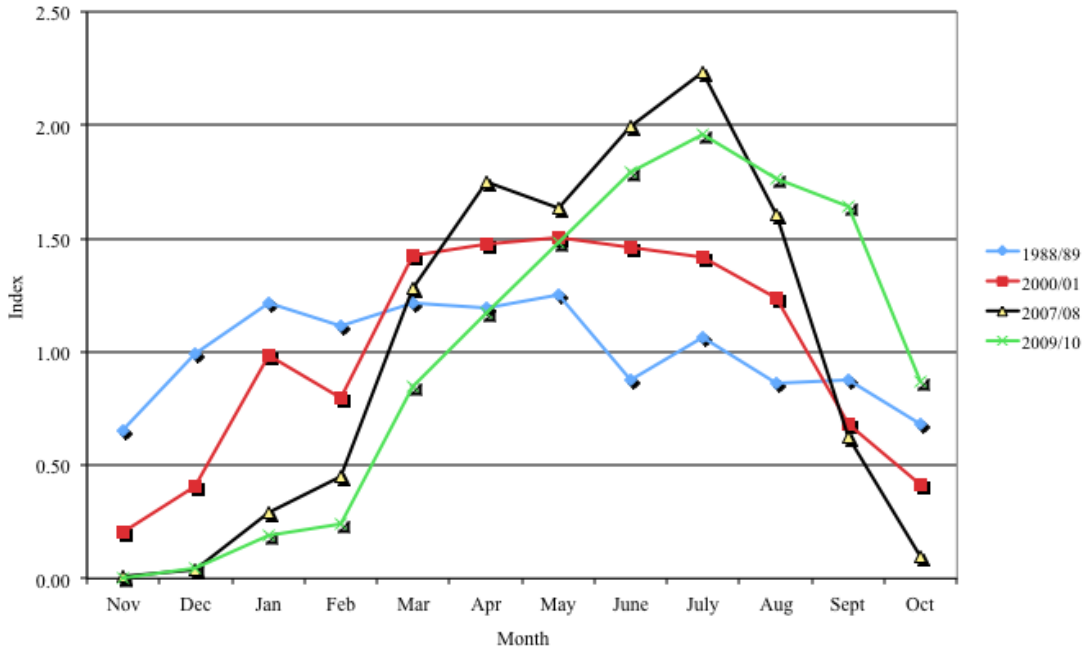

Figure 1. Seasonal Index of California Avocado Sales, Various Marketing Years

During the 2001 marketing year imports from Chile were significant, Mexican imports were beginning to grow (24.9 million pounds), and total imports were 169 million pounds; during 2008 California had a medium sized avocado crop (almost 329 million pounds), Mexican imports had grown to over 491 million pounds and total imports were 686 million pounds; California had a very large avocado crop in 2010 (over 534 million pounds), Mexican imports totaled 562.6 mil-

[2] The California avocado marketing year extends from November 1 through October 31 of the following year. The marketing year is designated by the second year, i.e., November 1, 2000 through October 31, 2001 is the 2001 marketing year.

lion pounds, and total imports were 769 million pounds. In total, imports' share of the U.S. avocado supply increased from less than three percent in 1989 to a range of 70.5 to 87.7 percent during the 2007 – 2010 marketing years.

Figure 1 demonstrates that California grower-shippers have responded to increased imports by shifting shipments from the low demand months of October through March to May through August when demand is the highest. California producers have shifted away from avocado varieties that mature in the low-demand months, which are also high supply months for imports, to the Hass and Lamb varieties that mature in the summer months. They appear to have also delayed harvest at the beginning of the marketing year in response to the pattern of imports.

The selection of states and months for Mexican avocado imports was made to minimize the probability that pests or diseases from Mexico would be introduced to U.S. orchards and especially to U.S. avocado production areas. An unintended consequence was that consumers in Northeast and Midwest markets who had previously experienced limited seasonal supplies of avocados now had increased year-round availability of the fruit. This, combined with increased promotion and the public relations program about the health benefits of consuming avocados, resulted in a very effective phased market development process as new states became eligible for Mexican shipments and the shipment period was lengthened.

Projected Economic Impact of Mexican Imports

Before each proposed change in rules for avocado imports from Mexico, APHIS published a regulatory impact analysis of the economic effects of increased imports. APHIS forecasts of the increase in Mexican avocado imports, price impacts on California avocado producers, and impact on California avocado producer revenue for each change in rules (Phase) are shown in Table 2. The last column shows actual Mexican avocado imports during each of the first three phases and average Mexican imports since 2007.

Data in Tables 1 and 2 illustrate that there were two major sources of concern to California growers. First was the possibility of introduction of a new pest or disease that would threaten the viability of avocado production in California. Second was the forecasted economic impact of a 25 percent reduction in grower prices and almost $85 million reduction in total revenue. These price and revenue projections were based upon import projections that were consistently and seriously underestimated by APHIS. Actual Mexican imports were 1.82, 1.61, 1.80 and 3.04 times greater than the APHIS forecasts in phases I through IV, respectively (Table 2). The low APHIS forecasts appear to be due to underestimating the growth in U.S. avocado demand and not fully recognizing the attractiveness of the U.S. market to Mexican avocado producers. APHIS forecasts were for Mexican imports to have a market share of 18.0 and 23.8 percent in Phases III and IV, respectively while the actual shares were 26.3 percent in Phase III and 47.6 percent from 2007 through 2010.

Table 2. APHIS Forecasts For Mexican Avocado Imports, Impacts on California Prices and Impacts on California Producer Revenues, with Comparison to Actual Imports.

Phase & Start Date	Forecasted Mexican Imports (mil lb)	Forecasted Impact on CA Price (%)	Forecasted Impact on CA Revenue ($mil)	Mexican Imports Annual Average (mil lb)
I – 1997	13.00	-2.00	-$3.9	23.66
II – 2001	37.66	-12.03	-$17.93	60.57
III – 2005	140.97	-15.60	-$52.39	254.09
IV – 2007	178.83	-25.60	-$84.50	543.52

Source: U.S. Department of Agriculture, 1997, 2001, 2003 and 2004.

The Hass Avocado Promotion, Research and Information Order

The phasing in of Mexican avocado imports combined with increasing imports from Chile provided California avocado producers with a sense of urgency and limited time to respond. California avocado producers had been spending millions of dollars annually since 1961 to promote their product, first using a California state marketing order and then the California Avocado Commission (CAC). Increased avocado imports through the 1990s were not only placing downward pressure on prices, importers were also free-riding on CAC promotion programs. Efforts to require all Hass avocados sold in the U.S. to financially support promotion programs cumulated with President Clinton signing the Hass Avocado Promotion, Research, and Information Act of 2000 into law on October 23, 2000. This Act established the authorizing platform and timetable for the creation of the HAPRIO that was approved in a referendum of producers and importers with 86.6 percent support on July 29, 2002. The HAPRIO became effective on September 9, 2002, with mandatory program assessments of 2.5 cents per pound on all Hass avocados sold in the U.S. market effective January 2, 2003. The assessment is collected by first handlers for California production and by the U.S. Customs Service for imports and forwarded to the Hass Avocado Board (HAB).

The 12-member HAB that administers the program is appointed by and operates under USDA supervision. The HAB, consisting of 7 domestic producers and 5 importers, is required to rebate 85 percent of domestic assessments to the California Avocado Commission (CAC) and up to 85 percent of importer assessments to importer associations, that use the funds for their own promotion programs. There are currently two importer associations, the Chilean Avocado Importers Association (CAIA) and the Mexican Hass Avocado Importers Association (MHAIA). The HAB uses the remaining 15 percent of assessments for its operations, promotion, and information technology programs.

During its first five years of operation, HAB collected assessments totaling $98.67 million and rebated $77.6 million to country producer organizations, including $38.64 million to the CAC, $20.54 million to the CAIA, and $18.42 million to the MHAIA. Total five-year promotional expenditures were as follows: CAC, $50.98 million; CAIA, $16.71 million; MHAIA, $14.35 million; and HAB, $9.27 million, for an overall total of $91.3 million spent on Hass avocado promotion in the U.S. market. We next discuss estimation of a demand function for avocados in the U.S. that can be used to estimate the economic impacts of HAB promotional and information programs.

U.S. Avocado Demand

Evaluation of the impacts of HAB promotion and information programs requires an empirical estimate of U.S. avocado demand. The model used for this analysis is based on previous empirical studies of the U.S. demand for avocados by Carman (2006) and by Carman, Li and Sexton (2009). Results of these studies are in line with expectations based on the economic theory of demand. That is, the per capita consumption of avocados is a function of the price of avocados, consumer income, advertising and promotion, and tastes and preferences. The estimated coefficients for the advertising/promotion and price variables were consistent and statistically significant across a variety of model specifications and estimation techniques. The coefficients for other variables, however, vary depending on the variables included in each demand equation estimated. Detailed analysis of the estimated equations and extensive statistical testing revealed strong positive correlations of the time-series data for several variables, including income, share of Hispanic population, and a linear time trend included to account for possible excluded variables and changes in tastes and preferences. [3] Multicollinearity was, thus, likely responsible for variability of coefficients on these variables depending upon model specification.

Carman, Li and Sexton specified and tested various combinations of variables, functional forms (linear and log linear) and estimation methods (OLS and 2SLS). Their linear demand equations specified two trend variables to capture the major impacts of the highly correlated variables, while still measuring consistently the effects of promotion programs. We used their specifications and methods to estimate an updated demand equation specifying U.S. per capita avocado consumption as a function of real prices and advertising/promotion expenditures (2008 = 1.00) with annual observations from 1962 to 2008. Our demand equation also includes a dummy variable to account for a mid-1990's shift in demand and two trend variables. The first trend variable (Trend) accounts for uniform annual increases in demand over the entire 47 years of observations while the second trend variable (T94-08) measures a much larger annual increase in demand beginning in 1994 and continuing through 2008. The estimated demand equation is:

$$Qa_t = 0.932 - 0.005\ Pa_t + 0.025\ A_t - 0.680\ D94\text{-}08 + 0.093\ T94\text{-}08 + 0.036\ Trend$$
$$(7.63) \quad (-9.30) \quad (2.71) \quad (-4.33) \quad (5.33) \quad (6.73)$$

where the t-statistics are shown in parentheses below each estimated coefficient and $R^2 = 0.96$
The variables are defined in Table 3.

The signs for each of the estimated coefficients are as expected and all are statistically significant at a 95 percent or higher level. Using these results, the estimated annual price elasticity of demand for avocados at the f.o.b. level is -0.36 and the estimated promotion/advertising elasticity of demand is 0.168 at the sample mean values for the variables. The total for the two trend coefficients (.036 + .093 = .129) is the estimated annual increase in per capita demand that has been occurring since 1994 as a result of highly correlated factors noted previously.

[3] Effects captured by the trend variable may include (i) the development of new regional markets, (ii) increased year-round availability of avocados, (iii) the growth in Mexican restaurants and increased popularity of Mexican food, price, and (iv) increased knowledge about the nutritional benefits of consuming avocados.

Table 3. Variable Definitions

Variable	Definition	Units
Qa_t	Annual average U.S. per capita sales of all avocados (California, Florida, and all imports)	Pounds per capita
Pa_t	Average annual f.o.b. price of California avocados deflated by the consumer price index (CPI) for all items (2008 = 1.00)	Real cents per pound
A_t	Annual advertising and promotion expenditures by the CAC, HAB, CAIA and MHAIA deflated by the CPI (2008 = 1.00)	Millions of real dollars
D94-08	Dummy variable with a value of 1 for each year from 1994 through 2008 and zero for other years	
T94-08	Time trend with value of zero for each year from 1962 through 1993; value of 1 in 1994, increasing by 1 each year to 15 in 2008	
Trend	Time trend equal to 1 in 1962, increasing by 1 each year to 47 in 2008.	

The hypothesized linear functional relationship between demand and promotion expenditures was not rejected by econometric tests.[4] However, the linear relationship would not be expected to hold for large increases in promotion expenditures; at some point the marginal effect of another dollar spent on promotion is expected to decrease.[5] We conclude that HAB promotion expenditures are not yet large enough to cause a decrease in marginal effectiveness.

Benefit-Cost Analysis of Avocado Promotion

Agricultural commodity organizations typically use benefit-cost analysis to determine the estimated returns from their advertising and commodity expenditures. Two types of benefit-cost ratios (BCR) are relevant in promotion-evaluation analysis—average benefit-cost ratio (ABCR) and marginal benefit-cost ratio (MBCR). Producers' ABCR from a promotion program consists of the total incremental profit to producers generated by the program over a specified time interval divided by the total incremental costs borne by producers to fund a program. Both the profit and cost streams should be properly discounted or compounded to a common point in time. The ABCR is the key measure of whether a program was successful, with $ABCR \geq 1.0$ defining a successful program.

[4] A number of statistical tests were utilized for the specification and estimation of the demand function. Formal tests for the time-series properties of the model variables show that the real price has no significant trend and is covariance-stationary (i.e., stationary without a deterministic trend) and that per capita consumption and real promotion expenditures are trend-stationary (stationary after removal of a linear trend). Using 2SLS results, we cannot reject promotion expenditures as exogenous based on the Sargan statistic, and we fail to reject the null hypothesis that California price is exogenous using the Durbin-Wu-Hausman chi-square test. Homoskedasticity of residuals is not rejected based on the Pagan-Hall test, and the hypothesis that the residuals are not autocorrelated of order 1 cannot be rejected under any versions of the Cumby-Huizinga tests.

[5] A square root function is often used to represent the relationship between promotion and demand, as this functional form guarantees a declining effect of marginal promotion dollars on sales (see Alston et al. 1997). We estimated various models with a nonlinear relationship between promotion expenditures and per capita consumption but none improved the model's performance. This outcome is consistent with results from the Ramsey/Peseran-Taylor Reset test that cannot reject the null hypothesis that the true relationship between the variables is linear.

The MBCR measures the incremental profit to producers generated from a small expansion or contraction of a promotion program. MBCR answers the question of whether expansion of the promotion program would have increased producer profits, with MBCR > 1.0 indicating a program that could have been profitably expanded. The ABCR is not equal to the MBCR when promotion expenditures are modeled as having a nonlinear effect on demand. However, for the linear model utilized in this study ABCR = MBCR, and, thus, the two questions "was the program profitable" and "could it have been profitably expanded" are one and the same. Our strategy was to simulate the impact of a small hypothetical increase in the HAB assessment rate from the current level of $0.025/lb. to $0.03/lb., i.e., an increase of one-half cent per lb., and estimate the benefits and costs to avocado growers from that assessment expansion. The ratio of estimated benefits to costs is then the estimated MBCR, and, given that the functional relationship is linear, it is also an estimate of the entire program's ABCR.

Measurement of the MBCR requires three pieces of information: (1) an estimate of the marginal impact of promotional expenditures on demand; (2) estimates of the slope or price elasticity of demand; and (3) estimates of the slope or price elasticity of supply of avocados in the U.S. market. Our estimated demand function provides the first two items, but we do not have a current estimate of the price elasticity of supply. Most promotion evaluation studies do not attempt to estimate the price elasticity of the supply relationship. Supply functions are difficult to estimate empirically, and the elasticity varies by the length of run, with supply becoming more elastic (responsive to price) over time as more productive inputs become variable to producers. Supply analysis is particularly difficult for perennial crops because the analyst must normally specify a dynamic model containing equations for plantings, removals, bearing acreage (as a function of plantings and removals), and yield. Carman and Craft (1998) specified and estimated a dynamic supply response model for California avocados but their study was conducted before imports from Chile and Mexico became important.

The short-run supply of a perennial crop is highly inelastic because it is the product of bearing acreage and yield, neither of which is likely to be influenced much by current price.[6] Thus, the supply of avocados from California is very inelastic for a given marketing year. The supply to the U.S. emanating from Chile and Mexico, however, is apt to be more elastic because the total supply in each country can be allocated to domestic consumption or to various export markets. Thus, an increase in price in the U.S. due, say, to successful promotions is likely to cause Chilean and Mexican shippers to increase supply into the U.S. We followed the lead of other studies and specified two values for the elasticity of supply, 1.0 and 2.0. We could specify other values but it would not add much information because the estimated dollar benefits and BCR both decrease as the supply function becomes more elastic.

Measurement of Benefits and Costs

Producer benefits from the hypothetical expansion of the promotion program are measured by the net increase in producer surplus. The estimated change in producer surplus from a hypothetical ½ cent per pound increase in promotion expenditures minus promotion costs was calculated

[6] In the case of avocados there will be a lag of five years from the time a decision is made to plant avocado trees until new production is available.

for each year 2003 through 2008.[7] The annual BCR was computed by adding program costs to net benefits to produce gross benefits and then dividing gross benefits by program costs. Results are presented in Table 4.

Table 4. Annual Estimated Average and Marginal Benefit Cost Ratios for HAB Promotion Programs by Marketing Year for Supply Price Elasticities of 1.0 and 2.0, 2003 – 2008.

Marketing Year	MBCR for Supply Elasticity =1.0	MBCR for Supply Elasticity =2.0
2003	8.4582	4.7177
2004	7.1232	3.7857
2005	7.9946	4.2925
2006	8.9943	4.8859
2007	7.9108	4.2013
2008	8.1642	4.3044
Annual Average	7.7817	4.2188

The estimated annual BCR range from 3.79 to 8.99, but, importantly, each exceeds 1.0, meaning it is highly likely that (a) the promotional programs supported by the HAB from 2003 through 2008 yielded net benefits to producers and (b) could have been profitably expanded each year for the period of analysis.[8] To place these BCR in perspective, the ratio of 3.79 indicates that the 2.5 cents per pound assessment paid by each avocado producer returned 9.48 cents per pound for a net return of 6.98 cents per pound. At the other end of the spectrum (less elastic supply), the BCR of 8.99 indicates that the 2.5 cents per pound assessment returned 22.48 cents per pound for a net return of 19.98 cents per pound.

HAB Information Program

HAB conducts an innovative internet information program through its network marketing center www.avohq.com. Growers, packers, shippers and wholesalers in the U.S., Chile, Mexico, Dominican Republic and New Zealand, as well as U.S. retailers, have access to the HAB website where they share harvest and shipment planning information. This program has an "orderly marketing" objective and is designed to help all marketers in the U.S. market develop a framework to ensure orderly flow of fruit and market stability. Producers and consumers can benefit from decreased price variability when price transmission is asymmetric. An analysis of the price transmission process for avocados by Li (2007) found that retail prices for avocados respond more fully to shipping-point price increases than to shipping-point price decreases. As a result, retail price margins for avocados will tend to increase with larger and more frequent price changes or decrease with smaller and less frequent price changes. Thus, information programs that smooth the flow to U.S. markets will reduce price variability, leading to smaller marketing margins that benefit producers with higher average f.o.b. prices and consumers with lower average retail prices.

[7] We followed the detailed steps for computing producer surplus in Carman, Li and Sexton (2009), pp. 18-20.

[8] Note that Carman and Craft's (1998) estimate of the average benefit-cost ratio for CAC's promotion programs from 1961 to 1995 was 2.84 while estimates for the first five years of HAB programs by Carman, Li and Sexton (2009) ranged from 1.12 to 6.73.

Changes in Price Variability and Marketing Margins

The HAB information program was initiated during the 2003 marketing year. The variance and standard deviation of weekly California f.o.b. avocado prices were calculated for each year of the ten-year period 1998 through 2007. This period was selected to include the five years before (1998 through 2002) and the five years after (2003 through 2007) initiation of the HAB information program. While there was not an evident trend over time, the standard deviation of weekly average prices for the most recent five years averaged 0.2045, a decrease from the first five-year weekly average standard deviation of 0.2843. Thus, the average annual standard deviation of weekly prices decreased 28 percent in the five years after initiation of the HAB information program relative to the last five years prior to its initiation. At the same time the annual average standard deviation of California weekly shipments increased from the first five years (1998 through 2002) to the most recent five years (2003 through 2007), while the standard deviation of total weekly shipments (California plus all imports) decreased. This indicates that coordination of imports with California shipments has smoothed total weekly avocado shipments and prices during the marketing year. While growing imports had the potential to introduce additional quantity and price variability into the U.S. market, the opposite has occurred. Imports have been timed to maintain a rather steady flow of avocados to retail markets, which tends to stabilize prices at both the f.o.b. and retail levels. A portion of the smoothing of quantity and prices as imports increased significantly likely can be attributed to the active HAB information programs.

The results from Li's research on price transmission in the marketing channel were used to estimate weekly changes in gross marketing margins between the shipping point (f.o.b.) and the retail price of avocados. Based upon Li's results on asymmetry of transmission of f.o.b. price changes to retail, we assumed that retail prices increased 76 percent of an increase in shipping-point prices and decreased 29 percent of a decrease in shipping-point prices. We used the aggregate estimated adjustment without attempting to account for the two to three weeks required for the total price adjustment, based upon Li's analysis. The changes in estimated gross marketing margins from week to week are based on total weekly shipments, the change in average weighted shipping-point price per pound for all Hass avocados and Li's estimated adjustment ratios. The estimated total five-year (2003-2007) increase in marketing margins as a consequence of price variability is $31,661,000. Considering that this figure represents a reduced value due to the presence of the information programs, the reduction of 28 percent in margins would have been worth a five-year (undiscounted) total of $12.3 million in terms of reduced margin that is reflected in both lower retail prices paid by consumers and higher prices to growers at the shipping point.[9] This comparison of the variability of prices immediately before initiation of the information program with variability of prices after beginning the information program has a limitation that the entire change in price variability is attributed to the information program, even if there were other factors contributing to more stable prices.

[9] Let M_0 denote the increase in margin due to price variability in the absence of the HAB programs and $M_1 = 31,661,000$ equal the value in the presence of the programs. Then we have $(M_0 - M_1)/M_0 = 0.28$. Solving for M_1 and subtracting M_0 from it yields $12.3 million.

Annual expenditures for HAB's information programs ranged from $340,179 to $1,090,228 over the five years from 2003 through 2007 with a total cost of $3,749,840 and average annual cost of just under $750,000. Given an estimated benefit of $12.3 million and costs of $3.75 million, the net benefit from reduced marketing margins attributed to HAB's information programs is $8.55 million. The division (incidence) of the total benefit, as well as the assessment cost to fund the information program, between consumers and producers depends upon the value of consumers' price elasticity of demand, ε_D, relative to producers' price elasticity of supply, ε_S, of avocados to the U.S. market. The share of a change in margin going to consumers in terms of lower price is $\Delta P = \frac{\varepsilon_S}{\varepsilon_S - \varepsilon_D}$. Using two values for the elasticity of supply (1.0 and 2.0) and an estimated price elasticity of demand of -0.20, based on the estimated demand equation and average prices and quantities for the most recent 10 years, we can estimate the portion of the benefits from reduced margins going to consumers and producers. The share going to consumers is estimated at 0.91 for a supply elasticity of 2.0 and 0.83 for a supply elasticity of 1.0 with the remaining 0.09 and 0.17 shares going to producers. Thus, the five-year information program net benefits are estimated to be $7.09 or $7.78 million to consumers and $.77 or $1.46 million to producers, depending on the elasticity of supply. While the majority of estimated benefits flowed to consumers, producers still received an attractive return for their share of expenditures.

Nutrition Based Public Relations

The CAC made a strategic decision in 1997 to fund nutritional research and to proactively communicate the nutritional benefits of consuming avocados through their public relations and outreach programs. Research focused initially on a detailed analysis of the composition and nutrient content of avocados, including fatty acids, vitamins, and minerals, and then emphasis shifted to quantifying and qualifying various phytochemicals (i.e. pytosterols, carotenoids, glutathione), as well as their health benefits and effects on disease processes. The CAC's public relations program emphasizing health and nutritional benefits associated with avocado consumption garnered the attention of news organizations, and the health and nutrition message has been widely disseminated with a modest expenditure of funds. In addition, the public relations program has been very effective since most consumers place much more credibility on a news story about health and nutrition benefits of consuming a product than they do on advertising with the same message. Internet readers can access recipes, read about the health and nutrition benefits of eating avocados, obtain nutrition facts, read news releases on health research, and learn about healthy eating by accessing partner websites.

HAB has continued funding nutrition research and has developed a new nutrition research plan with three strategic research pillars: heart health, weight/diabetes management, and healthy living. In a recent issue of AvoAction (2010), HAB announced that it is commissioning three nutrition studies that will get underway in the coming months. Researchers at Pennsylvania State University will evaluate the benefits of avocados on heart disease risk factors, Loma Linda University researchers will evaluate the effects of avocados on weight/diabetes management, and researchers at Ohio State University will determine the effects of avocado consumption on cardiovascular health.

Concluding Comments

Increasing the annual supply of avocados marketed in the U.S. from 406 million pounds in 1996 to 1.056 billion pounds in 2008 given inelastic demand was a recipe for a "price disaster." Instead, a combination of effective promotion, innovative information programs, and favorable demand trends interacted to increase avocado demand in pace with expanding supply, resulting in real (2008) prices of 94.8 cents per pound in 1996 and 99.5 cents per pound in 2008. During the same time period U.S. per capita avocado consumption increased from 1.51 to 3.47 pounds.

Few commodities have experienced this type of demand growth, and actions taken by the U.S. avocado industry in the face of rapidly increasing supplies can provide lessons for other produce industries facing similar challenges. Lower producer prices and profits are inevitable in these settings without demand expansion commensurate with the increasing supply. Such demand expansion in an agricultural industry involving many domestic and international producers and shippers is difficult to achieve without industry organization, leadership, and collective action in the form of government-sanctioned mandatory marketing programs. Voluntary programs will, even if they are effective, invite free riding, which will lead inevitably to their demise, in which case competition will be based solely upon pricing and only the lowest-cost producers will survive. U.S. growers of fresh produce commodities are unlikely to be the low-cost producers due to their high labor and regulatory costs relative to most importers.

Importers are free riders with respect to most U.S. mandatory agricultural marketing programs. The genius of leaders of the U.S. avocado industry was to seek and obtain legislation bringing importers under the auspices of the mandatory marketing program, both eliminating free riding and substantially expanding the resources available to promote avocado consumption in the U.S. The avocado industry also designed its programs wisely to maximize the impact of its expanded resource base. It implemented research and marketing programs that were in sync with growing interests of consumers in the health and nutritional benefits of food and with public policies promoting fruit and vegetable consumption to combat obesity and improve overall health. Results from industry-financed research helped secure mention of avocados in USDA diet recommendations, listing of avocados in Mediterranean diets and on diet pyramids, and partnerships with organizations promoting health and diet.

Our estimation results provide quantitative support for this assessment of the effectiveness of the industry's programs. They indicate that HAB promotion expenditures have been effective in increasing avocado demand and generating very favorable returns for producers. Indeed it appears that avocado producers could profitably increase promotion assessments and expenditures.

Fresh produce industries tend to be highly volatile and market participants can benefit from sharing production, shipping, and price information. Yet public market information programs for agricultural commodities have been scaled back or eliminated in recent years. Industry marketing programs operating with government sanction have exemption from antitrust laws and enable producers and shippers to actively share market information, which can stabilize shipments and prices. The HAB seized upon this opportunity and stepped into the information void with an innovative program that facilitated information sharing among market participants at all stages of the market chain. Our results showed that improved information flows likely reduced marketing

margins, benefitting both producers and consumers. Implementing similar programs relying on advanced information technology and rapidly evolving information delivery systems likely represents an opportunity for similar industries.

In sum, the actions of the U.S. avocado industry to obtain legislative approval of the Hass Avocado Promotion, Research and Information Order enabling creation of the HAB have prevented a financial disaster for U.S. avocado growers and shippers. The actions of the industry and the programs that it created in the aftermath of the legislation serve as a model for other produce industries facing similar challenges.

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Approaches for Selecting Product Innovation Projects in U.S. Food and Agribusiness Companies

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Abstract

Although executives acknowledge the strong link between innovations and performance, they are still challenged by crossing the bridge from great ideas to revenue. The objective of this paper is to understand better the approaches used by the food and agricultural sector to select product innovation projects, and to draw a picture of an innovation portfolio of a food and agribusiness company. This paper adds to the management literature by studying a different sector, the U.S. agricultural sector and focusing on the implementation of theoretical models. The survey of about 100 companies, indicate that the food and agribusiness sector tends to use cross-functional teams and several selection methods when they select product innovation projects. This selection process yields to a diversified portfolio in terms of potential for return, time to market, and costs already incurred. However, companies tend to be biased towards in-house and low risk projects. Company and industry characteristics' effects on the results are present but limited. It is important to note that this dissertation does not study the effect of these practices on performance, which is a necessary follow-up.

Keywords: food, agribusiness, innovation, selection method, portfolio, functional area, cluster analysis

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Introduction

Innovation is critical to the long-term success of a firm as well as the economic health of an industry and the overall economy (Gertner 2004). Brown and Teisberg (2003, p1) stated that "Innovation is the lifeblood of successful businesses. […] [It] has become every firm's imperative as the pace of change accelerates". Indeed, innovations are one strategy to develop and maintain a sustainable competitive advantage (Kirwin et al. 2008; Shanahan et al. 2008; Mikkola 2001; Bard et al. 1988) and to grow (Boehlje and Roucan-Kane 2009). Innovation is also essential to respond to the critical concerns of society such as climate change and global warming, food/energy scarcity and security, environmental challenges or resource use/sustainability.

McKinsey found that more than 70% of top business executives consider that innovation will be at least one of the top three drivers of growth for their company in the next three to five years (Barsh et al. 2008). Although executives acknowledge the strong link between innovation and performance, they are still challenged to cross the bridge from great ideas to revenue. Delivering on the promise of innovation is further complicated by shareholders' need for predictable and sustainable growth. Generating sustainable short-term and long-term growth through the selection of the right innovation projects is the main challenge facing companies in today's dynamic business environment. Most organizations find that they have several good ideas but lack the strategy, frameworks, processes, and funding required to select and convert the best ideas into new revenue (Anthony et al. 2006; Huurinainen 2007).

The literature on innovation management combines numerous different terminologies. In the resource-based view (RBV) of strategy and firm behavior and decision-making, innovations are defined as new combinations of existing and/or new resources and competencies (Penrose 1959, 85). There is a distinction between invention and innovation. Invention consists of the development of an idea for a new product, process, or business model. The innovation term goes further and includes both the invention process but also the use of that idea (Roberts 1988). An important part of the product innovation process is the selection of innovation projects to include in an innovation portfolio.

Empirical studies of the innovation process are limited (Cooper et al. 1997; Cooper et al. 2001; Cooper et al. 2004a, b, c; Huurinainen 2007; and Killen et al. 2007). In addition, although the agribusiness sector is no stranger to innovation, even less has been done on the innovation practices of agribusiness companies. Even though in terms of Research and Development (R&D) spending as a percentage of sales, the food and agricultural industries are not perceived as a high tech industry, there has been significant new product development in food products and agricultural production inputs. Over the last 150 years, there have been several waves of innovation related to agricultural machinery, chemistry, seed, and information management as well as new food products at the retail level (Graff et al. 2003; Gray et al. 2004). Therefore, using descriptive statistics and cluster analysis, the focus of this article is the study of the selection of product innovation projects by food and agribusiness companies through the analysis of survey data.

The selection of product innovation projects by food and agribusiness companies is only part of the entire innovation process. The innovation process starts with developing and maintaining a culture of innovation within the company. Many authors have developed and studied frameworks

that stimulate innovation ideas (e.g., Roth and Sneader 2006; Brown 2005; Barsh et al. 2008; Huurinainen 2007). In addition, the selection is a continuous process that happens all throughout the development of innovation projects. Cooper's stage-gate process (Cooper 2001) proposes a structure to continuously analyze the portfolio of innovations and increase the likelihood of success in an uncertain world. His structure encompasses five innovation stages: scoping, building a business case, developing the idea/prototyping, testing and validating, launching). At the end of each stage (and sometimes within a stage), the resource allocation and the prioritization of projects is reviewed and changed if needed. This prioritization is Cooper's "gate". This paper focuses on the selection of product innovation projects at each gate of Cooper's stage-gate process.

There are a myriad of innovations that can be organized into several categories: product, service, process and business model innovations. The scope of this paper is limited to product innovations for three principal reasons: 1) product innovation is quite different from the other aspects of innovation, 2) the increasing pressure on the agricultural industry to produce more food with less resources will require agribusiness firms to continuously improve their product innovation processes, and 3) it simplifies the survey process to allow for better clarity in responses. This is not to say that other aspects of innovation are any less important.

This article presents findings of a survey of 109 top executives of U.S. agricultural and food companies regarding their selection of product innovation projects and the portfolio of projects resulting from these practices. The survey instrument is available from the authors upon request. Given the lack of consensus on how to measure the success of innovation (e.g., Subramanian and Nilakanta 1996; Sampson 2007; Ahuja and Katila 2001) and the lack of previous literature on the ag sector, this paper does not attempt to study which selection approaches lead to the best innovators[1]. This paper focuses on indicating what previous research has shown to be the selection process of the best innovators across industries, and whether food and agribusiness companies are implementing those approaches. Specifically, to help executives who struggle at selecting innovation projects the literature has developed and shows that involving several functional areas in the selection process and using several selection methods will yield to better innovation performance and a more diversified portfolio. Therefore, the main research questions posed in the survey are:

1) Who is involved in the process of selecting product innovation projects in food and agribusiness companies?
2) What are the most common selection methods used by food and agribusiness companies when selecting product innovation projects?
3) What are the key characteristics of food and agribusiness companies' product innovation portfolios?
4) Does the selection of product innovation projects for food and agribusiness companies vary with company and industry characteristics?

The rest of the paper is organized as follows. We start with a presentation of the survey used to answer the research questions. The results are then presented with a focus on cross-functional teams, followed by the selection methods, and then a focus on product innovation portfolios. The

[1] Cooper et al. (2001) define best innovators/performers as companies that have high value projects, the right balance of projects, a portfolio that fits the strategy of the firm, the right number of projects, and etc.

difference across various company characteristics and industry characteristics is discussed in each results section. The data is then analyzed using cluster analysis to draw additional insights. The last section of this paper concludes the discussion.

The Survey

The survey was created and administered online in December 2009. The use of the Internet media for data collection presents advantages and disadvantages. Web-based surveys allows accessing an audience that are otherwise hard to reach and often travelling, while at the same time may create sampling issues by not reaching audiences that do not have access or are not comfortable with the technology (Wright 2005; Llieva et al. 2002). Using web-based surveys avoid paper, postage, and transcription costs and even costs associated with the collection of data with the use of some online survey software (Wright 2005; Llieva et al. 2002). Web-based surveys have also been associated with longer answers to open-ended questions than paper surveys (Llieva et al. 2002).

The software Qualtrics was used to generate and implement the survey. The online survey allowed randomization of questions and answer categories to control for some answer bias. Question branching was also automated to reduce respondent fatigue and increase response rates. Finally, the online format allowed for more timely responses and a more controlled environment to improve response rates. The survey link was sent via email to 849 top executives of food and agribusiness companies using the contact database supplied by the Center for Food and Agricultural Business (CAB) and the Purdue University Food Science department. These 849 executives represented all executives included in the database working for companies expected to be doing some form of product innovation. The survey included a number of questions within each of three areas:

1) The approaches used by companies when selecting product innovation projects (the functional areas involved in the selection and the top three selection methods used).
2) The company's portfolio of product innovation projects (percentage of projects with different return distributions, percentage of short-term versus long-term projects, percentage of projects using primarily in-house capability versus projects using partners capability, percentage of projects with low costs already incurred versus projects with a large proportion of costs already incurred, and percentage of projects with low risk versus high risk of technical/regulatory failure).
3) The company's descriptive profile (2008 fiscal revenue, scope, governance structure, primary sub-industry; and whether innovation is part of the company's core strategy).

A total of 136 surveys were returned out of the 849 recruitment emails. Of the 136 surveys, 109 surveys were usable; resulting in a 12.8 percent response rate. An examination of responses from surveys answered after the reminder email versus those responding to the initial email showed no statistically significant differences across time. This would suggest non-response bias is minimal; nonetheless a low response rate suggests using caution about broad implications from these results. The respondents were all involved in the selection of product innovations with 60 percent involved at the corporate level and 40 percent involved at the division/Strategic Business Unit (SBU) level. As to management responsibilities, 36 percent indicated they were a

member of the executive management team (CEO, COO, etc.), 21 percent had primarily marketing responsibility, 21 percent were involved in R&D, 8 percent had primarily sales management responsibility, and 14 percent indicated other responsibilities (e.g., finance, human resource, production, public relations, etc.).

These respondents represented several agricultural sub-industries, revenue ranges, governance structure, and scope. Regarding sub-industries, 23% of the respondents belong to the food sector, 20% to animal nutrition, 18% to crop protection, 12% to seed companies, 9% to capital equipment, 6% to animal health, 1% to biotechnology, and 10% to other. As for firm's revenue, 18% of the respondents worked for companies with a revenue of less than $100 million, 24% with revenues between $100 and $499 million, 5% in the revenue range of $500 to $999 million, 20% with revenues between $1 and $10 billion, and 33% with revenues over $10 billion. In terms of governance structure, 47%, 40%, and 13% of the respondents come from private firms, public firms, and cooperatives respectively. Regarding company scope, global companies make up most of the sample (67%), followed by multi-state firms (18%) and national firms (15%). Finally, given the importance of innovation in the growth and even survival of the companies, it is not surprising to see that most respondents (79%) state that innovation is part of their company's core strategy which shows a large commitment to innovation by agribusiness companies. Nonetheless, 18% report that innovation is not part of their company's core strategy and 2% have doubts ("do not know") despite their involvement in the innovation process of their company.

The Results

Responsibility and Cross-Functional Teams

The innovation literature has advocated the use of cross-functional teams to allow for a smoother and higher performing innovation process (e.g., Cooper et al. 2004b; Christensen et al. 2004; and Christensen and Raynor 2003). Cross-functional teams have been defined in the literature as a group of people with different functional specialties or skills that are responsible for carrying out all phases of the innovation process. Research on non-ag industries has shown that innovation processes use only a few functional areas (e.g., Huurinainen 2007; Cooper et al. 2004b; and Kelley 2005). It is hypothesized that food and agribusiness companies are no different than companies in other industries in regards to the implementation of cross-functional teams, i.e., a few functional areas are involved. It is also hypothesized that industry and company characteristics will affect the number of functional areas and the type of functional areas being used.

Respondents were asked to select all the functional areas involved in the selection of product innovation projects for their company. The categories offered to them were Executives, Marketing, Research and Development (R&D), Sales, and Other. The functional area the most likely to be involved was Research and Development (R&D) (with 90% of the respondents selecting it) followed by executives (89%), marketing (77%), sales (61.5%), and other (18%)[2]. Of the respondents who selected other and gave an explanation, 7 specified manufacturing/operations, and two listed finance. These are interesting numbers that show that sales and marketing were selected by

[2] Note that many companies use more than one functional area so the percentages of functional areas sum to well over 100%.

statistically significantly fewer firms. This suggests some firms rely less on functional areas close to the customer in the selection of product innovation projects.

On average, respondents selected 3.36 functional areas (out of 5) suggesting the existence of cross-functional teams. Seven respondents reported just one functional area (R&D or executives) involved in the selection of product innovation projects. In addition, the pair marketing and sales was never selected by itself. Future research should examine if excluding sales and marketing people from the selection process impacts a firm's innovation performance.

Based on results from past studies (Henderson 2007; Herath et al. 2010; Van Moorsel et al. 2005), it is hypothesized that industry and company characteristics will impact the number of functional areas and the type of functional areas included in the selection of product innovation projects. For example, it may be physically easier for smaller firms (e.g., firms with revenue <$1 billion or multi-state companies) to assemble cross-functional teams because of physical proximity. The data show that that there are indeed significant differences by company and industry characteristics (see Table 1). As expected, the size of the firm has some effect. Specifically, the sales department is more likely to be involved in smaller firms (in terms of revenue, scope, and governance structure) possibly because smaller firms are less likely to have a clear separation between functional areas. Firms committed to innovation are less likely to involve the sales department. A possible explanation is that salespersons tend to be too biased towards short-term projects, failing to see the potential of longer term projects.

As for sub-industry differences, the crop input sub-industry (crop protection, fertilizer, seed, and biotechnology) tends to use more functional areas and is more likely to involve marketing than the other sub-industries (animal nutrition, animal health, capital equipment, and food). Finally, the type of governance structure did not have a significant effect on the number of functional areas and the type of functional areas involved.

Selection Methods

Numerous R&D project selection methods (informal methods, graphical analyses, structured assessments, economic models, and complex models) have been proposed to help organizations make better decisions regarding innovation. Table 2 presents a definition of each of those methods.

No single selection method presents only advantages. They all have drawbacks and are actually extremely complementary of each other leading many such as Cooper et al. (2001) to find that the best innovators/performers (i.e., the companies that have high value projects, the right balance of projects, a portfolio that fits the strategy of the firm, the right number of projects, etc.) are using several selection methods. This leads to the question: Which and how many selection methods are used in the food and agribusiness industry for product innovation projects?

According to the findings from other industries (Cooper et al. 2001; Kester et al. 2009) and discussions with agribusiness companies, economic models are expected to be the most common selection method used for product innovation projects. Respondents were asked to answer the question: “Which of the following portfolio management selection methods best describe your

Table 1. Differences in the Use of Functional Areas across Company and Industry Characteristics

Functional Area Variable	Revenue <$1 billion	Revenue ≥ $1 billion	Multi-state	Global	Private	Public	Committed to innovation	Others	Crop inputs	Livestock inputs	Food
	Percentage of respondents reporting the use of:										
Executives	90%	88%	95%	92%	94%	93%	88%	95%	94%	89%	84%
Marketing	75%	79%	85%	73%	77%	73%	80%	70%	89%*	68%	72%
Sales	73%**[a]	52%**	80%*	55%*	75%**	50%**	57%*	80%*	69%	75%	52%
Mean of functional areas selected	3.47 (1.05)[b]	3.26 (1.04)	3.65 (0.88)	3.30 (1.08)	3.55 (1.03)	3.27 (1.11)	3.35 (1.06)	3.50 (0.89)	3.63* (0.94)	3.43 (0.96)	3.24 (1.16)

[a] *, **, and *** represent 0.10, 0.05, and 0.01 levels of statistical significance, respectively.
[b] Standard deviations are indicated in parenthesis.

Table 2. Definition of R&D Project Selection Methods

Informal methods	Graphical analyses	Structured assessments	Economic models	Complex models
Opportunistic: Take on projects as opportunities arise *Gut feeling:* Choose projects that sound successful *Scientist driven "genius" award:* Let (successful) researchers choose their innovation projects *Unstructured peer review:* Two or more referees (such as expert, peer, ...) comment on the same innovation project	Provide a visual picture of the portfolio of innovation project over a few dimensions used as determinants of success: reward; probability of risk; ease of undertaking; newness; project attractiveness; competitive advantage and benefits to customers; time to market; strategic fit; protectability with patents, secrets, copyright, ...; synergy between projects; relative market share and industry growth rate; company's business strength and industry attractiveness.	Decision makers score each project on a series of criteria that are each given a weight. Projects are then compared based on their weighted score	These models attempt to calculate a financial value for each project	*Mathematical programming:* select the projects that will optimize some objective function(s) subject to a set of constraints *Game theory:* Evaluate strategies with explicit consideration of competitors' actions *Cognitive modeling / Artificial intelligence:* model previous decisions to automatically make decisions regarding a new project that has comparable circumstances

company's primary selection process? (Please check the 3 most important methods)". As hypothesized, economic models are the most popular methods by being selected by 73% of the respondents, followed by informal (which is a bit surprising) checked by 63% of respondents, and structured assessments chosen by 51% of respondents. Graphical analyses are not used as much (only 33% of the respondents) which differs from Cooper et al.'s findings that they were the second most popular method after economic models. The lack of popularity of the complex models (only 3% of the responses) is not surprising given the significant costs associated with their implementation and their requirement for specific skills.

Respondents were allowed to report up to three selection methods, focusing on the most important methods used in their company's selection process of product innovation projects. The majority of the respondents (53%) selected 3 methods, 23% selected 2 methods, and 24% selected 1; resulting in an average of 2.27 selection methods per company (similar to the 2.34 average reported in Cooper et al. 2001; p16).

Table 3 shows that there are significant differences by company and industry characteristics in selection methods. It is interesting to note that company size has no impact on the number of methods used. However, smaller firms (in terms of revenue) use more informal methods while larger firms use more economic and structured methods. A possible explanation for this result is that larger firms may have more resources to develop more formal selection methods.

Publicly traded firms are expected to be more likely to use economic models because of the pressure to generate returns for stockholders. This hypothesis is confirmed in Table 3. Publicly traded firms are also less likely to use informal methods and more likely to use structured methods for the selection of product innovation projects. This may again be a result of stockholders' pressure or a size effect as discussed earlier.

Table 3. Differences in the Use of Selection Methods across Company Characteristics

Selection Method Variable	Revenue <$1 billion	Revenue ≥ $1 billion	Multi-state	Global	Private	Public
Economic models	**65%**	**79%**	**55%**[a]**	**80%****	**63%****	**82%****
Informal methods	**84%*****	**43%*****	**80%**	**59%**	**75%****	**48%****
Structured assessments	**37%****	**62%****	**40%**	**55%**	**39%****	**61%****
Graphical analyses	**33%**	**33%**	**35%**	**32%**	**29%**	**36%**
Average number of selection methods	**2.27 (0.85)[b]**	**2.26 (0.87)**	**2.2 (0.89)**	**2.32 (0.83)**	**2.16 (0.88)**	**2.36 (0.84)**

a *, **, and *** represent 0.10, 0.05, and 0.01 levels of statistical significance, respectively.
b Standard deviations are indicated in parenthesis.

Innovation Portfolio

Most strategy experts suggest investing in a diversified portfolio to limit risk (McGrath and MacMillan 2000). The innovation literature is no different given the risk embedded in innovation projects (Cooper 2004b). In this study, the diversification of the portfolio of product innovation projects is analyzed over five selection criteria dimensions. These five dimensions and their levels were chosen based on an extensive review of the innovation literature (e.g., DePiante Henriksen and Traynor 1999; Ringuest et al. 1999; Day 2007; Bard et al. 1988) as well as intensive phone interviews (using Yin's suggestions, 2003) with top executives of eight food and agribusiness companies in different sub-industries and of different size.

The five dimensions used were: distribution of potential return/market risk, risk of technical/regulatory failure, time to market, capability, and costs already incurred. Distribution of potential return/market risk indicates the probability that the product innovation's potential return will be below, near, or significantly above the average return of the firm's innovation projects which will depend on consumer acceptance. Risk of technical/regulatory failure specified whether the product innovation project is expected to have some significant technical/regulatory hurdles or not. Time to market defines whether the product innovation will reach the market and generate revenue in the short or long term. The capability criterion indicates whether or not the product innovation project will require working with other firms to have access to all the capabilities (financial resources, technological skills, infrastructure, capital equipment, and access to customers). Finally, costs already incurred refers to the amount of the product innovation project's total budget that has already been spent.

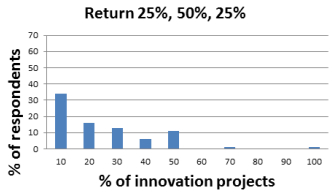
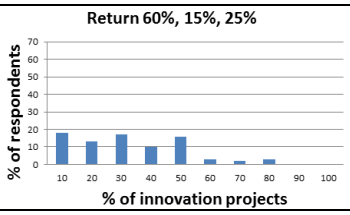
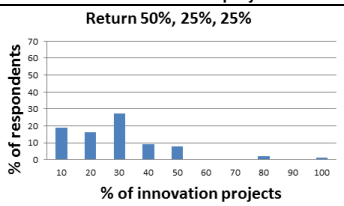
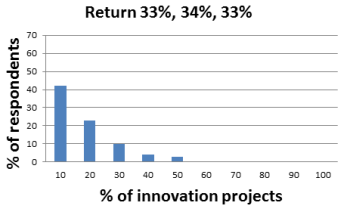
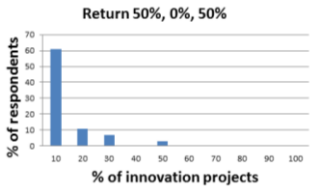
Table 4 summarizes the survey results in regards to the firm's portfolio of product innovation projects across a spectrum of risk/return distributions. The mean of the portfolios across respondents suggests that companies have a diversified set of product innovation projects with regards to return. They however maintain some bias towards distributions with high percentages for the probabilities near and above the hurdle rate (e.g., Return 60%, 25%, 15% and Return 50%, 25%, 25%), i.e., with low relative market risk. The distribution of individual firm responses indicates that the variable return (50%, 0%, 50%) is the most skewed to the left which indicates that the smallest portion of the companies' product innovation portfolio is made of projects with high potential return but also high potential unacceptable returns. The second distribution the most skewed to the left is (33%, 34%, 33%), followed by (25%, 50%, 25%), (50%, 25%, 25%), and (60%, 15%, 25%). These distributions suggest again that respondents prefer product innovation projects with low relative market risk.

As for risk of technical/regulatory failure, on average, the product innovation portfolio of companies presents a majority of projects with low-risk of technical/regulatory failure. The distribution of individual firm responses for this variable is bi-modal with a slightly greater percentage of companies with a portfolio heavily rich in product innovation projects with low risk of technical failure. The bi-modal distribution suggests a fairly heterogeneous group when it comes to investments in low or high technically/regulatory risky product innovation projects.

As for the capability characteristics, portfolios include a majority of in-house product innovation projects on average. However, the distribution of the in-house variable suggests that companies

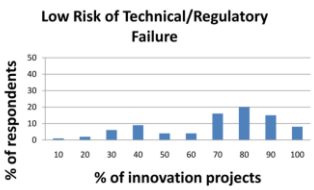
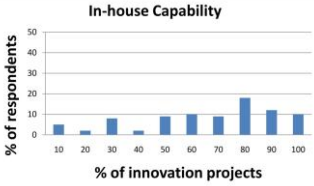
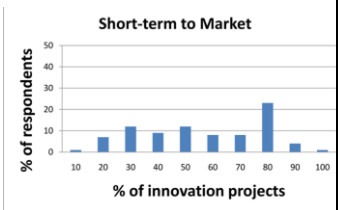
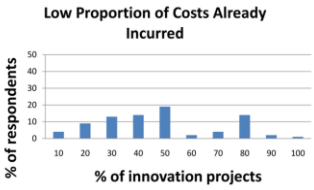
are again fairly heterogeneous in their portfolio regarding capability. Finally, on average, companies have diversified their product innovation projects when it comes to costs already incurred and time to market. However, the distributions suggest heterogeneity in those characteristics from one company portfolio to another.

Table 4. Innovation Portfolio of Food and Agribusiness Companies[3]

<table>
<tr><th>Question</th><th>Variable</th><th>(Mean) Standard Deviation</th><th>Distribution of Individual Firm Responses</th></tr>
<tr><td rowspan="5">The table below provides five different levels of uncertainty in the potential return of innovation projects. What is your estimate of the proportion of your company's R&D budget that is invested in projects at each level of uncertainty?
<table>
<tr><th colspan="3">Probability of potential return relative to the Hurdle Rate</th><th rowspan="2">Percentage of your R&D Budget</th></tr>
<tr><th>Above</th><th>Near</th><th>Below</th></tr>
<tr><td>25%</td><td>50%</td><td>25%</td><td></td></tr>
<tr><td>60%</td><td>15%</td><td>25%</td><td></td></tr>
<tr><td>50%</td><td>25%</td><td>25%</td><td></td></tr>
<tr><td>33%</td><td>34%</td><td>33%</td><td></td></tr>
<tr><td>50%</td><td>0%</td><td>50%</td><td></td></tr>
</table></td><td>Return 25%, 50%, 25%</td><td>20.96% (18.88%)</td><td> 
</td></tr>
<tr><td>Return 60%, 15%, 25%</td><td>29.91% (20.69%)</td><td> 
</td></tr>
<tr><td>Return 50%, 25%, 25%</td><td>26.16% (18.00%)</td><td> 
</td></tr>
<tr><td>Return 33%, 34%, 33%</td><td>13.82% (12.51%)</td><td> 
</td></tr>
<tr><td>Return 50%, 0%, 50%</td><td>9.15% (11.91%)</td><td> 
</td></tr>
</table>

[3] Please note that the y axes for all the graphs/histograms have a maximum of 50% (except the y axis for Return 50%, 0%, 50% which goes up to 70%) to allow for comparison and an easy read of the table.

Table 4[4]. Continued

Questions	Variable	(Mean) Standard Deviation	Distribution of Individual Firm Responses
What are the percentages of your company's product innovation projects with: Low risk of technical failure: Exclusively or primarily in-house capability: Short-term to market: Low proportion of the total budget already committed:	Low risk of technical failure	23.69% (67.87%)	
	Exclusively or primarily in-house capability	26.34% (64.33%)	
	Short-term to market	23.07% (55.34%)	
	Low costs already incurred	22.35% (46.94%)	

Some industry and company characteristics were found to impact the characteristics of the product innovation portfolio. For example, the data indicate that smaller firms (lower revenues and firms of small scope) choose fewer risky product innovation projects: they have more short-term projects and fewer technically risky projects. Meanwhile, larger firms are more likely to have product innovation projects with the return distributions (60%, 15%, 25%) and (50%, 25%, 25%), i.e., projects with lower relative market risk. As for industries, the food sub-industry differs significantly from the other sub-industries in terms of product innovation with more short-term projects, more in-house projects, and slightly higher acceptance of low returns distributions which increases the relative market risk. On the other hand, the results indicate that the crop inputs sub-industry chooses product innovation projects with higher probabilities of high returns, i.e., low relative market risk. Finally, the number of functional areas involved in the selection of product innovation projects does not make the portfolio more diversified and does not significantly change the portfolio. Nonetheless, companies involving the sales department in the selection process of product innovation are likely to have more short-term projects and fewer technically risky projects.

[4] Please note that the y axes for all the graphs/histograms (except the y axis for Return 50%, 0%, 50% which goes up to 70%) all have a maximum of 50% to allow for comparison and an easy read of the table.

Cluster Analysis

A review of the distribution of the characteristics of the innovation portfolio suggests that logical clusters of businesses exist with regard to their product innovation portfolio. It was of interest to identify these different clusters, search for differences between them, and, in so doing, gain more insights into the innovation practices of food and agribusiness companies. Cluster analysis was used to define these logical groupings of businesses in terms of four dimensions[5]: technical/regulatory risk, time to market, capability, and costs already incurred. We used the two-step clustering algorithm discussed in details in Roucan-Kane et al. (2010) which resulted in five distinct clusters (see Table 5). The first step is the use of a hierarchical clustering algorithm (Ward's Minimum Variance) to identify the appropriate number of clusters and obtain seed values that are being used in the second step, the non-hierarchical clustering algorithm (k-means). This two-step method yields more stable and reliable results than a hierarchical clustering algorithm (Larson 1993).

The five clusters identified in the cluster analysis were next characterized and labeled using McGrath and MacMillan's classification (2000) and described as follows:

- Platform launchers do not take too much risk: the majority of their product innovation projects has a low technical/regulatory risk and is short-term to market. These portfolios are also in line with tradition and status quo with a dominance of product innovation projects with in-house capabilities and high proportion of costs already incurred. This cluster includes the largest number of respondents.
- Enhancers take on slightly more technical risk and less market risk than platform launchers when it comes to product innovation projects. This cluster is also the cluster with the lowest percentage of product innovation projects with high costs already incurred and long-term to market.
- Scouters differ from the previous two groups by having a majority of long-term product innovation projects and slightly more technically risky projects. This is the cluster with the largest percentage of long-term projects and the lowest percentage of projects using partner capabilities.
- Positioners represent the only cluster with a majority of product innovation projects in the high technical risk category. It is also the cluster with the second largest percentage of long-term product innovation projects behind the scouters.
- The partner oriented cluster is the only cluster reporting a majority of its product innovation projects using partner capability. This cluster is also more diversified than the others in terms of time to market and costs already incurred. This cluster is the second largest.

Table 5 shows that the platform launchers and the enhancers, which are the two clusters that take the least amount of risk, represent about half of the sample - - indicating that the food and agribusiness industry is a fairly conservative industry in terms of product innovation. Yet, this research shows that despite the challenges associated with open innovation, (i.e., generating and producing ideas with other companies), a significant amount of product innovation projects are done with open innovation in the food and agribusiness sector. Indeed, the partner oriented cluster, which is primarily focused on open innovation, represents the second largest cluster in this

[5] The dimension return did not reveal any likely clusters.

data with 22% of companies. In addition, the other clusters have a non negligible percentage of projects using partner capabilities.

Table 5. Cluster Analysis for Innovation Portfolio

	Portfolio Clusters				
Factor	*Platform Launchers*	*Enhancers*	*Scouters*	*Positioners*	*Partner Oriented*
High technical/ regulatory risk	21% (14%)*	26% (14%)	31% (22%)	73% (12%)	30% (21%)
Partner capability	23% (14%)	31% (19%)	17% (13%)	33% (19%)	75% (16%)
Long-term projects	28% (10%)	21% (12%)	72% (7%)	68% (13%)	56% (19%)
High costs already incurred	65% (13%)	19% (8%)	39% (18%)	70% (13%)	56% (20%)
Percent of sample	35%	14%	15%	13%	23%

Significant additional differences in the selection of product innovation projects can be seen within this industry by cluster. More conservative clusters (platform launchers and enhancers) tend to be smaller in revenue, scope, and governance structure. The scouters and positioners, both representing the clusters with the larger share of long-term product innovation projects, are less likely to involve the sales department - - suggesting again that sales representatives may favor short-term product innovations. These two clusters also represent firms with larger revenues suggesting a relationship between revenue and long-term commitment. As for selection method, scouters are significantly more likely to use graphical analyses. Although we have no apparent justification for it, the partner oriented cluster has a significant smaller proportions of firms committed to innovation. This cluster is also the third cluster with a majority of its product innovation projects being long-term to market. Along with the other two clusters committed to long-term projects, this cluster represents firms that are global—confirming the significant effect of scope on the time to market dimension of the portfolio.

The analysis of the clusters by company and industry characteristics did not yield additional differences and implications. For example, the different sub-industries did not fall into specific clusters suggesting that an innovation portfolio may be a function of company but not industry characteristics. In addition, the number of functional areas did not significantly vary across clusters and the use of specific functional areas (besides the sales department) was not descriptive of specific clusters. Besides graphical analysis, the same held true for the use of selection methods. This lack of significant results suggests that belonging to a specific cluster may not be so much a question of which innovation selection management approaches are being used but potentially how enhanced or structured those approaches might be which was not tested. Alternatively, there might be details within the use of a functional area or selection method that could impact the portfolio of innovation projects and therefore its location in a specific cluster.

Conclusion

This study focuses on the approaches used by U.S. food and agribusiness companies when selecting product innovation projects. The innovation management literature suggests the use of cross-functional teams and selection methods for companies to be more successful[6] at selecting innovation projects. The results of this study show that managers are implementing these theories: they involve several departments and use several selection methods when selecting innovation projects. Specifically, food and agribusiness companies usually involve more than three departments/functional areas in the selection of product innovation projects. The results also suggest that sales representatives potentially because of their bias for shorter-term projects are less likely to be involved in the selection of product innovation projects. A variety of selection methods are being used in the selection of product innovation projects; the selection methods the most often cited are economic models, followed by informal methods, structured assessments, and graphical analyses. Yet, 24% of the companies in the sample do rely exclusively on one method, with half and a fourth relying on informal methods and economic models, respectively. Cooper et al. (2001) found that companies relying heavily on economic models or on one selection method in general may not generate portfolios of innovation projects that perform as well as companies incorporating more qualitative analyses.

In terms of portfolios, companies tend to diversify their product innovation projects in terms of time to market and cost already incurred. However, in general, companies favor product innovation projects that are done in-house, are not characterized by large risk of failure or high relative market risk. This suggests a conservative U.S. food and agribusiness industry in terms of innovation strategies. Yet, the cluster analysis indicates that at least half the companies surveyed are not that conservative. For example, about 13% of the companies in the sample are willing to initiate highly technically and regulatory risky product innovation projects. Approximately 23% of the sampled companies are highly willing to share capabilities with partners to embark in their innovation endeavor. And over 37% of the companies are willing to invest in long-term product innovation projects.

This research clearly indicates that company characteristics (such as revenues, scope, governance structure) and industry differences do affect the product innovation portfolios and innovation practices of firms. For example, larger firms and publicly traded firms tend to have a more structured selection process (more structured assessment, more economic models, more long-term projects that carry high risk of technical/regulatory failure) maybe because of their larger pool of resources, and in the case of publicly traded firms, because of shareholders' pressure to generate satisfactory results. As for industry differences, the crop input sub-industry (crop protection, fertilizer, seed, and biotechnology) tends to use more functional areas and is more likely to use marketing executives in the selection process than the other sub-industries (animal nutrition, animal health, capital equipment, and food). Meanwhile, the food sub-industry differs significantly from the other sub-industries with a focus on more short-term projects, more in-house projects, and slightly higher probability of accepting low returns which increases the relative market risk.

[6] Cooper et al. (2001) define best innovators/performers as companies that have high value projects, the right balance of projects, a portfolio that fits the strategy of the firm, the right number of projects, etc.

What can managers learn from these results and this paper? Before answering this question, it is important to mention that given the lack of consensus on how to measure the success of innovation (e.g., Subramanian and Nilakanta 1996; Sampson 2007; Ahuja and Katila 2001) and the limited previous work on innovation in the agricultural sector, we did not attempt to study which selection approaches lead to the best innovators. This paper focuses on indicating what previous research has shown to be the selection process of the best innovators across industries, and whether food and agribusiness companies are implementing those approaches. Researchers indicate that it is critical for managers to form cross-functional teams that use a variety of selection methods to successfully assess product innovation projects. They also suggest that this assessment should be done frequently to continuously evaluate the potential success of the innovations, reduce the risk of potential failure, and limit the research and development costs. This study shows that food and agribusiness companies are, on average, following these characteristics of best innovators, and do involve several departments and selection methods when assessing their product innovation projects. Based on interviews with executives, the authors list potential return, market uncertainty, technical/regulatory uncertainty, time to market, access to capabilities, and costs already incurred as criteria to include in the selection methods. It will also be important for executives to give guidelines to their cross-functional teams particularly when it comes to the direction the company wishes to take regarding market risk, technical/regulatory risk, and open innovation. The industry the company is in, as well as the company characteristics, will likely play a role in the sophistication of the selection process but the frameworks to follow should be the same.

This study opens the door to many more studies on the selection of product innovation projects by food and agribusiness companies. First, this paper focuses on product innovation and could be a starting point for a study on service innovation, which is an area of growing importance (Killen et al. 2007). Second, one of the limitations of this study is that the sample was a sample of convenience focusing on food and agribusiness companies. A larger study with more industries and more respondents would allow for more generalization and the testing of more hypotheses. A similar study could also be implemented in other countries which would provide a greater wealth of knowledge and show the effect of differences in institutional constraints (Lin et al., 2008) or cultural differences (Kogut and Singh 1988). The cluster analysis in this paper also reveals significant heterogeneity in the sample regarding companies' portfolio characteristics indicating that some food and agribusiness companies are willing to take on risk and are on the path to true disruptive innovations while others are being more conservative. It is necessary to study these true innovators further and determine their characteristics as this will help create guidelines to increase innovation in the food and agribusiness sector.

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Factors for Successful Development of Farmer cooperatives in Northwest China

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Abstract

Farmer cooperatives in Northwest China first appeared in the 1920s. Their development has been strongly influenced by the external environment and political approaches to cooperative promotion. Although farmer cooperatives have developed rapidly in China in the last three years, progress has not been uniform across the provinces, due to differences in farmer education levels and varying economic and social situations. In order to identify factors for the successful development of farmer cooperatives in Northwest China, two cases of provincially approved successful farmer cooperatives in Shandan county of Gansu province were chosen for this research. The results revealed that a stable legal environment; a dedicated initiator and leader; government financial and technical support; farmer understanding and participation of cooperative activities and appropriate external support from professional NGOs were the key factors for the successful development of farmer cooperatives in Northwest of China. This study also found some challenges that farmer cooperatives have faced in their development. The successful development of the cooperatives studied showed their significant influence on both their members and the local rural community.

Keywords: Chinese cooperatives, successful factors, cooperative development, Northwest China

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Introduction

Farmer cooperatives in Northwest China appeared in the 1920s. Their development has been strongly influenced by the political environment and the political approaches to cooperative promotion. Farmer cooperatives developed faster in the 1950s due to government authority changes from Kuomingdang (KMD) to China Communist Party (CCP) and the implementation of the Agriculture Cooperative law in 1956. However, the implementation of government policy, which changed cooperatives into people's communes, caused the stagnation of farmer cooperative development from the 1960s to the early 1980s. After the 1980s, farmers tried several types of economic organizations in response to the change from a planned to a market economy. Before 2007, different types of cooperatives developed in China due to the lack of cooperative policy and law and other government influences (Fock & Zachernuk 2005; Zhang 2007).

Realizing the importance of farmer cooperatives in rural development in China, the government enacted a Farmer Specialized Cooperative Law which came into force in 2007 to promote and guide farmer cooperative development. According to this law, a farmer cooperative should be set up by following the principles: (a) farmers play the dominant role amongst its members; (b) the key purpose is to serve members and act in the common interests of all members; (c) the members shall join and exit voluntarily; (d) all members are equal and cooperatives are democratically controlled; (e) surplus should be redistributed, based on the volume of members' patronage (NPC 2006[1]). Although this law provided a legal environment for the establishment of cooperatives in China, it is still not apparent how to successfully develop and operate cooperatives. Therefore, identifying the factors that could contribute to the successful development of cooperatives in China would help the promotion and future viability of farmer cooperatives. In the last few years, several studies have been done but most of them were based in the developed cooperative region of the eastern parts of China (Han et al. 2006; Yu 2009; Zhang and Yuan 2010). There is limited research on farmer cooperatives in Northwest China, especially in the western part of Gansu province.

The aim of this paper is to identify and discuss factors contributing to the successful development of farmer cooperatives in Northwest China and the Gansu province in particular. The aim is achieved by the following objectives: 1) to overview the evolution of farmers' cooperatives in China; and, 2) to analyze factors influencing the successful development of farmers' cooperatives in Gansu province.

In this paper, a successful farmer cooperative is define as follows: (a) it runs regular all-member meetings by following a democratic control principle; (b) its members are able to regularly access the cooperative's financial reports and there are bylaws in place to guide the management in the areas of marketing, financial management and staff management; (c) it provides a standard service for all its members and demonstrates stable relationships with its members; (d) it offers technical training and it guides the process of production and marketing; (e) it implements a united production system and products are marketed together; (f) the total service and annual business income of the cooperative should be more than one million yuan (RMB 1000,000 Yuan—200,000NZD); (g) it has a close business relationship with local farmers (non-cooperative

[1] Article 3/chapter 1/ paragraph 4

members) and plays a leading role in the improvement of the local agriculture industry (Nongjingchu 2008).

The paper is structured in five sections. Section two summarizes the cooperative development in China. The methodological approaches used in this study are presented in section three. Section four provides analysis and discussion while the final section outlines some conclusions.

Overview of the Development of Farmer Cooperatives in China

The development of farmer cooperatives in China can be categorized into four periods: pre 1949; from 1949 to early 1980s; early 1980s to 2007; and 2007 to present.

During the pre 1949 period, both government and non government organizations tried to promote modern cooperatives in rural China. However, due to the different understanding and approaches in promoting cooperatives, results and efforts were different. KMD followed a "three principles of cooperation' 'top down' approach by forcing residents' participation. Farmer cooperatives, influenced by the CCP cooperative ideology, were established by following a 'bottom up' approach and were more productive and their members were more active. Producer's cooperatives, consumer cooperatives, marketing cooperatives and credit cooperatives were the main types of farmer cooperatives developed (Jxcoop 2005).

In 1949, the establishment of the People's Republic of China (PRC) brought a new era for the development of farmer cooperatives in China. In the 1950s, the land reform program made farmers into landowners which raised farmer's enthusiasm (Tung 1959). A new agricultural cooperative law was enacted by the government to develop and guide farmer cooperatives. However, the government viewed the transformation from individual farmer proprietorship to collective farming as a long-term process and they recognized that collectivization was the way to mobilize rural surplus labor (Perkins & Yusuf 1984). This transformation process proceeded gradually, through three distinct phases: 1) mutual-aid team which was voluntarily formed by six or more households; 2) 'semi-socialist' or 'low' agricultural producing cooperatives, where land would be pooled and farmed cooperatively, whilst the farmers still retained their ownership of land; and 3) 'higher' or 'advanced' cooperatives, where private land ownership would be abolished (Meisner 1986). This policy resulted in the rapid growth of farmer cooperatives in rural China. In 1956, there were approximately 75,410,000 households, (or 62.6% of the nation's members), involved in either semi-socialist cooperatives or socialist cooperatives while in 1955 there were only 16,920,000, (14.2% of the nation's members (Tung 1959). In 1958, due to the political climate, the government forced the 'lower level' cooperatives to be merged into 'higher level' ones, which was represented by phase three of the original vision (Perkins & Yusuf 1984). As a result in the early 1960s, 26,000 communes were created and each commune comprised about 5,000 households or 40 villages. Under this commune operating system, each commune planned its own activities, including the overall management of its small industries, secondary education and hospitals. It covered almost everything related to its members' lives (Warshaw et al. 1973; Perkins & Yusuf 1984). This 'rushed' government policy failed due to the lack of mass support plus bad weather. Farmer cooperatives stagnated in the 1960s and the 1970s (Tung 1959; Warshaw et al.1973).

The period early 1980s until 2007 was characterized by the implementation of the household contract responsibility system (in the 1980s) based on the central government decision in 1978 and the establishment of farmer specialized cooperatives and associations (in the 1990s). The household contract responsibility system together with remuneration linked to output was the main policy tools for the reform in rural areas. The people's commune system was cancelled and a system of township government was restored. Farmers were given greater freedom to choose which crops to cultivate and the household became the dominant unit of production (Croll 1987; Vermeer 1987). This reform greatly enhanced and stimulated farmers' motivation and it resulted in a sufficient increase in agricultural production and rural incomes (Vermeer 1987; Shi 1998). Towards the end of the 1980s, various households (with common specialties) combined and specialized associations began to appear. However, since there was no prompt formulation of cooperative law, those specialized farmer associations could not register and obtain legal status as cooperative enterprises. They were unable to carry out independent economic activities. These types of new farmer associations were left to live or die (Liu 2007; Yuan 2008).

In the 1990s, earlier experiments in enterprise forms began to spread nationwide, following the publication of the Ministry of Agriculture circulars, aimed at standardizing models. At this stage, attention was particularly focused on specialized production within technical associations; the reform of township and village enterprises into shareholding cooperatives; and rural cooperative fund associations (Clegg 2006). By 1997/1998, the ground rules for the agricultural economy began to fundamentally change, as emerging national markets in agricultural produce shifted, from a supply to a demand orientation (Zhang 1999). Farmer Specialized Cooperatives had begun to emerge, especially in fruit and vegetable sectors. These specialized cooperatives were involved in pre- and post-farm production activities, in relation to purchasing, processing and marketing (Shen et al. 2005; Clegg 2006). In the 1990s and early 2000s, there were two main types of farmers' economic organization, which included farmers' specialized association and farmers' specialized cooperative. The main difference between these two forms was the ownership of fixed assets and the functional activities (production, marketing, or processing). Specialized cooperatives were registered with the Administration of Industry and Commerce Bureau and had fixed assets while Farmer specialized associations were registered at the Civil Affairs Bureau and they normally did not have any fixed assets (Hu 2007). It was clear that the lack of legislation has affected the development of farmer cooperatives in China. In 2006, the Chinese Farmer Specialized Cooperative law was enacted aiming to formalize and standardize the farmers' economic organizations and took into place in 2007.

After 2007, with the release of the Farmers' Specialized Cooperatives Law (2007) and various governmental support polices, farmer cooperatives developed very rapidly in rural China. According to the data from the Ministry of Agriculture (MOA), there were 310,000 registered farmer cooperatives with 26,000,000 households members (about 10% of the total national farmer households) in June 2010. These farmer cooperatives have shown remarkable results in the acceleration of the agricultural development and an increase in farmers' revenue (Yuan 2008). Therefore, the development of farmer cooperatives has become a highlight in the innovation of China's agricultural management organizations and systems (MOA 2011).

Methodology

Qualitative methodology was employed in this research using a case study approach. Shandan County (in Gansu Province) was chosen as the study site for its location (Northwest China), its uniqueness in having a local (county level) professional cooperative development NGO, lower levels of both industrial and rural cooperative development —and offered easy access for the researcher. Dongwan Lvdadi Melon and Vegetable Growing Cooperative and the Ronghua Growing cooperative were selected for this study following the recommendations from the county Agriculture Bureau and the Shandan Cooperative Federation (NGO-independent organization). The evolution of these two cooperatives reflects the development of farmer cooperatives development in this region (see Appendix 1). They also met the criteria and went through an approval process (see Appendix 2) deeming them in the top 100 provincial cooperatives. This criteria is mainly reflected in cooperative annual income and its impact on the local community.

Secondary data were collected from reports (both published and unpublished) undertaken by the Agriculture Bureau of national, provincial, district and county level and the Shandan Cooperative Federation (NGO) and government. Data, such as the cooperatives' constitution and bylaws of financial management, relating to the cooperatives were also collected from the cooperatives studied.

Primary data were collected through face-to-face semi-structured interviews. Interviewees were selected using purposive sampling and included cooperative leaders, cooperative members, government officials and NGO representatives. Nineteen interviews were conducted using a questionnaire. Data were analyzed using categorizing and pattern-matching structure (Yin 1994). Ethics issues were a high concern in this research, particularly relating to the participants' privacy and confidentiality.

This study was limited as it involved only two farmer cooperatives in Shandan County, Northwest China due to time and capital limitations. The 'household' membership structure and the future successful cooperative development with a higher number of cooperatives involved needs to be further studied.

Results and Discussion

The Dongwan Lvdadi Melon and Vegetable Growing cooperative is located in Dongwan village (Weiqi township) of Shandan county (Figure 1). It was initiated by Wang Deqin, who is a farmer but also a party secretary of the Dongwan village party commission. This cooperative produces mainly onions and markets them using contracts. Seventy-nine melon and vegetable growers formed the initial establishment in 2007, and grew to 486 members (some of them coming from outside of Dongwan village) by 2010. The cooperative also has 1,500 associate members who produce the same products but cannot vote (see Appendix 3). At the end of 2009, this cooperative was approved by the Gansu provincial government as one of the 122 pilot cooperatives, within Gansu province. It was also evaluated as one of the top 100 provincial cooperatives by Gansu provincial government (Nongjingchu 2009).

The Ronghua Growing cooperative is located in Shanyangpu (Dongle township of Shandan county (Figure 1). It was initiated by Yin Huawen, an ordinary farmer who has large contract land. Initially, 18 farmers joined and established this cooperative in 2007. This is the first officially registered farmer cooperative in Shandan County. In 2010, the number of membership has increased to 106, and they are all from the same village. This cooperative produces maize seed, Chinese herbs, and now tries to grow some vegetables. They market maize seed by contract (only about 60% of its products) and sell the other products locally (see Appendix 3). In 2009, Ronghua cooperative was approved by Gansu provincial government as one of the 122 provincial model cooperatives.

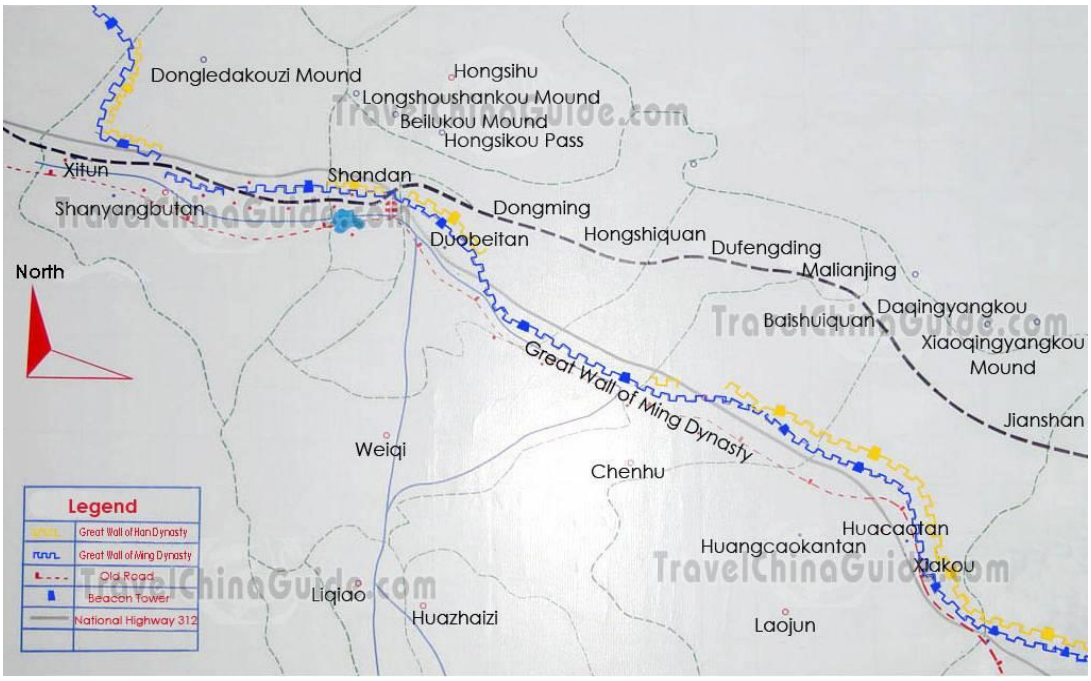

Figure 1: Map of Shandan

Legal Environment and Government Policy

Several key factors influenced the successful development of the two cooperatives. First, a stable legal environment and appropriate government policy were important for the successful development of the cooperatives studied. This is similar to Sargent's (1982) comparative analysis of cooperative development in seven countries which included UK, Ireland, the USA, Denmark, the Netherlands, France and Italy. This is also similar to a few studies (Han et al. 2006; Yu 2009; Zhang and Yuan 2010) of farmer cooperatives development in the middle and eastern area of China.

Government policy also had a strong influence on farmer cooperative establishment and development. The evolution of farmer cooperatives in China, in the 1950s and from 2007 onwards, showed the importance of government policy in fostering farmer cooperative development. The case of Northwest China where government policy affects almost all economic activities in some

form or another though differs from Bekkum (2001) who identified in his research that government policy has a limited impact on cooperative development in liberalized countries.

The implementation of the cooperative law (with its stricter specifications) also speeds up and standardizes the establishment of farmer cooperatives at the early stage of their development. The unsuccessful experience of farmer cooperative development in the 1950s in China provided a good lesson for both the government officials and farmers today. Cooperatives successfully develop only when members work for the community instead of just for their own gains (Cheney 1999).

Another interesting finding was that although the government supported policies such as free registration, free training, easy access to capital and financial support, all aimed to foster the cooperative development; some farmers may join without being fully committed to the cooperative and its operations.

Cooperative Initiator and Leadership

The establishment and development of the two cooperatives shows that a dedicated initiator with vision, business and management capacity, who is well educated, with an enthusiasm for innovation and being open-minded and who also has excellent communication skills, is critical for the success of the farmer cooperatives studied. This is similar to Banaszak (2008) analysis in Poland who also stated that the initiator/s of the cooperative/s were key factors for success. Similarly, Zhang and Yuan (2010) further argued that people who found the cooperatives, often as cooperative core leaders had a big influence on cooperative development. Therefore, in order to ensure ongoing successful development, cooperative initiators need to continually enhance the strength of leadership. This strength of leadership may include their vision and spirit as well as a time commitment to the organization, together with their honesty and openness.

This study also found that the roles that the initiators played were very complicated. They had three roles. As a board member, the initiator had the role to show his vision and governing ability for the cooperative to develop. As a member of management, the initiator had the responsibility to administer the cooperative properly to achieve the cooperative's goals. As a member of the cooperative, the initiator had to produce a certain amount of products to complete the contract with the cooperative and commit to the future development of the cooperative. The two initiators of the cooperatives under study here played key roles for the success of their cooperatives. This has been a challenge for cooperatives like the Ronghua cooperative where the majority of cooperatives members have a very low level of education and technical skills, and lack of capital resources.

Cooperative Members

The study of these two cases showed that cooperative members are fundamental to the success of their cooperative. As the literature suggests, the success of a cooperative is determined by the members' knowledge of their organization; their education level; technical skills; participation; commitment; and the relationship between members and managers (Harris at al. 1996; Fulton 1999). The results of this study suggested similar results and identified members as an important

factor for success. It further revealed that members' knowledge of their cooperative, member technological skills and their participation at cooperative meetings and training courses were especially important for the successful development of farmer cooperatives in the less developed area of Northwest China.

This study also showed the influence of the household membership structure on the development of farmer cooperatives in Northwest China. The cooperative membership is based on household, which meant each household/member has one vote in the cooperative. In the early stages of cooperative development the household membership contributed positively to the successful development of the cooperatives. However, in the future changes can occur as to who represents the household and who does the actual farming. This study suggested that mainly women were doing most of the farming while men (traditionally head of the household), working as migrants somewhere else, were attending the cooperative meetings and participating in the decision making process. In the future, women might start requesting more voice in the cooperative representation and decision-making.

The change of membership from homogeneity to heterogeneity is another issue in the case of the Dongwan cooperative. Research of cooperative development in Poland revealed that homogeneity was a factor that influenced the success of cooperatives (Banaszak 2008). The study of Dongwan cooperative suggested that the change from homogeneous (members only from one natural village) to heterogeneous (more associate members from other villages and townships) could help the cooperative grow and increase its income. However, this change is likely to affect the cooperative's future development in both positive and negative ways. In a positive way, the increased size of the cooperative will support the cooperative growth. This will help the cooperative to produce more and increased market power, which will lead to increasing the members' income. The importance of market power and scale is consistent with Brunyis et al. 2001 that found that adequate business volume and adequate marketing agreements were critical success factors for cooperatives. But the increased number of cooperative members has the potential to cause conflict amongst the members—and the members and management. Furthermore, conflicts could exist between formal members and associate members. These conflicts have the potential to influence the effectiveness of the cooperative's operation.

Cooperative Governance

This study found that the governance structure of the two cooperatives was well defined due to the criteria for cooperative registrations (following the cooperative law). It is clear that a well-informed governance structure is important for the success of a cooperative (Chaddad & Cook 2004). It is about the relationships between the cooperative's members and their board and management (Bird 2001). However, this study also found that although farmer cooperatives in Northwest China have a well formed governance structure due to the requirement of official registration, this did not necessarily mean that all the members fully understood why and how cooperatives worked. This is quite different to other studies, where the organizational innovations often showed a long initial phase of build-up and experimentation before they were functional (Fairbain 2004).

Cooperative Management

Study of the two cooperatives showed that high level efficient internal management, transparency, democracy and excellent communication between members and management were important for the successful development to the cooperatives. This is similar to the studies, such as Sargent's (1982) in USA, Suksawang's (1990) in Thailand and Han et al (2006) in China in the Zhejiang, Shandong and Hebei provinces. However, this study further focused on the importance of members' understanding, communication and support for their management. The cooperatives studied identified that management and governance work were done on a voluntary basis (no pay) in the early stages of development.

Literature revealed that management of cooperatives is a crucial factor to success or failure. Indicators, such as sound finance, increased income, marketing capability and business planning and management could all be used to measure the economic and business outcomes of the success of farmer cooperatives (Suksawang 1990; Bruynis et al. 2001; Fulton 2004; UN 2005), This study demonstrated that the financial and business management of the cases studied was successful as the members increased their income, their turnover also increased and there was significant market development in the last two years. However, the results also revealed that the selection of a core product which fit the natural resources and market needs (like Dongwan cooperative mainly producing onions) was also important for the success of the cooperative. This is similar to Pan's (1999) research of farmer vegetable growing cooperatives in Shandong province in China.

Another important finding was that working with contracts, both with the 'customer' companies and its own members, played a significant role for their success of business management. Signing contracts with customers, in the case of the Dongwan cooperative, guaranteed them markets, which reduced their markets risks and allowed them to plan their business ahead. Signing contracts with members was also a good business practice, at their early stage of cooperative development, adopted by both cooperatives.

Training and Education

Training and education, as one of the cooperative principles, has been recognized as an important factor for the successful development of cooperatives worldwide. The results revealed that regular training has partially increased members' understanding and knowledge on cooperatives and their potentials. This study further suggested that the participatory approach such as role playing is an efficient training tool for the members with limited education. In the Ronghua cooperative most of the women (around 40 years old) involved in the cooperative activities had only two to four years education. With the limited level of literacy, trainers (Shandan Cooperative Federation) developed hands-on and role-play methods that help the members to gain some general cooperatives skills. Furthermore, finding the balance between technical and cooperative training was also important for the successful development of farmer cooperatives in Northwest China.

Problems and Opportunities for Future Cooperative Development

Cooperatives face five general problems in their development such as horizon problem, free rider problem, portfolio problem, control problem and influence on cost problems (Cook 1995; Zeuli

1999; Baldwin 2001; Egerstrom 2004). Although this study has demonstrated that farmer cooperatives in Northwest China could be successfully established and developed, there were also signs that these two cooperatives have also faced some common problems. First, following the cooperative business expansion and increase in income, members might ask for more income instead of investing further in the cooperative which would appear as a 'horizon problem'. Second, the increasing number of cooperative associate members in the case of the Dongwan Cooperative suggested a 'free-riders' problem. Third, the increasing gap between larger producers and smaller producers might cause decision-making problems. Furthermore, smaller producers might gradually lose their confidence in the cooperative if only the larger producers formulate the policy and become dominant in the cooperative business. Fourth, as the cooperatives grow, especially in size, misunderstanding between members and governance and management might arise and cause 'control problem' Fifth, the cost of management has been increasing which might become more demanding on committee members' time and finances as cooperatives become bigger, indicated as 'influence on cost problem'. Last, due to the characteristics of 'household' membership, there could be conflict among the household members when the incomes from their cooperative economic participation increase. Who participates in the meetings could also affect the successful development of cooperatives. It seems likely that farmer cooperatives in Northwest China such as the Dongwan and Ronghua cooperatives, will face the common development problems described above thus the board, management and members of the cooperatives in Northwest China toned to address these issues in their future planning.

Other problems influencing farmer cooperative development in Northwest China would be the danger of government over-intervention. Although this study revealed that government support was very important for the establishment of farmer cooperatives, it also indicated that government over-intervention could negatively affect these cooperatives. Therefore, government officials have to find a balanced approach to foster, guide, support but not to intervene in cooperative management.

This study also outlined some opportunities for farmer cooperatives in Northwest China. The stable legal environment together with government supporting policy in rural development has created a better social environment for developing farmer cooperatives. These support policies for training and financial support might enable cooperatives to develop faster and grow larger in a short period of time. The current land leasing policy also facilitates cooperative growth. Increased market demand (local, provincial and national) for safe and high quality agricultural products is another opportunity for farmer cooperatives in Northwest China. As the farmer cooperatives develop, the small cooperatives might get together and form federations, which would increase their market power and provide more services for their members. Therefore, cooperation with other cooperatives in different regions could be perceived as another opportunity for farmer cooperative development.

Conclusion

Farmer cooperatives in Northwest China first appeared in the 1920s. Their development has been strongly influenced by the political environment and the political approaches to cooperative promotion. Although the newly enacted Farmer's Specialized Cooperative Law (2007) aims to promote successful development of farmer cooperatives, the level of cooperative development varies in different regions of China due to different economic development and different levels

of cooperative understanding. The farmer cooperatives in Northwest China are still at their initial stage. Factors such as a stable legal environment, government support, a dedicated initiator, farmers understanding and participation of cooperative activities, transparent and efficient internal management; product orientation, cooperative and technical training, and appropriate external support from professional NGOs could contribute to the successful cooperative development in Northwest China.

The successful development of these two cooperatives in Shandan county showed their significant influence on both their members and the local rural community. A stable legal environment and government policy builds up farmer confidence in the potential of cooperatives. Farmer cooperatives in Shandan County, Northwest China could grow bigger and stronger with better management capability, better member participation and better understanding of the nature of cooperatives. Farmer cooperatives could play a significant role in fostering local, social and economy development. More and different types of farmer cooperatives could be established in Northwest China to the benefit of future cooperative members.

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Appendix 1:

Evolution of Shandan Cooperative

Time	Number of cooperatives	Number of households	Other items
1952	116 (mutual-aid groups)	812	6.9 % of total farm households
1953	1132 (261/871) (mutual-aid groups)	6885	53.2 % of total farm households
1954	3 (primary farmer cooperatives)	108 (642 farmers)	Labor force 208 Land: 4323.5mu 2-3 managers to manage plan, finances etc.
1955	76 (low level)	5222 (39%)	
1956	196 (higher level)	All farmers joined	547799 mu (total)
1957	37 (reformed)		
1958	3 people commune	29 bridge; 176 production team	
1965-1982	10 people commune	91 bridge team; 532 producing team	1752 households per team (average)
1982	11 townships	2.4314 rent 54.7588 mu land	Household responsibility system established
1980-2006	60 farmer economic organizations (associations and cooperatives)	15,530 household from 115 villages in 11 townships	Household responsibility system
2007-2009	62 farmer economic organizations (45 officially registered farmer cooperatives)	15,630 households from 115 villages in 9 town-ships	Cooperative law took effect

Source: Shandan Xianzhi, 169-175. Data from report of Shandan Agriculture and Economic Administration. 2010.

Appendix 2.

Criteria and process for the approval of the top 100 cooperatives in Gansu Province

1. *Criteria:*

- Registration as a cooperative at the Industrial and Commercial Bureau, according to the Farmer Specialized Cooperative Law.
- In 2007, the total service and business income of the cooperative is more than one million yuan (RMB 1000,000 Yuan—200,000NZD) and it has a close business relationship with farmers and plays a leading role in the improvement of the local agriculture industry.
- It has a fully structured governance body. According to its constitution, all sections of governance and management have to be set up and regular all members meeting must be held, which are based on a democratic control principle. Members are able to regularly access the cooperative's financial reports. There are bylaws in place to guide the management in the areas of marketing, financial management and staff management.
- There is a standard service for all its members. The cooperative demonstrates stable relationships with its members, when sharing information about purchasing raw agricultural materials. It offers technical training and it guides the process of production and marketing. It implements a united production system and products are marketed together (those cooperatives, which have formed a product brand, have this priority to consider).

2. *Process and approval:*

- Applying should be voluntary. Any cooperative can undertake a self assessment, by following the above criteria and filling in application forms to hand in to their local county level Agriculture Bureau. The Farmers awareness, willingness, knowledge and skills about cooperative are fundamental for cooperative establishment and development.
- Local County Agriculture Bureau assesses the candidate (cooperative) and if it meets the criteria, then they report this to the Agriculture Bureau at district level.
- The Agriculture Bureau at district level has to re-check or verify the candidate cooperative and then report to the Provincial Agriculture Bureau
- The Provincial Agriculture Bureau will invite an expert committee to assess the candidate cooperative, by following the criteria set out previously and they will publicise the results of their assessment
- After a certain time, acceptance will be confirmed and approved and then publicised to the public.

(Gannongjinghan 2008)

Source:, Gansusheng Nongmuting Nongcun hezuojingji zhidaochu, Gannongmujinghan 2008: 90.
http://www.caein.com/index.asp?xAction=xReadNews&NewsID=32876

Appendix 3.

Key findings of the two cooperatives studied.

Items	The Dongwan Lvdadi Cooperative	The Ronghua Growing Cooperative
Location	Close to center town of the county	Far from the center town of the county
Background of initiator	Farmer, also village Party secretary	Farmer
Members motivation for establishment	More income and new technical skills, marketing information	More income and new technical skills, marketing information
Membership	Based on household	Based on household
Time of registration	Dec, 2007	Sept, 2007
Number of funding members	79	18
Percentage of small scale (less than 20 mu/1.3ha) members	64%	77.8%
Farmer's contracted land resources	4.3 mu/0.3 ha	3.2 mu/0.21 ha
Members experience as farmer association	Five years before cooperative	No
Number of cooperative member in 2010	486	106
Members structure	From different villages	Only from one village
Associate members	1,500 (different villages)	No
Governance structure	Well formed by following the law	Well formed by following the law
Decision-making	One member one vote	One member one vote
Main products	Onions, melon and other vegetables	Maize seeds, vegetable and Chinese herbs
Business management	Work on contracts (90% of its products)	Working on contracts (60%) and depend on current market (40%)
Financial management	Have special bylaw, maintain transparent	Have special bylaw, maintain transparent
Training and education	Regularly include both cooperative and technology	Regularly include both cooperative and technology

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Performance of Smallholder Agriculture Under Limited Mechanization and the Fast Track Land Reform Program in Zimbabwe

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Abstract

The Zimbabwean government has long been committed to expansion of agricultural production through mechanization and pursued this goal under the unpopular fast track land reform program (FTLRP). The acquisition and use of tractors by arable crop farmers in communal and resettlement state land were encouraged. This research examines the performance of the program in the Bindura District. Ninety farmers were interviewed using a multistage sampling technique of structured questionnaires to collect data on demographic background, investment levels and production in terms of costs and returns. The Stochastic Frontier Model revealed the significant impact of the program on participating farmers, highlighting the significance of land and other productive factors. While overall production and productivity remain low, triggering a hyperinflationary situation due to supply constraints, practical implications for agribusinesses are foreseen.

Keywords: agricultural mechanization, fast track land reform, agricultural development, Stochastic Frontier model, technical efficiency, agribusiness management

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Introduction

When the Government of Zimbabwe launched the farm mechanization program in 2007, the goal was to support the land reform program

and improve farm productivity on newly resettled farms where output was either beginning to decline or had never looked good since the white farmers were forcibly driven off most land (FAO/WFP 2007; Mugabe 2007). Not long after the launch of the fast track land reform program (FTLRP), it became clear that the expectations had been exuberant at best as production declined dramatically and only about 30-55% of the arable land was being cultivated (Chatizwa & Khumalo 1996; Moyo 2004; FAO/WFP 2007). Although the area cultivated after the FTLRP was considerably larger than the 10-15% attained in the pre-land reform era (Scoones et al. 2010), it was grossly inadequate to reverse the downward spiral of the Zimbabwean economy that was already underway as a result of a plethora of other factors. As the FAO/WFP (2007) mission noted, such problems as shortages of tractors and draught power, fuel, and fertilizers, under-investment in infrastructure, the disincentive effects of price controls, and absenteeism of beneficiaries of the earlier land reform, were already causing serious supply bottlenecks. Theoretically, Zimbabwe's problems at that time lend themselves to the application of induced innovation interventions of which farm mechanization could be seen to be an important component, in order to contribute to increasing land and labor efficiency.

On the occasion of the 27th Anniversary of Zimbabwe's Independence, President Mugabe called attention to the creation of a Ministry of Agricultural Engineering and Mechanization to spearhead an agricultural mechanization program (Mugabe 2007). The goal was to help realize the Government's aim of raising productivity "…following the successful implementation of the Land Reform Program…" (Mugabe 2007). According to official Zimbabwean sources the main reason for the agricultural mechanization program was to replace obsolete equipment on farms while ensuring enhanced access to farm equipment for farmers considered to be inadequately served at the inception of the program. Under the program, rehabilitation of irrigation infrastructure was also an important component. The contention was that land resettlement and the provision of inputs to farmers without the support of a strong mechanization program would impact negatively on crop productivity and food security (Mugabe 2007; Muchara 2009). As farmers got land and inputs, the missing link had therefore been mechanization, which had rendered land preparation ineffective across the country (Chisoko 2007). The failure to prepare land on time because of the shortage of tractors and machinery resulted in dwindling crop yields and consequently falling agricultural productivity. For years after the Fast Track Land Reform (FTLR), the absence of an effective mechanization program was seen as the major obstacle to increasing efficiency in crop production at the individual farmer level in Zimbabwe (Made, 2006).

Before the launch of the mechanization program, the District Development Fund (DDF), a department mandated by the government to control funds donated by Non-Governmental Organizations (NGOs) for fostering rural development, provided tillage operations to the small-scale farmers who benefitted under the Fast Track Land Reform Program during 2000-2009 (designated as A1 and communal farmers) (NORAD 1984; FAO 2000; Gongera and Petts 2003). In most areas of Zimbabwe, animal draft power is used in preparation of 70% to 90% of the cropped area, tractor power for between 2% to 15%, and hand tillage for 5% to 15% (Chisoko 2006). Tra-

ditional Conservation Farming where farmers practice zero tillage is used in some areas. In areas where rains normally start late, the understandable anxiety of the majority of farmers to plant with the first rains often meets with frustration due to scarcity of equipment which entails long waiting times with the result that many of these farmers resort to minimum tillage practices (FAO, 2002). With the political atmosphere now largely normalized and the Government and the international community once again turning attention to crucial development concerns, it seems timely to undertake an assessment of the impact of some of the key strategies that will undoubtedly continue to play a pivotal role in the restructuring and realignment that will be required to restore growth to the Zimbabwean economy. Hence the current interests in the agricultural mechanization program.

Objectives

The main objective of this paper is to examine the performance of the agricultural mechanization program launched to reverse negative production and productivity trends that emerged in the wake of the fast track land reform program in Zimbabwe. A considerable amount of criticism has been leveled against the FTLRP and its attendant agricultural mechanization program because it was launched without proper planning and implemented in an almost arbitrary and haphazard manner. In the absence of a systematic assessment, the extent to which the operations of these programs account for the difficulties of the past few years remain unclear, hence the present investigation. This paper is an attempt to fill this gap. The first effort is to describe the key features of the fast track land reform program. Subsequently, the international experience in agricultural mechanization is highlighted. The paper then presents evidence from an empirical study to demonstrate the relative importance of agricultural mechanization, especially when introduced to jump-start a land reform program that was already fuelling serious productivity concerns.

Research Questions

The following research questions are considered:

- To what extent has agricultural mechanization been adopted and implemented to boost land productivity in the project area?
- What has been the impact of the agricultural mechanization on crop production and productivity among A1[1], A2[2] and communal farmers under the fast track land reform program in Zimbabwe?
- What are the implications of the findings for managers of firms in the food and agricultural industry?

[1]A1 farmers are small scale farmers who benefitted under the Fast Track Land Reform Program between 2000 and 2009. Each resettled farm household was allocated between 3- 6 hectares of arable land with the rest of the land being reserved for communal grazing purposes (GOZ, 2001; UNDP, 2002; Sukume, Moyo and Matondi, 2004; Matsa, 2011; ZIMSTAT, 2011).

[2] A2 farmers are medium to large scale commercial farmers who benefitted under the Fast Track Land Reform Program between 2000 and 2009. The farm sizes are considerably larger and the farmers are mainly distinguished by their demonstration of farming experience and ability to repay cost of the farm following which a 99-year lease is granted with option to purchase (UNDP, 2002; Chiremba and Masters, 2003; ZIMSTAT, 2011).

The Fast Track Land Reform Program in Zimbabwe

Following years of bitter armed struggle triggered by intolerable levels of oppression and deprivation that revolved around access to land, peace finally came to Zimbabwe as the 1970s drew to a close. Driven by commitments made at the Lancaster House Agreement that reinforced faith in the crucial steering role of Britain, Zimbabwe launched its ambitious land resettlement program in September 1980, a mere five months after political independence was granted to this former British colony. The program was intended to redress the huge imbalance in land distribution and enhance access to land for victims of the liberation struggle and the landless, while consolidating commercial agricultural production. Kanyenze, Kondo, Chitambara and Martens (2011) have recently provided a graphical description of the extreme inequalities that preceded Zimbabwean Independence in 1980 and how much of the inequalities still remain. By the end of the 1990s, there was widespread disenchantment with the slow progress in resettling the indigenous population. At that time, in spite of nearly two decades of implementation of land reform, a mere 4,500 white farmers still controlled 28% of the land while more than a million black farmers struggled to eke out a desperate existence in largely unproductive and dry "communal areas" (Mushunje 2005). In between these two extremes, the political élites received preferential treatment in allocation of land expropriated from white owners even though much of that was promptly abandoned or mismanaged, with disastrous consequences for farm production and food prices. At the same time, Zimbabwe's macro economy began to experience serious balance of payment problems for which a structural adjustment program was launched. As the hardships deepened, political interests capitalized upon the situation to manipulate an electoral process to seemingly obtain a popular mandate to accelerate the land transfers.

The ensuing "Fast Track" program that began in July 2000 was marked by violent invasions of white-owned farms in which war veterans and their sympathizers unleashed a wave of terror on the large-scale farm sector. Subsequently, legislation was passed to institutionalize the "fast track" process, adopting two key implementation models, namely Model A1 (to decongest communal areas by targeting the tribal areas suffering severe land constraints), and Model A2 (to promote agricultural commercialization at various scales) (Zikhali 2008; Muchara 2009). But in the view of the donor community in Zimbabwe who had privileged access to the ideas as the land invasions were just beginning, this process "had no goal, no plan, no timetable, no budget, no capacity and no transparency" (Kinsey 1999).While the FTLRP clearly led to substantial repossessions and transfers of land, it seemed to have created a number of other problems.

At one level, the FTLRP is blamed for directly leading to a 30% drop in agricultural production, a hyper-inflationary situation, and a 15% contraction of the economy that culminated in 2008 to an unemployment rate estimated to exceed 80% (Zikhali 2008). At the other level, the human rights abuses came to a head with members of opposition parties being victims of extreme persecution, beatings and murders. Not even the landmark ruling by the Southern African Development Community (SADC) Tribunal on the court challenge mounted by the Commercial Farmers Union of Zimbabwe could stop the farm seizures which continued unabated (SADC 2008). The installation of a transitional government of national unity in which the opposition party is playing a limited role has also not moderated the level of political intolerance. Targeted sanctions on the regime in Zimbabwe are still in place to force the regime's hands. Whether or not these sanctions are worsening the political and economic crises in Zimbabwe is now being debated but a recent

effort by the South African government to secure some easing-off of the sanctions has failed as Britain insists on seeing real changes first.

International Experience with Agricultural Mechanization

Several studies have been conducted on the impact of agricultural mechanization on production, productivity, cropping intensity, human labor employment as well as income generation for sustainable livelihoods of households. The faith in agricultural mechanization as a panacea to the production and productivity problems of Zimbabwe has its roots in the policy and theoretical developments of the last half a century drawing from the major conclusions of the induced innovation literature much of which was motivated by the seminal works of Ruttan and Hayami (1972 1984), Mellor (1973, 1984), Binswanger (1986), Binswanger and Von Braun (1991), Hayami and Ruttan (1995), among others. Arguing along those lines, Nweke (1978) observed that for post-Independence Ghana, tractor mechanization may have accounted for production expansion arising from bringing more land under cultivation.

The thinking then, as now, was that efficiency and tractor operations/ownership are highly correlated, with tractor efficiency increasing as farm size rises above 20 hectares (Nweke 1978). But possibly as a result of the perceived substantial displacement of labor and effective subsidization of agricultural machinery prices relative to labor (Mellor 1984), agricultural mechanization lost some popularity among academic economists who easily linked it to the growing unemployment in the wake of the introduction of the Basic Needs Strategy in many developing countries in the 1970s. Such sentiments have naturally resulted in considerable policy confusion as political élites have wavered between extremes depending on how loud and/or convincing the arguments have been. As a result, conflicting policy prescriptions have been given for the African agricultural mechanization problem by the academic, donor community and national governments but with little or no impact on productivity. The failure of many Government sponsored tractorization projects initiated in the late 1950's and early 1960's emboldened the critics who easily attributed the decline in agricultural productivity and growing unemployment as witnessed in Zimbabwe to farm mechanization (Salokhe and Oida 2003). Overall, it is safe to conclude that agricultural mechanization has had a chequered history in the African policy terrain and remains a questionable input in African agriculture particularly in the smallholder sector (FAO/UNIDO 2008).

Early literature on agricultural mechanization has defined it chiefly in terms of farm power and transportation. According to Binswanger (1986), agricultural mechanization implies the use of various power sources and improved farm tools and equipment, with a view to reducing the drudgery of farm work. Three main options were generally agreed for farm production and transportation of agricultural produce to markets, namely human power, animal power and the use of motors (Bordet and Rabezandrina 1996). Human, animal and machine power is believed to complement one another in the same household, farm or village, the choice being determined by local circumstances. Ultimately, farm mechanization aims to enhance the overall productivity and production at the lowest cost. Possibly in recognition of this fact, the use of agricultural machinery has grown progressively over the past two to three decades, with its popularity growing in land-surplus areas where it has been clearly demonstrated that one labor unit working with suitable machinery can afford to plough in excess of 10 hectares in a day (Chatizwa and Khumalo, 1996).

The contribution of agricultural mechanization has been well recognized in enhancing production together with irrigation, biological and chemical inputs, high yielding seed varieties, fertilizers, pesticides and mechanical energy. The Indian Green Revolution which is regarded as one of the greatest achievements of the 20th century (Madras 1975), is well-known for the manner in which it promoted the adoption of mechanization on a large scale for the benefit of small, medium and large sized farms. Effects of mechanization such as its impact on human labor employment in a labor abundant economy have always evoked sharp responses from the policy makers (Jafry 2000). The notion of "appropriate technology" has evolved as a compromise to ensure that adequate scope is provided for human labor to participate while equipment is phased in to respond to the need for expanded output at minimum human costs. But even the concern about equipment replacing human labor and thus increasing unemployment rates has been shown to be unfounded. For instance, it has been shown that agricultural mechanization led to overall increase in the employment of human labor (Chatizwa and Khumalo 1996). The reduction in aggregate labor used on tractor operated farms was quite low (1.3 to 12%) compared to bullock operated farms. The increase in employment of casual male labor was reported to be up to 38.55% and the mechanized small farms used 3.7 times more labor NCAER (1974). As Mellor (1984) noted, the role of farm machinery in shortening land preparation time has often made it possible for households to plant a second crop within the year, thus providing year-round employment for labor that would otherwise have been redundant for much of the time.

Of course, even before Mellor (1984), many researchers had observed that mechanization does not lead to decrease in human labor employment because with mechanization, the demand for hired labor increased while participation of family labor in crop production declined. Carney (1998) also indicated that net human labor displacement in agricultural operations was insignificant and it was more than compensated by increased demand for human labor due to multiple cropping, greater intensity of cultivation and higher yields. Furthermore the demand for non-farm labor for manufacturing, servicing, distribution, repair and maintenance as well as other complementary jobs substantially increased due to mechanization. As observed by Chatizwa and Jones (1997), farm mechanization displaced animal power from 60 to 100% but may have resulted in less time for farm work. Also mechanization has probably led to increase in the human labor employment for the on-farm and off-farm activities as a result of manufacture, repair, servicing and sales of tractors and improved farm equipment (Farrington, 1985).

Over the past half a century developing regions, with the exception of Sub-Saharan Africa, have seen labor-saving technologies being adopted at unprecedented levels (Jafry 2000). Intensification of production systems created labor bottlenecks around land preparation, harvesting and threshing operations. Alleviating these labor bottlenecks with the adoption of mechanical technologies has been linked to the enhancement of agricultural productivity and lowering of the unit cost of crop production even in the densely populated countries such as China (Bergmann 1978). Economic growth and the commercialization of agricultural systems are leading to further mechanization of agricultural systems in Asia and Latin America (Rijk 1999). Sub-Saharan Africa continues to have very low levels of mechanization and available data indicate declining rather than increasing levels of adoption, even among the countries that were the early trendsetters, such as Kenya and Zimbabwe (Binswanger 1978; FAO/UNIDO 2008). Granted that the recent macroeconomic history in many of these countries may account for the low adoption rates, but

the fact remains that many of them were already under-performing even before the economic crisis of the 1980s and 1990s.

According to FAO (2000), the general trend is that agricultural production in most African countries still relies on the centuries- old hand tool technology. Whereas, everybody agrees that this has to change, the main question has been on how the change should come about. One question that has often been posed (Binswanger 1978) is: should African countries go through the evolutionary path from hand tool through animal powered to mechanically-powered agricultural mechanization as it has happened in the developed countries, or should they aim at skipping the intermediate stage of animal powered mechanization? The experience of seven African countries (Botswana, Ghana, Kenya, Nigeria, Swaziland, Tanzania and Zambia) in agricultural mechanization policy confirms that these have failed to yield positive results (FAO 2000).

Sticking to the wholly optimistic and positive view, various researchers have concluded that farm mechanization has managed to achieve enhancement of the production and productivity of different crops due to timeliness of operations, better quality of operations and precision in the application of the inputs. Madras (1975) found that the productivity increase on tractor owning and hiring farms ranged between 4.1 and 54.8 %. The % increase was comparatively low on non-mechanized farms as compared to tractor-owning farms due to higher level of inputs and better control on timeliness of operations. These productivity increases were attributed to higher doses of fertilizer, irrigation and mechanization (Bina 1983). Several studies have indicated that there was significant increase in cropping intensity due to the use of tractors and irrigation as a consequence of mechanization. The increase in cropping intensity has been reported to be 165, 156 and 149 %, respectively for tractor-owning, tractor using and bullock operated farms respectively (NCAER 1980). Similar results have been reported in other studies which concluded that as a consequence of mechanization, cropping intensity increased significantly. Furthermore, irrigation and mechanical power helped the farmers in raising the cropping intensity of their farms (Patil & Sirohi 1987). Singh (2001a and 2001b) concluded that cropping intensity was mainly dependent on annual water availability and nature of the farm power available.

Farm mechanization has been credited with the significant improvement of the economic circumstances of farming communities in which this technology has been popular. Tractor owners and users derived higher per hectare gross income compared to traditional subsistence farms (NCAER, 1980). The gross income per hectare was reported to be about 63% higher on tractor owning farms compared to the traditional farms. The average net return from a tractor owning farm on per hectare basis was reported to be 152% that of a non-tractor owning farm (Chopra, 1974).

The Model

This study applies the Stochastic Frontier Model to estimate farm level technical efficiency with particular focus on the contribution of the agricultural mechanization program towards the attainment of the goals of the fast track land reform program of the Government of Zimbabwe. The model is based on the Cobb-Douglas model in which capital represents various forms of non-labor inputs, including mechanical power. While there are many other factors affecting economic

performance and technical efficiency, the flexibility of the Cobb-Douglas model makes it a very convenient for modeling technical efficiency. The formal model is generalized as:

(1) $Q = AL^{\alpha}K^{b}$

Where:

Q is output,

A, α, b are constants, and

L and K are labor and capital, respectively.

Capital can be interchanged with labor without affecting output. Or

(2) $P(L,K) = bL^{\alpha}K^{b}$

Where:

P = total production (the monetary value of all the produce or goods produced in a year)
L = labor input (the total number of person-hours worked in a year)
K = capital input (the monetary worth of all machinery, equipment, and buildings)
b = total factor productivity

The terms α and *b* are the output elasticities of labor and capital, respectively. These values are constants determined by available technology. Output elasticity measures the responsiveness of output to a change in levels of either labor or capital used in production, ceteris paribus.

Applying the foregoing relationships to the case under consideration, the stochastic frontier production function can be specified as:

(3) $Y_i = f(L_{it}, K_{it}, X_{it}; A; e_i)$

where Y_i is the output by farmer *i,* and L_{it}, and K_{it} are Labor and Capital inputs as defined in equation (2) above, X_{it} represents a range of other factors deployed by the farmer, including locational and seasonal dummies, while A is a vector of parameters, and e_i is the disturbance term. The Stochastic Frontier Analysis (SFA) assumes that the disturbance term consists of two components, a stochastic error component V which is assumed to be symmetric, depicts the random variation of the production function from one farm to the other, and may be due to such factors as measurement error and factors that the farmer cannot control. On the other hand, the second error component, U, represents the technical inefficiency relative to the optimum.
Defined in logarithmic form, the stochastic frontier production function in this case can be expressed as:

(4) $\ln(Y_{it}) = \beta_0 + \beta_1 \ln(L_{it}) + \beta_2 \ln(K_{it}) + ... + \beta_n \ln(X_{it}) + V_{it} - U_{it}$

Where the subscripts *i* and *t* refer to the *i-th* farmer and *t-th* observation, respectively, and
Ln is the natural logarithm

Y represents the total value of farm output in 2008 in monetary units (US$).

L, K, X are the inputs of labor, capital, and others, respectively. Labor and equipment use were inserted in the model as a dummy where 1= mechanical power used and 0=no mechanical power used (meaning operations were labor-based). The *X's* represented all the other factors such as age, land, fertilizer, seed, output of the two principal crops maize and soybean, livestock and irrigation that formed part of the production package.

β's are the regression coefficients or parameters to be estimated, and

$V_{it} - U_{it}$. constitute the disturbance term or errors, .

The Data

The variables collected in the field survey are presented in Table 1 and explained below.

GINC: Refers to total gross household income in 2008. Gross value of annual farm production from crops and livestock. It is hypothesized that low values signify lack of machinery, finance and access to vital resources.

AGE: this variable measures the actual age of the household head in years. Younger farmers are expected to be more mechanically constrained than older farmers who are perceived to have acquired enough wealth to access these resources. Therefore, it is hypothesized that age of household head and machinery access are positively correlated. This is supported by an observation by Mushunje, Belete and Fraser (2003) that older farmers are likely to have more resources at their disposal.

LAND: This variable refers to the size of farm land in hectares. Increase in land size may enhance production if the land is effectively utilized. At the same time, land may be available but not being effectively utilized. Effective utilization will entail application of appropriate farm practices that will lead to higher physical output than otherwise would be the case. In the absence of more direct means of assessing effectiveness, this can only be inferred from the results. Intuitively, one can expect higher output if there is effective utilization of available land, and lower output otherwise. It is also reasonable to expect that the more physical output a farmer produces, the more surplus is marketed, and hence higher gross farm income.

FERT**:** A number of studies have established that fertilizer usage is positively related to productivity (Reardon *et al.,* 1996; Xu, Guan, Jayne and Black, 2009). Conversely, a farm unit that is too constrained to afford adequate amounts of fertilizer will most probably experience lower productivity which will translate to lower physical output.

SEED: this variable refers to farm inputs such as hybrid seeds, pesticides and chemicals. It is hypothesized that farmers with inadequate inputs are less likely to achieve higher levels of production leading to lack the purchasing power for machinery and equipment.

TOTPRDMZ: Physical production of maize in kg. It is hypothesized that the total physical output of maize is positively associated with the gross farm income and explains differences in income between farming households. The physical production of maize will also be related to the

area cultivated which will equally be a function of the availability of mechanical power required to bring more land under cultivation that would otherwise be the case.

TOTPRDSB: Physical production of soybean in kg. It is hypothesized that the total physical output of soybean is positively associated with the gross farm income and explains differences in income between farming households. The physical production of soybean will also be related to the area cultivated which will equally be a function of the availability of mechanical power required to bring more land under cultivation than would otherwise be the case. As a leguminous crop, it is obviously a high value crop with high potential contribution to household earning from farming.

LVSTK: Whether or not farmer kept livestock. Livestock farming is important in many parts of Mashonaland Central Province of Zimbabwe although as much as 50% of the population live in the so-called "high potential zone" where crop production is important. Livestock is kept principally for draught power, milk, meat and marginally as a source of income. There is no doubt that livestock plays a positive economic role in Zimbabwe and it is hypothesized that a positive relationship will exist between livestock ownership and gross farm income for farming households.

MECH: Whether farmer used equipment and machinery. This is calibrated as a dummy as shown in Table 1. Despite the agricultural mechanization program being described as "…the largest in the whole of Africa", not all farmers have access as would be expected. The hypothesized relationship between use of machinery and gross income is a positive one and it is expected that farmers using equipment would bring more land under cultivation and potentially realize larger revenues that those who did not.

Table 1. Definition and units of measurements of key variables modeled

Dependent Variable	**Definition**	**Value**	**Hypothesized Relationships**
GINC	Gross Farm Income	Continuous	
Independent Variables	Definition	Value	
GENDER	Gender of the household head	A dummy variable coded 1 if male and 0 otherwise.	+/-
AGE	Age of the household head in years	Actual age in years	+/-
TOTPRDMZ	Physical production of maize in kg	Continuous	+
TOTPRDSB	Physical production of soybean in kg	Continuous	+
FERT	Expenditure on fertilizer in US$	Continuous	+
SEED	Expenditure on seeds in US$	Continuous	+
LVSTK	Whether farmer kept livestock	A Dummy variable = 1 if the farmer kept livestock; 0 otherwise	+
MECH	Whether farmer used equipment and machinery	A dummy variable coded 1 if farmer used equipment and machinery and 0 otherwise	+
LAND	Area cultivated by farmer in hectares	Continuous	+
IRR	Use of Irrigation for farming	Coded 1 if the farmer uses irrigation, and 0 otherwise	+

Source: Field study. 2009.

IRR: Use of Irrigation for farming was calibrated as a dummy. Part of the agricultural mechanization program is the development of irrigation facilities and rehabilitation/maintenance of existing ones. Water availability has always been a challenge especially in the regions 3-5 of the province. It is hypothesized that farmers using irrigation with have higher gross farm income than those who do not use irrigation for crop production.

Data Collection Methods

The study was undertaken in the Mashonaland Central Province of Zimbabwe within the Bindura District which is one of the seven districts of the province. These districts are well-known for their large areas of good crop land, especially in the districts of Mazowe, Bindura and Guruve. Fine grained archaelian rocks, granodiorites soils with pockets of dolerite and gneiss are predominant in the study area. The underlying geology has a marked influence on soils in the study area, which are mostly sandy fersialitic soils with inherent low fertility and low water holding capacity (Nyamapfene, 1991). Masembura and Musana communal areas are the preferred study sites because they are contiguous to the other land reform typology, namely the resettlement areas, targeted by this study. These communal areas are dominated by the Miombo woodlands, and most predominantly bush land with canopy 28–80%. Musana communal area is particularly characterized by more intensive cultivation of horticultural crops and mixed rangelands than woodlands.

Both primary and secondary data were employed. For the secondary data, consultations were held at the provincial level with officials of the Ministries of Agriculture (Arex), Lands and Resettlement, Local Government and Agricultural Engineering and Mechanization. These consultations were of immense help in accessing previous studies conducted in the study area, on related subjects, as well as gaining insights into current and prospective policy initiatives for the area and the sector as a whole. In general, data and information obtained at this stage were helpful for profiling and gaining a deeper understanding of the study area. The Voters' Roll was another source of information on the broad demographics (GoZ, 2008).For the primary data, the focus was the southern part of the district between latitudes 17^0 17´ and 17^0 30´ which enclosed the key communal areas of Masembura and Musana as well as some Resettlement Areas, including the Simoona Estate.

Although this is a relatively extensive area with 18 rural electoral wards and an estimated population of 108,396 (Oxfam, 2000), only 50 farms were set aside for the land reform process, with about 2300 persons identified in the voters' roll as beneficiaries (GoZ, 2008). According to the FAO (2008), a considerable degree of absenteeism among the land reform beneficiaries has been identified as one of the most serious problems affecting the effectiveness of the land reform program; many of the farmers simply disappeared after being allocated land. For the resource-poor communal farmers, the situation was complicated by their lack of access to vital production inputs which resulted in many of them abandoning the newly allocated farms (FAO, 2008). For this reason, the present study defined a narrower sampling frame comprising land reform beneficiaries who were actually confirmed by the village chief to be residing within the area at the time of the study. Within this group, the study defined another sub-group, in line with the study objectives, comprising land reform beneficiaries who were recipients of further government assistance in the form of farm machinery. As was observed in the case of the larger groups above where access difficulties were severe, this group was similarly handicapped by non-availability of the promised machinery. According to a study conducted under the auspices of the African Institute

for Agrarian Studies (Moyo et al. 2009), access to animal-drawn equipment ranged from as low as 4% to a little under 49% of the beneficiaries, while access to tractors and motorized equipment could only be guaranteed for between 2.5 – 8% of the land reform beneficiaries. This group was purposively identified and sub-divided into two further sub-groups, namely farmers with cattle and ox drawn machinery and farmers with tractor drawn or powered machinery. The active farming population targeted by this study was therefore considerably less than 1000. Other studies conducted in the same area, notably Foti et al. (2007), encountered similar shortfalls in farmer population. A random sample of 30 farmers was drawn from each of the sub-groups to give 60 farmers who benefitted from land reform and received farm equipment of one type or another. A final group comprised farmers without machinery or were non beneficiaries of the mechanization program. Another random sample of 30 farmers was drawn from this group. The overall sample of 90 farmers drawn from both communal and resettlement areas of Bindura district therefore represents about 10% of the target population if the figure of 1000 active farmers confirmed by the local chiefs.

For the purpose of collecting the primary data, the study implemented a systematic and multi-pronged data collection procedure. A single-visit farmer survey based on a structured questionnaire was employed to generate demographic, production and marketing information that varied from household to household. Table 1 above presents the relevant data collected by this process. Group meetings and focus groups were also conducted to generate community-level data as well as supplement information obtained from the extension personnel and official sources in respect to broader patterns and trends that have implications for the agricultural sector in general. The group meetings and focus groups were guided by checklists and discussion points developed on the basis of initial situational surveys, literature reviews and personal experience. Special arrangements made to improve interview effectiveness and data accuracy included prior intensive training of the enumerators and the use of local guides wherever necessary. Within the communities, meetings were held with the village chiefs during which they were fully briefed about the purpose of the study and their approval obtained well in advance. At the end of the study, before the departure of the team from the district, feedback sessions were also held in the villages.

The province has one of the most productive communal lands, producing both food and cash crops. Maize is the dominant crop; however the main sources of income include cotton, tobacco, sunflower, soya bean and sugar bean production. Employment on A1 (small scale resettlement) and commercial farms is also an alternative source of livelihood. Poor households depend equally on their own crops, daily wages from casual labor, selling of sugar cane and gold panning. In general, crop production (food and cash crops), livestock rearing or a combination constitutes the primary livelihoods in the rural provinces. These livelihood options in turn define most of the secondary livelihood options – such as employment on commercial farms and game reserves.

Estimation and Results

The estimates of the maximum likelihood ratios for the parameters in the single equation reduced form proposed in equation (3) above are presented in Table 2. Table 2 presents results with respect to the extent of technical efficiency in the communal farming system under a farm mechanization regime. Looking at Table 2 specifically, it is clear that land ownership and use of mechanical power are important contributors to the gross income of smallholder farmers, without prejudice to the absolute levels of incomes eventually attained. The indication is also that pur-

chased inputs such as seeds and fertilizer strongly influence gross income in the farming system studied. The negative coefficients for Soybean output and seed are interesting and probably reflect the competition between the main crop maize, as the principal crop, and soybean which still represented an alien crop to the majority of the black farmers, especially the resource-poor farmers operating in the communal areas. It is understandable that inadequate knowledge about the agronomic characteristics of soybean, leading to the application of sub-optimal practices for its cultivation, may account for its negative influence on the gross farm income for the communal farmers. Seed costs had risen quite sharply in the period covered by the study and were a major disincentive to small farmer development under the fast track land reform in Zimbabwe.

Table 2. Stochastic frontier maximum likelihood estimates

Ginc	Coef	Std. Err	Z	p>|z|	95% Coef. Interval	
GENDER	42.49213	56.0706	0.76	0.449	-67.40421	152.3885
AGE ACTUAL	-1.804542	2.273684	-0.79	0.427	-6.260882	2.651798
TOT PROD MZ	.1517116	.0217881	6.69	0.000***	.1090077	.1944156
TOT PROD SB	-.4569862	.0604846	-7.56	0.000***	-.5755338	-.3384386
FERT	.7127523	.2765718	2.58	0.010***	.1706815	1.254823
SEED	-15.52525	3.039578	-5.11	0.000***	-21.48271	-9.567789
LAND	347.9645	63.21514	5.50	0.000***	224.0651	471.8639
LVSTK	-68.52655	56.23232	-1.22	0.223	-178.7399	41.68677
MECH	134.5086	66.01683	2.04	0.042**	5.118034	263.8992
IRRIGATION	93.83527	73.69449	1.27	0.203	-50.60327	238.2738
-CONS	8.883757	3202.386	0.00	0.998	-6267.678	6285.446
|INSIG2V	10.81111	.1491386	72.49	0.000	10.51881	11.10342
|INSIG2U	-5.148053	105240.8	-0.00	1.000	-206273.4	206263.1
SIGMA-V	222.6399	16.6021			192.3665	257.6775
SIGMA-U	.076228	4011.15			0	
SIGMA2	49568.54	7399.489			35065.81	64071.27
LAMBDA	.0003424	4011.683			-7862.754	7862.754

Likelihood-ratio test of sigma-u=0: chibar2(01)=0.00 prob>=chibar2=1.000
Significance denoted as follows: * (10%), **(5%), and ***(1%).

But from the point of view of technical efficiency, the lower panel statistic denoting "Insig2V" and "Insig2U" yield more policy-relevant information. Based on the relationship depicted in equation (3) above, it is obvious that the estimates indicate high random errors with the high variance of the random component. Further, the "rho", calculated by the formula:

$$(5) \qquad rho = \left(SIGMA\_U\right)^2 \Big/ \left(\left(SIGMA\_U\right)^2 + 1\right)$$

is almost close to zero, at 0.00577 (not different from zero). Given that the LR test actually tests the hypothesis that "rho" =0 (see Table 2 above), and "rho" gives the proportion of the total variance contributed by the variance components, it can be concluded that all the variance in the estimates come from the variables themselves and not due to error. This would suggest high degrees of inefficiencies in resource use in the smallholder system. Thus, while mechanization and land reform can potentially contribute to gross income growth, there is clear evidence of sub-optimal resource utilization which is consistent with generally-held views about the arbitrariness and poor planning that have characterized Zimbabwe's recent economic management processes. Recent evidence from other parts of Zimbabwe (Obi, 2010) has shown that without proper plan-

ning, land reform can lead to supply bottlenecks as a result of declining productivity and production. Some of the effects have already been felt in the weakening of the primary markets that serve smallholders, with negative consequences for smallholder livelihoods and welfare.
Since the functional form of the model cannot be definitively predicted by visual inspection, a multivariate Ordinary Least Squares (OLS) model was fitted and the results are presented in Table 3.

Table 3. Multivariate regression results

	Coef	Std. Err	t	p>|t|	95% conf. interval	
GINC						
GENDER	44.99384	49.0565	0.92	0.362	-52.6317	142.6194
AGE ACTUAL	-1.64166	1.011684	-1.62	0.109	-3.654974	.3716549
TOT PROD MZ	.1513992	.0227257	6.66	0.000***	.1061735	.1966248
TOT PROD SB	-.4568934	.0641437	-7.12	0.000	-.5845435	-.3292434
FERT	.7157122	.2906488	2.46	0.016**	.1373028	1.294122
SEED	-15.52149	3.223673	-4.81	0.000***	-21.9368	-9.106173
LAND	348.2635	66.93156	5.20	0.000***	215.0655	481.4616
LVSTK	-67.95647	59.15114	-1.15	0.254	-185.6709	49.7581
MECH	134.5513	70.0215	1.92	0.058*	-4.795972	273.8985
IRRIGATION	94.56949	77.5421	1.22	0.226	-59.7442	248.8832

Significance denoted as follows: * (10%), **(5%), and ***(1%).
Number of obs=90
F (10, 79)=58.33
Prob > F=0.0000
R-squared=0.8807
Adj R-squared=0.8656

Ultimately, these two models serve different purposes which need to be explained. While Table 2 presents results with respect to technical efficiency, Table 3 present insights into the determinants of technical efficiency in the Zimbabwean smallholder sector under land reform and agricultural mechanization of the type described in this paper. Furthermore, Table 3 provides the indication that the model is more or less linear and that most of the gross income earned in the smallholder sector examined are explained by the model. As indicated earlier, Table 3 presents the results of the multivariate OLS which are close enough to the frontier estimates to suggest a generally linear model. Thus, if all that was needed was to explain the causation of gross income in the farming system, a linear model of this sort would have sufficed. The model fit is also adequate, both in terms of the whole model and the individual regression coefficients. The R-Squared value of 88% which adjusted to 86% suggests a good-fit, while the F-statistic of more than 58 confirms a whole model adequacy.

Implications of Results for Agribusiness Management

The foregoing results have far-reaching and important practical implications for agribusiness management. An obvious point from the results is the glaring government failure in introducing a mechanization program at a scale that is inappropriate to the realities of the farming system. While the estimates suggest that the system was technically efficient, the sector exhibited pronounced shortfall in output which resulted in hyper-inflation. A possible reason for such a paradox was low capacity utilization. The positive contribution of farm mechanization to enhanced labor and land efficiency is not questionable, but the mechanization program must be appropriate

to the situation of the farmers, including the availability of complementary inputs and a ready market for the produce as incentive to expand production. As a matter of historical fact, the situation in Zimbabwe during the period under investigation was the exact opposite of what would have been required to enhance the effectiveness of a farm mechanization program. The evidence was that the government was unable to finance broader development imperatives which resulted in an acute shortage of essential inputs, equipment and spares. Human resource constraints were also so severe that crucial agricultural support services could not be provided in a timely manner if at all. At the same time, government imposed severe restrictions on cross-border trading in the staple maize crop. The country thus found itself in a low-equilibrium trap of proportions unheard of in other than a war context. As production economics theory (initially, Nelson, 1956) makes clear, low-equilibrium traps occur where output is falling while prices and wage rates are rising in both farm and non-farm sectors, and no costless re-allocation of resources is possible. In such a situation, external intervention such as technological and institutional innovations may be necessary to bring about the desired improvements.

The foregoing results obviously present immense opportunities for the private sector. The crucial areas of input supply, logistics (particularly in haulage of inputs and produce) and extension, have traditionally featured a high degree of governmental involvement, which explains why government failure would have such a devastating effect. The participation of the private sector in these areas will go a long way towards relieving a large part of the bottlenecks that farmers were experiencing at that time. Market pricing of the farm machinery input would also contribute to more efficient deployment of this resource according to the real need. The Zimbabwean situation also presented a scenario that lent itself to the testing of alternative innovative organizational arrangements among farmers to pool resources and rationalize costs, including the consolidation of land and implementation of variants of group farming to the extent that existing norms allowed.

Conclusion

The primary aim of this paper was to carry out a limited evaluation of two key agricultural development programs implemented within the last decade in Zimbabwe, namely the fast track land reform program and the agricultural mechanization program. The intention was to examine how these programs have impacted on the smallholder sector in terms of their importance in explaining variations in earnings. Related to this was the need to ascertain the extent to which the sector has made use of the opportunity afforded for enhanced access to the vital resources of land and farm machinery. This latter aim referred to the issue of technical efficiency which was examined indirectly without any attempt to relate observed productivity to any norms since such norms will at best be only subjective. The procedure of examining technical efficiency in terms of contributions of error variance components to total variance is justified by the fact that more direct approaches would call upon data that for Zimbabwe have become highly unreliable and contestable in the wake of the considerable degree of political interference into even the most common-place and basic human processes.

The study does find that the expected positive relationships between key productive inputs and farm performance still hold for Zimbabwe. It was found that, despite considerable political interference, Zimbabwe's agricultural production is still amenable to objective economic analysis. This is important for policy since it confirms that incentive mechanisms can still be effectively

manipulated to achieve real growth if attention is paid to the rational allocation principles devoid of political influence as has been the case in recent years. What seems to be lacking, as confirmed by a large number of other studies (Obi, 2010), is proper planning. Without a doubt, proper planning is non-negotiable for a land reform program to successfully deliver the benefits of equitable distribution of land and enhanced agricultural productivity. As well, a farm mechanization program requires that needs are more precisely determined in terms of the nature of equipment required for particular purposes and environments. It smacks of unbridled politicization when the senior government functionary quoted earlier boasts of Zimbabwe having the "largest farm mechanization program in the whole of Africa". There is definitely a mismatch there and an anxiety to appeal to sectional sentiments. As serious as Zimbabwe's economic crisis can be, it does not qualify to mount the largest farm mechanization program on the continent where most of the beneficiaries of the land reform program are either absent from the farms or lack the skills to utilize the resources put at their disposal. It is also unclear how Zimbabwe can afford to finance the "largest farm mechanization program in the whole of Africa".

Increased technical efficiency at the production level is also meaningless in the absence of enhanced market access. And profitable marketing is impossible in the absence of goods and services. So there is a two-way link. Anything that chokes off supply of physical output is bound to weaken primary markets serving the poor. Policies to empower small farmers by re-distributing land in order to boost food production and link them to markets must undoubtedly be sensitive to these issues. There are opportunities for private sector involvement to fill gaps in input supply, shortage of extension services, and inadequate facilities for haulage of inputs and outputs to facilitate market access in order to provide positive incentive to farmers to expand production. There is also a role for collective innovation in agriculture and agribusiness management to take advantage of all these opportunities.

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Back to the Future? Understanding Change in Food Habits of Farmers' Market Customers

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Abstract

This study analyses how attending farmers markets may affect consumers' willingness to change food habits toward high-quality products. A discrete choice model was applied using data collected through an extensive field survey in 2009, which involved 400 consumers in 12 different farmers' markets in Italy. Changing consumption habits was examined taking into account attendees' personal profile, motivations, the main features of the farmers' markets, as well as the local social context. Attendees reported an increased consumption of organic products, and fresh vegetables. Motivation seems to play an important role as a driver of change. Results also indicate that consumers sensitive to environmental issues related to their consumption choices, are more likely to change food habits in favor of high-quality foods as well as consumers who are looking for fresh products. Based on these findings, possible interventions are explored to further develop farmers' markets and promote high-quality consumption.

Keywords: farmers' markets, food habits, Italy

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Introduction

Enhancing high quality food systems is one current priority of the European Union. Indeed, the European Commission is strongly supporting policies aimed at reducing environmental impact and enhancing positive socio-economic externalities of food systems, as well as strategies to improve health, food-chain safety, consumer protection, and animal welfare. Consumption habits related to high quality food products are understood to be a key-element of policy actions in the domain of Public Health. Health is a fundamental human right, but it is also central to EU competitiveness. The EU spends 8% of GDP on health, yet loses over 100 billion euro costs related to lung disease, 135 billion to cardiovascular disease, 3% of GDP, and 500 million lost work days in work-related health problems and accidents (EU Commission 2010). When more sustainable practices in food producing and delivering are adopted, food habits might also change in a way that sustainability of the food system improves. Therefore, it seems that the impact of a change in food habits is twofold as it may affect both the health of the consumer and the sustainability of the whole food system. Social scientists and policy-makers concerned with public health have found the challenge of changing food habits to be very difficult and extremely costly in terms of social and private efforts. Moreover this mechanism is not completely understood.

This paper explores this gap in order to better understand the mechanism of food habit changes. More specifically, we analyse whether or not increasing consumer exposure to direct and personal relationships with sellers (i.e. farmers) increases consumer willingness to change their food habits. Following this line of thought, our research hypothesis is based on the idea that consumers participating in farmers' markets are more likely to change their food buying habits regarding high quality products such as fresh, organic, and local-made fruits and vegetables than consumers who are not attending them. Moreover we use this analysis to propose the implementation of innovative marketing and management models of high quality food transactions, which may even be internalized into mainstream retailing.

Food Community Networks: State of the Art

Alternative food supply systems, such as direct sales at farms, farmers' markets, box-schemes, community supported agriculture, and food stores run by cooperatives of producers have recently been defined as Food Community Networks (FCN) (Pascucci 2010). FCN can be conceptualized as an alternative form of distribution which originally arise in contrast to the mainstream food supply systems based on large-scale production and standardization (Higgins et al. 2008). FCN are based on completely opposite concepts like the relational (often local-based) dimension of production and consumption processes, and the absence of intermediaries between farmers and consumers. Ideally, FCN combine both of these characteristics (Renting et al. 2003; Pascucci 2010). FCN are recently becoming more and more popular, both among farmers, and society. This is often viewed as a reaction to the problems and contradictions related to the mainstream systems of food distribution (Ilbery and Maye 2005). In a given local context, shortening the supply chain may be achieved through various forms of distribution that, in different ways, bring producers into direct contact with consumers. The adherence to these forms of marketing, although it remains very limited if compared to physical and economical sizes of the mainstream distribution systems, has been experiencing a period of growth in recent years, which has also encouraged the proliferation of studies on this phenomenon (Wilkinson 2002; Lamine 2005). An

example is given by the development and diffusion of farmers' markets both in Europe and North America. In the next sections we will first discuss some of the broad issues raised by recent international literature on farmers' markets, and then we will focus on the relationship between farmers' markets and food habit change.

Development and Diffusion of Farmers' Markets

The research on farmers' markets dates far back in history. The first contributions were made in the 1940s. Brown (2002) identifies three main issues central to farmers' markets in her review of the literature: the type of producers and consumers which are more likely to join farmers' markets; the economic impact; and the socio-political impact of such markets. Brown concludes that the start-up and spread of farmers' markets during the 20th century has been mainly motivated by economic factors; namely the farmers' need for diversified sources of income. Various non-economic factors have also been recognized to play a very important role in the development of farmers' markets: the increase in the number of jobs (Curry and Oland, 1998), the development of informal economy and trust (Hilchey et al. 1995; Lyson et al. 1995; Morales et al. 1995), the preservation of open space (Hilchey et al. 1995), and the positive atmosphere of farmers' markets (defined as "happier markets" by Sommer, 1981).

In the following researches, the socio-political issues of farmers' markets, as well as their positive impact on the local communities, have been investigated more deeply. In a subsequent review, Brown and Miller (2008) stress the impact of farmers' markets at the community level. Following Oberholtzer and Grow (2003), such impacts often relate to "making a place for social activity and promoting a sense of community, in addition to providing fresh food for consumers and positive economic impacts for local businesses". This means that economic issues, although they can still be very important, are part of a wider range of farmers' markets impacts on the whole community.

Under these premises, farmers' markets, settled both in rural and urban areas, can represent the "keystones" for rebuilding local food systems (Gillespie et al. 2007). On one side income and human capital are likely to improve (Brown and Miller 2008), while on the other side customers are educated to seasonal limits of local food by making it more visible in public spaces (Gillespie et al. 2007). Hence, it is very difficult, and probably incorrect, to separate social and economic issues when an analysis of local food production and consumption is carried out (Hinrichs, 1998). This is especially true when the economic exchange incorporates wider shared value acts (Fieldhouse 1996), as it happens to be like for farmers' markets and other forms of FCN.

Farmers' Markets and Consumer Behavior

Another part of the literature on farmers' markets focuses more specifically on consumers' attitudes and behaviors. These studies mainly aim at the identification of a typical profile of the farmers' market attendants, in terms of demographic features, motivation to attend the market, and appreciation of local products. Most of these studies agree in identifying the average customers in women (McGarry Wolf et al. 2005), aged 51 to 65 (Varner and Otto 2008), with a post graduate education (McGarry Wolf et al. 2005). A primary reason for them to attend farmers' markets is high-quality products (McGarry Wolf et al. 2005; Lyon et al. 2009; Holloway and

Kneafsey 2000). Other motivations may also be important, such as freshness and local origin (Archer et al. 2003), direct dealing with producers (Lyon et al. 2009), better taste of products (Teng et al. 2004), and specific quality features such as additive-free, free-range, home-made, and organic (Holloway and Kneafsey 2000). A fair price-quality ratio is also often mentioned (Lyon et al. 2009). There is evidence that the high quality of local products is even more important for consumers because of the its contrast to the beliefs they have regarding the food bought in supermarkets, which are seen as risky and of low quality (Holloway and Kneafsey 2000). Thus there is evidence of an element of risk-avoidance in the choice of buying at farmers' markets, as buying direct and local is for consumers a guarantee of quality, freshness, and safety (even though for the latter, contrasting evidence has been found; Archer et al. 2003); in this context, the direct relationship with farmers acts as a tangible quality assurance (Lyon et al. 2009; Shapiro 1983).

Consumers seem to highly appreciate farmers' markets and the majority are willing to visit the market again (La Trobe 2001; Archer et al. 2003). Regardless, it is not clear whether they are also willing to pay for local-based products. Carpio and Isengildina-Massa (2009) report a high willingness-to-pay (23 to 27% more than normal price), which may exceed the willingness-to-pay for organic products (Louriero and Hine 2002). This is consistent with other evidence about the positive correlation between income and consumers purchasing attitudes who are willing to spend more money to obtain farmers' market products (Varner and Otto 2008). On the contrary, other studies conducted in Europe (Weatherell et al. 2003) show a rather small quota of people willing to pay a premium for local products.

This suggests that while for some buyers "local" equates to a higher quality standard of purchases, embedded with a socio-cultural perception of food (Bell and Valentine 1997; Hunt 2007) for which they are willing to pay more, this is not the case for other people. Indeed, many consumers are not looking for "something different" in their purchase, thus expecting local foods to accord with their usual shopping habits, retail outlets, and end-product formats (Weatherell et al. 2003).

Therefore, while the initial researches about farmers' markets put a lot of emphasis on economic issues, the start-up of the first experiences mostly shifted the focus from producers to consumers. Attention was paid to the identification of latent consumer's attitudes towards food purchases, namely to the analysis of those which are likely to be expressed only at farmers' markets, but not in large retailer environments. As it might be expected, following the evidence that consumer spending decisions are socially embedded, most of these "new" attitudes are related to social issues, (Hunt 2007), which is also consistent with research on social capital theory (Frentzen and Davis 1990; Flora 1998).

For the purpose of this paper, a little insight in such issues may be useful. Social embeddedness of purchase decisions may be favored by many features of the farmers' markets buying environment. First of all, producers and consumers attending farmers' markets can talk to each other, and they usually do, as reported by Hunt (2007); 94% of consumers talk with vendors, and 81% meet people they know at the market. Such interactions suggest that farmers' market are more likely to be perceived as a social event than a food store (Hunt 2007).

Consumers' buying behavior, as well as meaning and value attributed to products, are also highly influenced by the areas and sites where consumption occurs (Gregson and Crewe 1997; Abram 1996). The farmers' market context may then lead to distinctive types of producer-consumer relationships and to the construction of certain meanings and ideologies around the products on sale (Holloway and Kneafsey 2000). According to Hunt (2007) this could turn into increased consumer spending, as well as changes in producers and consumers behavior as a consequence of their mutual interaction.

Participation in Farmers' Markets and Change in Food Habits

But why is it so difficult to move to high-quality food habits? And why can motivations for attending farmers' markets, lead to this type of habit change? One of the basic elements is that in order to move into the direction of high-quality food habits, consumers require to "take care" of the way foods are produced. There is evidence that farmers' markets are more likely to sell environmentally friendly (Bullock, 2000) and socially responsible products (Sivini 2007). Such foods correspond to the notion of credence products firstly introduced by Darby and Karni (1973). According to their classification a credence characteristic (or attribute)[1] emerges when the good or service quality can be detected only with high ex-ante and ex-post transaction costs (Andersen and Philipsen 1998). It means that even after consumption, the quality attributes cannot be verified without costs (Vetter and Karantininis 2002). Therefore, high-quality foods (e.g. local-produced, organic, animal-welfare oriented, fair trade, etc.) belong to the category of credence products because producers (sellers) have to provide sufficient and reliable information to the consumers about the production and distribution process to the consumers (buyers). This is costly and risky for both parties, and it is a first barrier to change because it leads to cause that high-quality foods become also more expensive. Thus, only consumers with fewer budget constraints can afford to buy high-quality foods. In other words low income consumers are less likely to move into high-quality consumption habits.

These barriers may be partly overcome by the direct interaction between producers and consumers, which acts as an informal assurance of quality, with reduced costs with respect to formal certification (Hinrichs 2000). Therefore we expect a food habit change in the direction of high-quality consumption only if the overall benefits overcome associated costs. In other words we expect that consumers oriented on high-quality products have a structure of preferences (i.e. food habits or values) which justify the higher costs of such products.

In this perspective, FCN represents a new frontier for increasing sensitiveness towards quality and sustainable food products, with farmers' markets being a possible example. As explained in the previous section, the mechanism at the base of whatever FCN, is that producers (sellers) strongly integrate their functions with consumers (buyers) via social interactions (networks). This mechanism produces two desirable outcomes: (i) integration reduces the transaction costs associated to food purchases; and (ii) interaction is able to stimulate changes in consumer preferences, and contribute to switching different consumption patterns. This is a way for considerably expanding the market of foods with high-quality attributes.

[1]In this paper we use the terms "characteristic" and "attribute" as a synonymous even if we are aware of different definitions in economic psychology and marketing where they are mainly consider separately. For a detailed discussion on this issue, readers can refer to Andersen (1994) and Andersen and Philipsen (1998).

(i) Let's first motivate transaction cost reduction via integration and interaction. In a process of consumer-producer (buyer-seller) integration the transaction mechanism is based on the principle of sharing and pooling resources which are specific for the two parties. Consumers (buyers) provide resources such as time, information, and knowledge about their preferences. They decrease the costs of monitoring, and experience leisure. On the other side producers (sellers) also reduce transaction costs (i.e. certification costs), together with uncertainty of specific investments and income instability. They also provide time, information, and knowledge to consumers. The next key element in this mechanism is that consumers increase their benefits not only via consumption of more quality foods, but also via the social interactions with producers (sellers). This is consistent with a model of consumption in which both goods and leisure time contribute to enhance consumer's wellbeing (Becker, 1965). Therefore the time spent by consumers in social interactions is assumed to be leisure time. It is not a cost. This time is also used to monitor, build up trust, and therefore reduce the risk of producer (seller) moral hazard. Producers may also reduce their transaction costs by decreasing the cost of "formal labelling/certification" based on the involvement of a third party. This mechanism is very close to the one described in relational contracting (Karantininis and Graversen, 2008). If the reduction of monitoring costs and the increase of consumers' wellbeing (due to the leisure time allocation) compensate the increased organizational and opportunity costs, then FCN may be a "competitive" mechanism for marketing more sustainable foods. This "competitiveness" with respect to mainstream food supply systems could be increased by considering aspects other than time allocation: for example knowledge and information sharing, and financial investment participation. The interaction between consumers and producers within the developing process of the FCN may also be based on sharing strategic information and knowledge between members (Pascucci, 2010).

(ii) A further effect produced by social interactions is to facilitate involvement and sensitiveness towards high-quality consumption and to overcome the problem of habit formation and the relative endowment effect. Behavioral economics strongly underlines the importance to consider several aspects of the individual decision-making process such as individual ability (knowledge, education, intelligence, etc.), motivation (impulsivity, involvement, etc.), opportunity (i.e. time pressure, repetition, cognitive load), and the presence of mental dual processing (Kahneman et al., 1982; Kahneman, 2003). Oskam (2009) recently connected the endowment effect to the resistance of economic agents (i.e. consumers or farmers) to change their status quo (i.e. the consumption habits or policy preferences) due to "hidden" transaction costs (Oskam, 2009). These transaction costs are higher if the change in the status quo implies losses rather than gains (Kahneman, 2003). Within the FCN mechanism, the involvement in social interactions acts as a stimulus for consumers to switch from mainstream food retail to other types of markets, i.e. farmers' markets. This change in shopping habits might also facilitate other types of changes more specifically related to food purchases, i.e. stimulating consumers to switch their food purchases towards foods of higher quality. Indeed, the "hidden" or "psychological" transaction costs related to these changes may be reduced by the involvement in social interaction and the motivational effect that consumers experience in FCN.

Both transaction cost reduction, and motivational and psychological factors seem to be a crucial point when analyzing attendants' behavior at farmers' markets and their impact on changing food habits. In this paper we focus our attention on the latter while postponing the analysis of the role of the transaction costs to future research. In the empirical analysis reported in the following section of this paper we analyze motivations and psychological factors related to consumers' decision of participating in farmers markets, and changing their food habits as a main component of this participation process.

Empirical Analysis

Farmers' Markets in Italy

The development of alternative food supply systems in North-Western Europe has been much faster than in Italy. In France, in 2007, direct selling was well established and covered 15% of food products purchased by consumers, leading to 20-30% savings in food purchases (www.helpconsumatori.it). In the UK there are over 500 farmers' markets, frequented by 15 million consumers a year; together, they represent a business of 166 million pounds (www.farma.org.uk). Currently in Germany there are more than 5,000 active farmers' markets (www.farmersmarkets.net).

In Italy the phenomenon of direct sales has grown with some delay (Aguglia 2009), and it is still a marginal reality in the distribution organization (Lazzarin and Gardini 2007).

The first impetus in the development of Italian farmers' markets dates back to 2007, which is when the Finance Act (article 1, paragraph 1065) set a policy for farmers' markets mandating municipalities to take charge of their promotion. In the meantime, regional administrations also increased their interest in farmers' markets, which they started to support through Rural Development Programs 2007-2013 (Aguglia 2009). This effort in the policies is mainly driven by economic concerns: the farmers' market is seen as a means of reducing the gap between the price of the product in the early stages of the supply chain and the price for final consumers (Galisai et al. 2009). Nevertheless, policies also aim at the preservation of the viability of farming, which is severely threatened in a lot of Italian rural areas. Indeed, farmers' market may then act as a promoter of local products and a driver for rural development, also improving the vitality and the quality of life in rural areas (Galisai et al. 2009).

Thanks to these incentives, a lot of farmers' markets have started up throughout Italy in recent years. In 2009, Coldiretti, the largest Italian farmers' association, reported 500 farmers' markets with a total estimated value of trade of 3 billion euro (Coldiretti 2009).

In Italy there are 63,600 farms that sell directly (Coldiretti 2009); most of them located in the north and centre of the country. Tuscany is the region with the highest number of sales at the farm level, with Lombardy and Piedmont being the main followers (Aguglia 2009). Farms mostly sell fresh fruit and vegetables, and/or processed products (wine, olive oil, canned vegetables or fruit). The latter are particularly suited to be marketed through direct channels, because the value added through processing is recognized and, furthermore, their shelf-life allows for greater flexibility in the timing of placing the product on the market (Cicatiello 2008). However, only 8% of

the farms that sell directly to consumers are participating in farmers' markets: the great majority wait for customers to come to the farm (Coldiretti 2009). In general, an incentive for participation in the farmers' market is the supply of typical, regional products. This trend may lead to an increase in local tourism (Aguglia 2009), but may also represent a limitation to the development of farmers' markets as an everyday supply channel for consumers living in the area. It is perhaps for this reason that, according to some authors, the phenomenon of farmers' markets will remain marginal in terms of quantity (Raffaelli et al. 2009) and therefore cannot be considered by producers as a main outlet channel (Santucci 2009, with regard to organic products).

It is true that in general the products sold at the farmers' market are valued as "local". As highlighted by Grando (2009), this feature is relevant in itself, but it is also considered to be as a condition that guarantees or influences other dimensions of quality: freshness (linked to location and season), the peculiar organoleptic characteristics, and reliability.

The relationship between producers and consumers also plays a cultural role, strengthening urban-rural relationships (Graziano 2008), and turning the experience of buying food into a pleasant and sociable activity (Grando 2009). The adherence to short supply chains may then act as a stimulus to change consumer habits, namely to a change in the type of products consumed and in the expenditure for food, as verified in the case of raw milk sold at farmers' markets (Fantuzzi and Brugnoli 2009; Bettocchi 2003).

Survey Methodology

The survey on attendants of farmers' markets is part of a broader research project funded by the Italian Ministry of Agriculture, and executed by CURSA (University Consortium for Socioeconomic Research and Environment) to analyze the influence of alternative food supply systems on local sustainability, and to develop convenient strategies for their promotion. This project included, among other activities, a survey on producers, consumers and administrators of 12 farmers' markets located in different Italian cities. The geographical distribution of surveyed markets is shown in Figure 1, while the related table reports the main features of the surveyed markets.

Farmers' markets included in the survey have been selected based on several factors. First, we tried to maintain a degree of territorial differentiation, by not including several markets located in the same city (the only exception was made for the city of Rome). The farmers' markets selected represent different sizes and organizational arrangements as truly found in Italy.

Eight out of these twelve markets, are supported by Coldiretti, as part of the CampagnaAmica project. This project aims to increase the direct sale of agricultural products by farmers to consumers by supporting farmers' markets, and namely (i) to sustain the promotion of cooperation between farmers willing to open a new market; (ii) to improve the control on compliance with a set of requirements, including self-production of the food sold by farmers at the market; (iii) to promote a strong marketing strategy based primarily on price competition. In these markets a 30% discount with respect to traditional food stores is claimed. This form of organization is currently the most widespread among Italian farmers' markets.

Farmers' Market	Region	Freq.	Surveyed Consumers
	CampagnaAmica		271
Torino	Piemonte	daily	31
Milano	Lombardia	biweekly	42
San Giovanni	Toscana	weekly	33
Vetralla	Lazio	weekly	19
Roma Circo M.	Lazio	biweekly	42
Roma Testaccio	Lazio	biweekly	35
Bari	Puglia	daily	37
Taranto	Puglia	daily	32
	Municipal Markets		120
Padova	Veneto	weekly	32
Montevarchi	Toscana	daily	57
Pontecagnano	Campania	-	31
	Slow Food		39
Bologna	Emilia Romagna	weekly	39

Figure 1. Location and features of the Italian FMs in the survey
Source: Own elaboration on data from the field survey

One of the farmers' markets involved (marked blue in figure 1) is related to the initiative of Mercati della Terra by Slow Food, an association founded in 1989 with the aim to counter the culture of fast food and fast life, as well as to preserve local food traditions. Thus, the structure and scope of this market is pretty different, as it focuses mainly on local products, and it also includes, besides product sales, areas intended for meal consumption, exchanging information, and cultural events.

The remaining markets (marked red in Figure 1) take place because of the initiative of the municipalities that have made available to farmers dedicated areas for marketing their products. Thus, their rules may largely vary from place to place.

The interviews were conducted in September and October 2010. The questionnaire used for consumers' interviews consists of 13 closed-ended questions, divided into three sections:

- reasons and motivations for going to the farmers' market;
- purchasing behavior and related issues (expenditure, other shops used for food purchases, changing in food habits, social meaning of the market); and
- personal data (gender, age, composition of the household, job, education).

For the purpose of the study, eight questions were considered. They are listed in Table 1.

Table 1. Selected questions from the questionnaire

Question code	Question type *	Question text	List of answers
Q1	MCo	How often do you shop at this farmers' market?	Every time it is open; more than once a month; once a month; less than once a month; it's the first time.
Q4	MCm	Why are you shopping at this farmers' market?	To save money; to buy local products, to preserve the environment; to buy quality food; proximity of the market; to buy fresh products.
Q5	MCm	Besides this market, where do you usually buy similar products?	This FM only; supermarkets; small grocery shops; discount; street markets.
Q6	MCm	Did you change your food habits since you started shopping at the farmers' market?	No; I eat more organic food; I eat more fruit and vegetables; I eat a greater variety of foods; I eat less ready-to-eat meals; I eat more local products.
Q9	MCo	How often do you meet acquaintances or friends at the farmers' market?	Seldom; sometimes; often.
Q10	OP	How much did you spend at the farmers' market today?	-
Q11	OP	How much do you usually spend at the farmers' market?	-
Q12.1	OP	How old are you?	-
Q12.2	MCo	Gender	Male; female.
Q12.3	MCo	Do you live in this town?	Yes; no.
Q12.4	OP	What is your education?	-
Q12.5	OP	Do you have a job?	-
Q12.6	OP	How many people live in your family?	-
Q12.7	OP	How many children live in your family?	-

* MCo: multiple choice, one answer; MCm: multiple choice, multiple answer; OP: open question

Consumers were approached at the exit of the market, after completing their purchases. A non-probability sampling was adopted, as respondents were casually selected among the customers going out of the market. It is therefore likely that the samples are not representative of the population of customers of the single markets, although the total sample of respondents involved in the survey is large enough to allow the drawing of inferences from the data recorded. The interviews had an average duration of five minutes. In total, 430 interviews were completed. The number of respondents per market varies from 19 (Vetralla), to 57 (Montevarchi), with an average of 35.

Description of the Sample

As a first step of the empirical analysis the basic characteristics of the sample are investigated. For this purpose, some demographic and behavioral variables are analyzed.

As it concerns the demographic profile of the surveyed consumers, age, gender, level of education, employment, composition of the households, and residence are considered.

The age of respondents ranges from a minimum of 19 to a maximum of 89 years, with an average of 55 and a median of 57 (Figure 2). It is therefore a set of mature consumers, whose distribution with respect to age classes is shown in the figure below. The gender distribution is quite skewed towards women, who account for two thirds of respondents. Age and gender of the average consumer surveyed in the farmers' market are consistent with other findings in literature, although the large majority of female respondents might also be due to local social rules and habitudes. Indeed, women's competence in the household food shopping is still the rule in most Italian families. A Eurostat study carried out in 2008 proves that Italian women have a very high commitment to housework activities, on average three times larger than men. This imbalance is among the highest in Europe (Eurostat 2008).

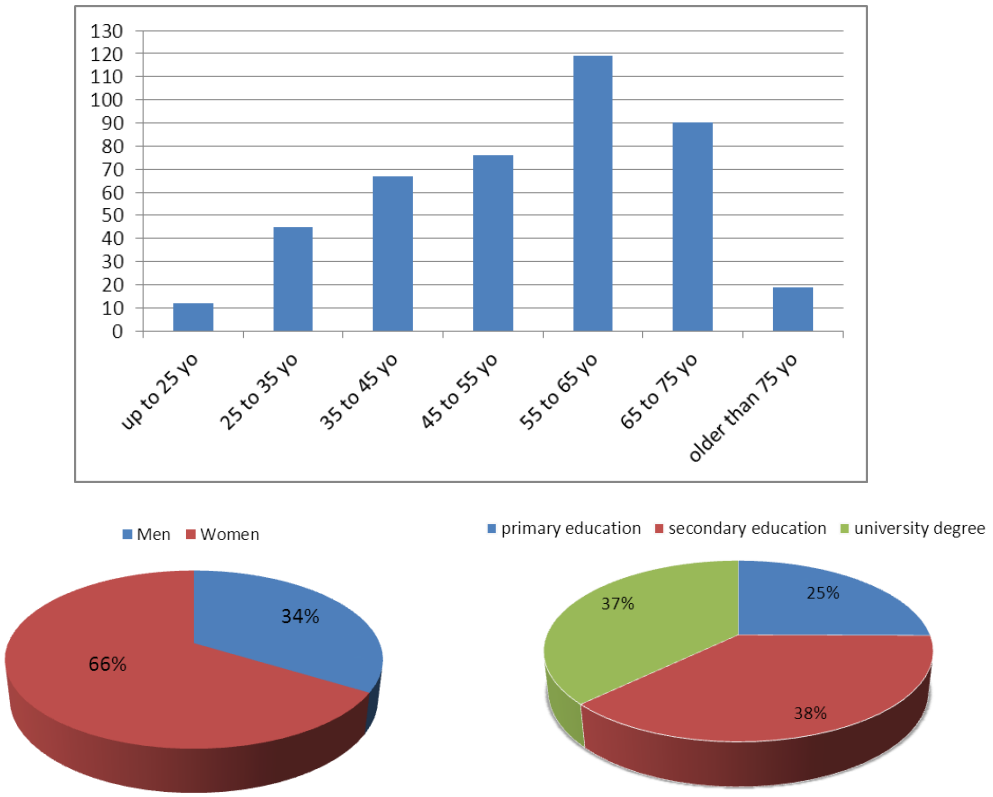

Figure 2. Sample Characteristics
Source: Own elaboration on data from the field survey

Regarding education, a relatively high proportion of graduates (37%) is found, well above the Italian average of 10% reported in the last census of 2001 (ISTAT, 2005). This result confirms that in Italy, as well as in other countries, the average customer of farmers' market is high educated. Only half of surveyed consumers have a job; the other half includes housewives, retired people, students, and the unemployed. Gender distribution can explain the high number of housewives, while age-related data probably affect the proportion of retired people. The latter also influences the composition of the household. Average respondent's family is made up of 2.7 elements, but the presence of children is rather rare (only 19% of households). Hence, this seems not to be a major driving factor to stimulate the attendance of a farmers' market, as is the case for, for example, the purchase of organic products (Thompson, 1998; Wier and Calverley, 2002). The vast majority (85%) comes from the municipality in which the market is held. The location is therefore a key factor in determining which consumers attend the market. In fact, precisely because they are local, farmers' markets tend to attract mainly people who live nearby (La Trobe, 2001).

The next step regarding sample description is the analysis on consumers' attitudes towards farmers' markets. Surveyed consumers are mostly regulars of the market: only 11% is joining the market for the first time, while 25% usually attends the market regularly at every opening. Moreover, the expenditure recorded on the day of the interview (on average €17.36) slightly differs from the average expenditure at the market as it was estimated by the respondents themselves (on average €19.63), revealing the stable nature of the relationship between these consumers and the farmers' market they go to. Among the reasons that lead consumers to attend the farmers' markets, those related to the availability of local goods and quality attributes of the products stand out (figure 3). They are mentioned by more than half of the respondents among the top three determinants of their presence in the market. Perhaps it is surprising that only 24% of respondents cited economics as one of the decisive factors, since the price is often thought to be one of the major drivers that influence purchase decisions of food (Weatherell et al., 2003). Indeed, other studies on this topic (i.e. Hunt, 2007) suggest the key role of the social outcomes in the customer decision to visit farmers' markets.

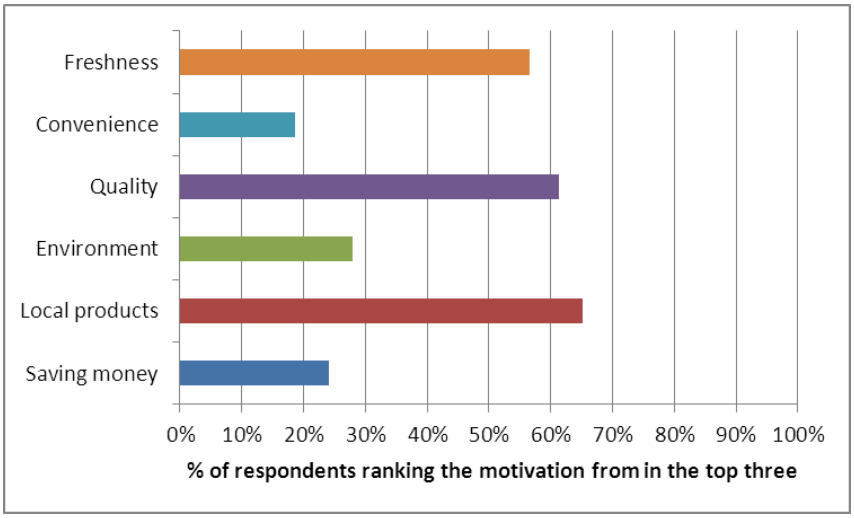

Figure 3. Consumers' Motivations
Source: Own elaboration on data from the field survey

Other behavioral characteristics of the sample lead us to believe that participating in a farmers' market can somehow help to bring out a different approach to the purchase and consumption of food. More specifically, it is significant that these consumers seem more likely to integrate shopping at the farmers' market with the purchase of food from other street markets, while very few of them go to discount stores. On the other hand, the supermarket remains the benchmark for food purchases for more than 60% of respondents. Another typical feature of farmers' markets, as seen in the literature analysis, is the development of a socially vibrant environment. During this survey, a surprising 69% of respondents said they usually meet friends or acquaintances at the market, which seems to turn the act of food purchasing more and more to a social dimension.
Actual and potential changes in attitudes and behaviors represent the central element of this paper. They have been the focus of investigation in the survey, asking consumers whether they had changed their food consumption habits as a consequence of participating in the farmers' markets (Figure 4). 17% of respondents said they had changed their eating habits as a result of attending the farmers' market. As shown in the figure, the changes are mostly related to more consumption of vegetables, and organic products.

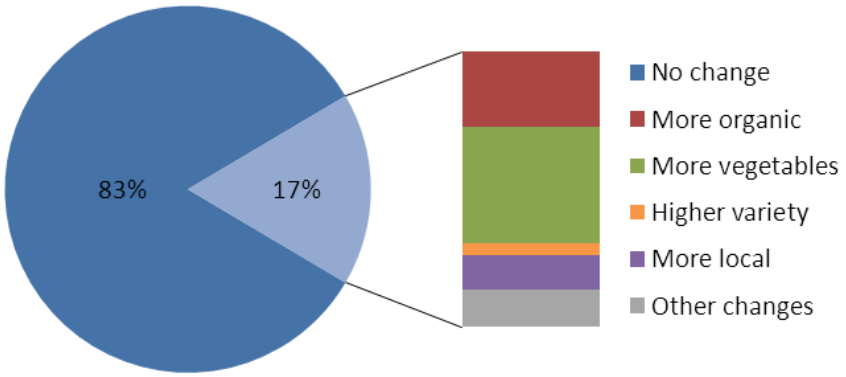

Figure 4. Consumers' change in food consumption habits
Source: Own elaboration on data from the field survey

The following sections of the paper will then attempt to explain attendants' attitude to change with respect to the demographic, behavioural, and environmental variables, which have been illustrated so far, with the final aim of understanding the determinants that significantly influence such changes.

Characteristics Associated with Food Habit Change

In this section we analyze the likelihood of observing a change in food habits toward high-quality products in association with a set of characteristics related to both farmers' markets and attendant characteristics. Therefore the evaluation concerns the analysis of respondents' decision to change their food habits as a consequence of shopping at the farmers' market. The change in food habits is explained with respect to different issues, related both to the features of the market

in which the respondent was surveyed, as well as the personal and behavioural characteristics of the consumer.

The Model to Analyze Habit Change

For this purpose a discrete choice modeling appears to be the most appropriate approach to use. In this model the presence of a choice (change in food habits) is related to the variables representing the driving factors. This evaluation model is based on the idea that the decision making unit (farmers' market attendant) can choose one of the two alternatives represented by modality 0 (non-change) and modality 1 (change) of the dependent variable, related to a series of features representing the model's explanatory variables (or driving factors). If we know these features we can estimate an equation which enables us to predict the choice. The aim is to determine how likely it is for a certain participant to prefer an option over another.

$$(1) \qquad y_i^* = \beta' x_i + u_i$$

*yi** is not observable. The observable variable is represented by a dichotomy that takes the followings values:

$$(2) \qquad \begin{array}{ll} y = 1 & \text{if } yi^* > 0 \\ y = 0 & \text{elsewhere} \end{array}$$

In this model $\beta' x_i$ equals E(yi* |xi). Followinf this, it is possible to state that:

$$(3) \qquad \text{Prob } (y_i=1) = \text{Prob}\,(u_i > -\beta' x_i) = 1 - \text{F}(-\beta' x_i)$$

Where F is the distribution function of u, and x_i is the independent variable vector. The functional form for F will depend on the assumption made for u_i. When it is supposed to be logistic, a logit model will be determined:

$$(4) \qquad \text{F}(-\beta' x_i) = \frac{\exp(-\beta' x_i)}{1+\exp(-\beta' x_i)} = \frac{1}{1+\exp(\beta' x_i)}$$

$$1 - \text{F}(-\beta' x_i) = \frac{\exp(\beta' x_i)}{1+\exp(\beta' x_i)}$$

The empirical model can be formalized in this way:

$$(5) \text{ Prob } (y_i = 1) = \text{F } (\beta'_{FM}\,\text{FM} + \beta'_{CF}\,\text{CF} + \beta'_{MO}\,\text{MO} + \beta'_{OR}\,\text{OR} + \beta'_{EX}\,\text{EX}) \,,$$

$$i = 1, 2, \ldots n$$

where FM refers to the set of variables related to farmers' market features, CF to the variables related to consumer personal features, MO to motivations, OR to the use of other typology of retailers, and EX to the overall expenditure at the farmers market. Table 1 presents the results of the probit model.

Table 2. Results of the discrete choice *model*

Explanatory variables		*Marg.effect*	*S.E.*	
Farmers' Market Features (FM)	CampagnaAmica Market	0,0040	(0,0543)	
	Slow Food Market	-0,0412	(0,0845)	
	Age of the FM	0,1240	(0,0449)	***
	Number of producers	-0,0024	(0,0032)	
	Frequency of the FM	0,0008	(0,0033)	
Consumer personal features (CF)	Age of consumer	-0,0042	(0,0015)	***
	Gender of consumer	-0,0539	(0,0411)	
	High-educated consumer	-0,0230	(0,0411)	
	Work position	0,1118	(0,0490)	**
	Locate in the same town of FM	0,1039	(0,0332)	***
	Households number of members	0,0348	(0,0171)	**
	Number of children	-0,0530	(0,0300)	*
Motivations (MO)	To meet friends	-0,0142	(0,0410)	
	If habitual consumer	0,0065	(0,0647)	
	Saving money	0,0572	(0,0467)	
	Local products	0,0046	(0,0376)	
	Environment	0,1946	(0,0549)	***
	Quality	0,0360	(0,0365)	
	Convenience	0,0772	(0,0554)	
	Freshness	0,0890	(0,0371)	**
Other typology of retailers (OR)	This FM only	0,0788	(0,0427)	*
	Supermarkets	0,0963	(0,0347)	***
	Small grocery shops	-0,0071	(0,0460)	
	Discount	-0,0866	(0,0395)	**
	Street markets	0,0044	(0,0378)	
Expenditure (EX)	Today expenditure	-0,0016	(0,0015)	
	Habitual expenditure	0,0010	(0,0014)	

Log-likelihood = -149.26 % Corr. Answers = 83,72% Adj-R^2 = 0.183

LR chi2(28) = 66.66Prob> chi2 = 0.0001

N = 393

*** significant at 1%; ** significant at 5%; * significant at 10% level

The model indicates a good-fitness with an adjusted R2 of 0.183, and a percentage of correct answers close to 84%.

Results and Discussion

Results indicate that some of the explanatory variables used have a significant impact on the likelihood of farmers' market attendants to change their food habits toward high-quality products.
Among the factors related to farmers' market features only the dummy related to the age of the farmers' market results as significant in shaping food habits. Therefore it is confirmed that the probability to change food habits is indeed a matter of time and requires a long-run decision making process.

If we look at the personal characteristics of the consumers we can notice that being older and having children reduces the likelihood to observe a habit change, while a positive habit change effect is observable for consumers with a stable work position, more family members in their household, and are situated in the same town/city where the farmers' market takes place. Hence, proximity is another major factor that undermines consumers' "resistance to change". Motivations seem to play an important role as drivers of change. Results indicate that consumers sensitive for environmental issues related to their consumption choices, are more likely to change food habits in favour of high-quality foods as well as consumers who are looking for fresh products. Thus, ethical motivations seem to play a more important role than economic and social issues. Finally it is interesting to highlight a positive impact of supermarket retailers, while a negative effect is shown by hard-discounts. If the latter is quite easy to explain considering the main motivations driving change, then the influence of shopping at supermarkets on consumers' attitude to change is controversial. Two main interpretations are possible here: on one hand the spread of a shopping pattern among consumers that includes the purchase of fruit and vegetables at farmers' markets (consistent with the driver motivation of "freshness") while other products (not available at the farmers' market) are purchased at supermarkets; on the other hand it is possible that some supermarkets respond to ethical reasons concerning the environment, thus facilitating, together with farmers' markets, a change towards organic products. It is also important to highlight how the expenditure does not seem to have an effect on consumers' attitude to change.

Conclusions

In this paper we analyze how new, direct relationships between producers and consumers can influence the adoption of high-quality food habits. We define these as new and alternative producers-consumers relationships with the concept of food community networks (FCN).
Insights from the literature about FCN, and more specifically, participation to farmers' markets, suggests potential benefits for farmers participating in alternative food supply systems, as well as positive impacts on environmental and social sustainability of the food systems. Many studies mentioned in the review also focus on the advantage to consumers who join food community networks, which are able to shape customers' motivations to buy food in alternative markets.
In this study we focus on a specific issue which is related to farmers' markets positive influence on attendants' change in food habits. The objective was to understand how a change in food habits due to shopping at farmers' markets is shaped by characteristics and motivations of the attendants while controlling for farmers market features.

The empirical analysis, based on a fairly large sample of famers' market attendants as surveyed in the major Italian cities, indicates that one out of six consumers participating in farmers' markets experienced a change in food habits since attending the market.

The study confirms that price and saving money are not determining factors in attendants' decision to participate in FCN, just as it is found in some other literature studies. Therefore, it seems that price is not a useful tool to promote farmers' markets and their positive implications for high-quality food consumption.

Focusing on the change in food habits, consumers reported an increased consumption of organic products and vegetables. This certainly has a positive impact on their health, as well as a broader impact on the economic, environmental, and social sustainability of the area. The major drivers of such changes, identified with a discrete choice model, should be used by farmers' market promoters to extend the dimension of these local markets and by policy makers to maximize these positive externalities of consumer choice. Regarding farmers' market promoters, it may be appropriate to address the marketing policies of FCN to those subjects who show a lower "resistance to change", namely young consumers, residents of the area where the market is held, and large families. In this process, the integration with other types of food retailers is controversial: from an empirical point of view, an integration of farmers' markets and large retailers such as supermarkets seems possible, and is indeed desirable. While this could lead to larger scale benefits, it is clear that such integration in practice presents many challenges. Looking at the implications for policy makers, the results of the study suggest some directions for supporting farmers' markets development. One first issue concerns the need to ensure time continuity (both in terms of time and place) in the presence of these alternative markets, because the chance of food habits changing is strongly linked to age of the farmers' market and its localization in the same town where the consumer lives. Second, ethical (environmental) motivations that push consumers to farmers' market should be enhanced, especially in younger people, as they are positively correlated with turning to more sustainable food habits. Finally, it would be very important to monitor the products offered at FCN for their environmental impact and their freshness, as these issues have shown a significant ability to push a change in food habits among customers of the farmers' markets.

Such insights for policy makers represent the main innovative issues highlighted in the paper, although they should be carefully evaluated considering the limitations of the empirical research. Among them we report: the survey was completely based on customers' perceptions, while no information on their real behaviors was considered; the sample was not fully representative of the Italian population. For these reasons, the findings of this study might be usefully integrated with further studies on the topic. Indeed, this research has been able to highlight the potential role of farmers' markets in improving consumers to seek high-quality foods, opening the way for further research focused on new ways to broaden the scale of these experiences. A possible way to explore these options could be the application of new Information Communication Technologies (ICT) and social networking, for example by building up virtual FCNs. Indeed we consider this development as the next step in enhancing the capacity of high-quality food supply systems to be more competitive with respect to mainstream food supply systems which are based on trading commodities, and usually have a lower transaction costs (Raynaud et al. 2005). In this perspective, the use of (virtual) FCN could be a frontier to be explored in the very near future.

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Large Commercial Producer Market Segments for Agricultural Capital Equipment

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Abstract

Using cluster analysis, this research identifies four buying behavior segments of commercial producers who purchase capital items: Convenience, Price, Performance, and a group of Balance buyers who consider all of these factors as well as customer service and support services in roughly equal allotments. The Balance segment is the largest of the four. Price and Performance buyers tend to be younger, larger, and better educated than the Convenience or Balance buyers. We discuss the implications of these customer market segments for capital equipment marketers and salespeople.

Keywords: Cluster Analysis, Capital Equipment, Market Segmentation, Commercial Producers

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Introduction

A review of the current literature reveals that not much has been written about the buying behavior of farmers as they make decisions about the purchase of capital items. Yet this information is critical for firms to deploy marketing budgets effectively. Consolidation among farming operations today means that there are fewer potential customers for capital equipment dealers and manufacturers. One implication of consolidation, first noted by Kohls (1959), is that the remaining, larger customers have seen an expansion in purchasing power. This translates to tremendous market opportunities for suppliers of capital items. Understanding how producers buy is valuable to those sellers who hope to develop strategies for attracting and retaining customers in an evolving agricultural marketplace. This information is also valuable to researchers who are concerned about the factors that drive economic decisions on the farm.

This paper presents the results of a market segmentation of U.S. commercial producers using cluster analysis that will help practitioners and researchers better understand buying preferences for capital items in the agricultural sector. U.S. commercial agricultural producers are defined as farming operations with annual sales of $100,000 or greater[1]. This group represented 16% of operations in 2007 but accounted for 58% of the estimated value of machinery and equipment in the United States (USDA, 2007; p104). Therefore, understanding and successfully serving these commercial producers who represent such a large portion of machinery and equipment expenditures is critical to the success of dealers and manufacturers as they look for ways to retain customers, increase repeat customer transactions, and capture and increase customer lifetime expenditures.

This research aims to identify today's distinct market segments for capital items for U.S. commercial agricultural producers. This cluster analysis is used to segment the commercial producer market based on survey data describing their buying behavior for capital items (such as equipment, machinery, etc). We find four buying segments for capital items: Balance, Convenience, Price, and Performance. Finally, we discuss the implications of our results for suppliers of capital equipment serving these market segments.

Previous Research

To the best of our knowledge, there has been very little research on buying behavior and customer segmentation of agricultural capital markets. The literature that specifically focuses on agricultural capital equipment market segments is a subset of the broader literature on market segmentation and of the industrial market segmentation focuses on segmenting business customers. Kotler and Keller (2011) define market segmentation as a three-step process that starts by identifying distinct groups of consumers who have different needs and wants, then selecting one or more market segments to target, and lastly communicating the benefits of the company's offering to each target market. Much of the industrial market segmentation literature focuses on the first step of identifying the distinct groups of buyers and the bases (for example, demographics, purchasing approaches, etc.) for segmenting them, rather than the strategic problem of allocating

[1] When the Large Commercial Producer Survey was first conducted, the USDA definition of a commercial farm was a farm with at least $100,000 in gross sales (USDA, 1998). In the 2008 survey, we still use $100,000 in gross sales as a benchmark definition of a commercial farm.

marketing resources (Plank, 1985; Freytag and Clarke, 2001). In one seminal study on how firms use market segmentation, Wind and Cardozo (1974) found that it is most often used as a marketing tool *ex post* to explain the outcome of a marketing effort but they argue it would be best used *ex ante* in the planning and implementation of marketing efforts. Freytag and Clarke (2001) argue the segmentation approach depends on the whether the market situation can be characterized as a simple market transaction or a complex relationship management. In the case of complex relationship management, which is most relevant to our study of agricultural producers, the firm needs to understand the customers' needs and wants and the choice of which segments to serve will depend on how well the firm's strengths match the customers' needs and wants. Overall, the industrial market segmentation literature focuses on the analytical tools of how to segment the markets and on how firms utilize segmentation in their marketing efforts.

As with the industrial market segmentation literature, most of the literature on market segments for agricultural capital equipment focuses on both how to segment farmers and on describing the market segments. Kohls (1956, 1959) was one of the first to study how farmers purchase capital equipment and he interviewed 201 farmers in Central Indiana in June 1955. He found that although capital purchases tend to be relatively large, farmers do not shop around much and most of their purchasing activity is done within five miles of their home (Kohls, 1956). Before making their purchase decision, farmers discuss it with the dealers, consult neighbors, relatives, and friends, have read some form of literature about the product, and have usually seen a similar item in operation on friends' or neighbors farms (Kohls, 1956). Kohls (1956) also indicated that a favorable price and having the desired item are the two main reasons that explain the farmer's decision to choose a specific dealer. Kohls (1956) also studied dealer and brand loyalty and found that no socioeconomic characteristics significantly explained dealer loyalty. Although only significant at the 20 percent level, brand preference tended to be negatively related with income, age, and farm experience; and positively related with farmer's exposure to radio, television, and printed publications. Farmers who believed there were greater differences among available dealers tended to have higher brand preferences as well.

Kool et al. (1997) studied Dutch farmers' purchasing decision processes for inputs. They found that the more familiar the farmer was with the product and the smaller the purchase, the quicker the farmer makes a purchase decision. In this case, farmers mainly focus on prices, the availability of alternatives, and special bargains. Thus, suppliers should emphasize price level, distribution (availability), and brand knowledge. In contrast, for infrequent decisions, farmers spend a considerable amount of time on the decision and suppliers in those cases should focus on product performance, price in relation to product performance, and personal selling. The authors also found that a personal relationship between the farmer and the vendor decreased the evaluation of other alternatives by the farmers, which suggests that suppliers should spend time investing in their relationship with the farmer. The Kool et al.'s (1997) study highlights that both price and relationship appear to play a role in farm buyer preferences for equipment.

Pratik (2008) presented a case study of an Indian company manufacturing small-scale tractors. The company was trying to select the most appropriate market segment for its product given the advantages of their product, tractorization in India, the industry, and the available market segments. The company's major dilemma was determining whether the small and marginal farmers were the most appropriate target market, whether they would represent enough sales, and wheth-

er these farmers could be convinced to buy a small tractor instead of a large one given the saying "the bigger, the better".

Gloy and Akridge (1999) used cluster analysis to segment the commercial producer market for agricultural inputs (expendable items, such as feed, seed, and fertilizer, relative to capital items, such as equipment). Their work was based on data from the 1998 Purdue Large Commercial Producer Survey and they identified four market segments: Balance, Price, Performance, and Convenience. Their four market segments refine the traditional three segments of Business, Economic, and Price (Downey, Holschuh, and Jackson, 1999) where members of the Balance and Performance segments are Business buyers, members of the Price segment are Economic buyers and members of the Convenience segment are Relationship buyers.

Walley et al. (2007) used data from a survey of farmers and farm contractors to examine the importance of brand in the industrial purchase decision, and more specifically in the United Kingdom (UK) tractor market. They found that brand name was the most important purchase decision factor with a 38.95% weight in the decision and ranked above price, dealer proximity, and quality of dealer service. The dealer is also an influential part of the decision through their location and their quality of service. Since the respondents award the highest brand utility scores to the brands they own, with the exception of one tractor brand, the authors concluded that tractor owners are very brand loyal.

Harbor, Martin and Akridge (2008) used data from the 2003 Purdue Large Commercial Producer Survey to assess the nature of brand loyalty for capital items among commercial agricultural producers in the United States. They found that over half of the respondents consider themselves loyal to brands of capital items. The data show that attending but not completing high school and producing corn or soybeans increased the likelihood of being brand loyal to capital items. Other variables that positively influenced capital brand loyalty included the reported use of media to obtain information useful for making input decisions, and the perception that substantial differences in performance exist across branded capital items.

Boehlje and Roucan-Kane (2009) presented a case study of Deere's market segmentation. Deere had historically focused on and had a strong market position in power, implement and combine equipment with traditional commercial producers in Midwest corn/soybean agriculture. However, a customer segmentation analysis indicated that there are eight different and important customer segments in the farm machinery and equipment market (not-for-profit public companies, not-for-profit property owner, part-time producers, traditional producers, large producers, extra-large producers, agricultural service providers, and commercial companies) with different attitudes, goals, behaviors, and needs. By starting from the customer's standpoint, Deere realized that some of these segments were growing exponentially — particularly the large/mega farm, the agricultural service provider/custom contractor, and some of the not-for-profit (state and federal government, etc.) segments – and could be Deere's future source of growth. However, these "new" customers needed machinery and equipment with different features convincing Deere to invest in electronic technology as long as it was simple to use and reliable.

The segmentation literature in general focuses more on grouping customers into market segments than on the implementation of a marketing plan based on these market segments (Dibb and Sim-

kin, 1994). Therefore, after we identify the market segments, we will focus on describing the customers in each segment based on characteristics salespeople can easily observe or elicit by asking key questions (Wind and Cardozo 1974; Gupta and Chintangunta 1994; Wyner 1999; Mudambi 2002). Finally, we will discuss implications of these market segments for salespeople interacting with their customers.

Data

This research uses phone survey data collected during the 2008 Large Commercial Producer Project conducted by The Center for Food and Agricultural Business at Purdue University. The survey specifically targeted mid-size and large producers of corn/soybeans, wheat/barley/canola, cotton, dairy, swine, and beef farming operations. State quotas were set so that targeted producers were in states that accounted for 75 percent of 2007 U.S. production in each of the six target enterprise classes. The questionnaire was successfully answered by 2,575 producers during January and February 2008, resulting in a response rate of 28 percent (Roucan-Kane et al. 2010).

Methods

The cluster analysis used in this study follows the same methodology as Gloy and Akridge (1999), Alexander, Wilson and Foley (2005), and Roucan-Kane et al. (2010). First, we select the clustering variables. We used responses to a buying behavior question because behavioral data is more descriptive of the customers' basic reasons for purchase (Dibb and Simkin, 1994; Assael, 1995). In addition, one advantage of using cluster analysis is that it "minimizes research bias by not specifying classes according to pre-specified conceptions (Rosenburg and Turvey, 1991). This key survey question asked the respondents to weigh the influence of five factors they may consider to choose their capital equipment supplier.

We used a two-step clustering algorithm (Gloy and Akridge, 1999; Alexander, Wilson and Foley, 2005; and Roucan-Kane et al., 2010). First, we used Ward's Minimum Variance hierarchical clustering algorithm to identify the appropriate number of clusters and obtain seed values that are being used in the second step. Second, we used the k-means non-hierarchical clustering algorithm to identify the market segments.

Results

The key survey question used in the segmentation analysis asked the respondents to weigh the influence of five factors they may use to choose their capital equipment supplier. The influence of these factors was measured on a forced sum scale using the following question: *When you choose a supplier for capital equipment, how is your decision influenced by the following factors? Assign a percentage value to each factor based on its importance in the decision. The percentages should add to 100 in each column.* The response categories included convenience/location, customer service/information, price, product performance, and support services. The survey defined customer service/information as responsiveness, follow-up, advice, etc. Product performance referred to characteristics such as durability of the equipment. Support service was related to whether the dealer offered delivery, repair, and application services. We left the definition of convenience/location, customer service/information, and price up to the re-

spondent's interpretation. Our discussion with some respondents on this topic suggested that producers relate convenience/location to the presence of local suppliers, long operating hours, etc. The same question was asked for financial products, animal health, feed, seed, and crop protection chemicals.[2]

The data cleaning process, prior to the cluster analysis, consisted of deleting 227 observations that represented respondents that had a farm size less than the lower bound of the mid-size farm definition as defined by Alexander et al. (2009). We then deleted 124 observations where the respondent allocated the full 100% to a single factor. These single-factor buying behaviors each represent a distinct, and narrowly defined, market segment. Further, these single-factor market segments each represent about 1% or less of the respondents and are too small for a capital equipment firm to serve with a tailored marketing program. The data cleaning process reduced the number of observations from 2574 to 2223 producers.

Based on the pseudo-t^2 value and the pseudo F-statistic for the cluster analysis, there were four natural clusters for capital equipment buying behavior. Table 1 presents the sample means for the clustering variables and the names of each cluster based on the most influential factor in the choice of a capital equipment provider. Tables 2 and 3 demonstrate that these clusters meet the validation criteria suggested by Gloy and Akridge (1999), i.e. that members of the segments differ in the non-clustering variables such as their demographics, general business characteristics, management practices, and attitudes.

Segments' Characteristics

The Balance segment is the largest segment, with 59% of the farms (Table 1). Buyers in the Balance segment consider all of the capital supplier criteria (convenience/ location, customer service, price, performance, and support service) to be equally important. Members of the Balance segment look for a capital supplier who can provide a wide array of benefits including service and information, convenience, competitive prices, and equipment that performs well.

Table 1. Mean Percent Importance for each Factor in the Capital Supplier Decision by Market Segment

	Market Segment			
Factor	*Balance*	*Convenience*	*Price*	*Performance*
Convenience/Location	18	**48**	12	7
Customer Service	22	27	17	12
Price	22	15	**47**	21
Performance	21	6	16	**50**
Support Service	17	5	8	10
Percent of Sample	59%	12%	18%	12%

The Price segment was the second largest segment with 18% of the farms. Buyers in the Price segment place a large emphasis of 47% on price when selecting a capital provider. Customer service/information is the second most important factor followed closely by performance.

[2] Roucan-Kane et al. (2010) presents the analysis of this question for financial products.

The Convenience segment accounted for 12% of the farms. This segment placed an average weight of 48% on the convenience and location provided by a capital provider. Customer service/information is the second most important factor to the Convenience segment.

The Performance segment also accounted for 12% of the farms. Approximately one half of the purchase decision of producers in the Performance segment is based on the performance of the products. Price is the second most important factor to the Performance segment.

Figure 1 indicates differences in market segment membership between the crop and livestock producers. Crop producers are slightly more likely to be Performance and Price buyers, while livestock producers are more likely to be Convenience buyers of capital items.

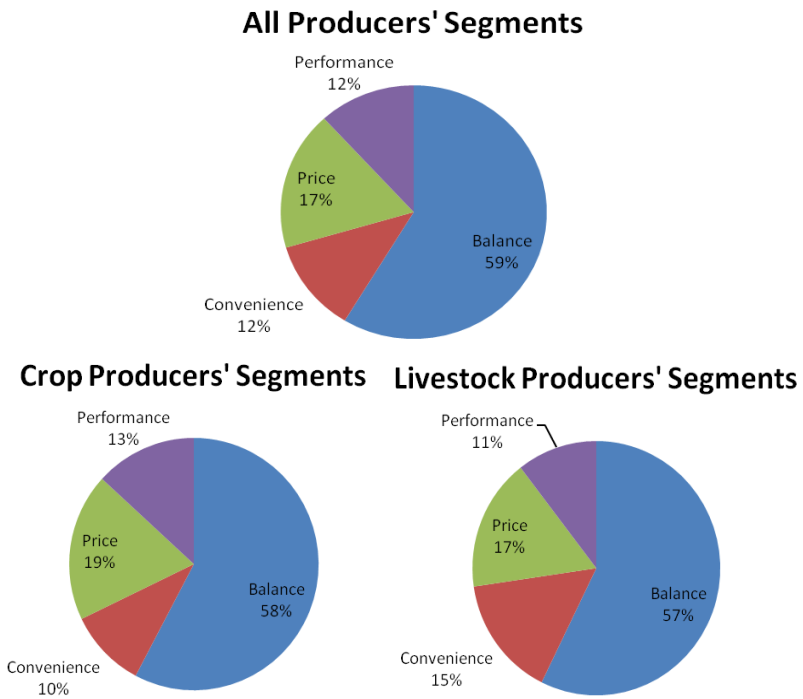

Figure 1. Market Segments for Crop and Livestock Producers

Demographics

Producers in the Balance segment are slightly less educated than the average with 27% having a bachelor's degree or more education (Table 2). They also tend to be slightly older than producers in other segments. In terms of gross sales, 37% of the Balance segment have gross sales over $1 million, 25% have sales between $500,000 and $1 million, and 38% have gross sales less than $500,000. We cannot draw any inferences about the sales distribution for the population of Balance buyers since we oversampled producers with higher gross sales; that said, we can compare the distribution of gross sales across segments. The majority of the Balance buyers (76%) consider themselves primarily crop operations, while 24% of the Balance buyers consider themselves primarily livestock operations.

Table 2. Demographics and General Farm Characteristics

Demographic and Farm Characteristics	Definition of Categories	Balance	Convenience	Price	Performance	Prob of No Assoc.[a]
Percent of College Graduates	Highest level of education is a bachelor or more	26.6%	23.7%	34.6%	37.8%	23.203***[b]
Average Age		54.05	53.89	52.28	52.79	2.965**
Total gross farm sales	Less than $500,000	37.9%	48.5%	34.6%	32.8%	20.217***
	$500,000-1 million	25.4%	21.4%	28.2%	23.7%	
	$1 million +	36.7%	30.2%	37.2%	43.5%	
Self-stated primary enterprise	Crop	75.20%	66.40%	77.30%	79.20%	7.079*
	Livestock	24.80%	33.60%	22.70%	20.80%	

[a] The numbers in the column "probability of no association" represent the Pearson chi-square in the case of the chi-square test of cross tabulation or the F statistic in the case of the Anova table.
[b] *, **, and *** represent 0.10, 0.05, and 0.01 levels of statistical significance, respectively.

Producers in the Convenience segment have the least amount of education relative to the other segments, with only 24% of them having a bachelor's degree or more. After the Balance segment, they are the oldest segment with an average age of 54. Farms in the Convenience segment are the smallest as measured by gross sales with the largest proportion, with sales less than $500,000 at 49%. Convenience buyers are also the most likely to have livestock operations, with the largest proportion of farms that consider themselves primarily livestock farms.

Producers in the Price segment have the second most years of education with 35% having a bachelor's degree or more education. This segment is the youngest with an average age of 52 years. Looking at gross sales, the Price segment represents relatively large farms with 37% having gross sales over $1 million, and 28% having gross sales between $500,000 and 1 million. The Price segment has the second lowest proportion of livestock farms after the Performance segment, with only 23% of the farms in this segment considering themselves primarily livestock farms.

Producers in the Performance segment have the most education with 38% having a bachelor's degree or more. They are the second youngest segment after the Price segment with an average age of 53 years old. Looking at gross sales, the Performance segment is more likely than other segments to be in the $1 million plus category. The Performance segment is the least likely of all segments to have an operation that is primarily livestock oriented.

Additional analyses were performed on other farm characteristics to determine demographic differences across segments, but no clear differences could be found on factors such as expected change in farming over the next five years, outsourcing and contract production, growth expectations, management challenges, and risk management approaches. A closer analysis comparing crop producers and livestock producers indicates that the four segments for crop producers do not vary much in terms of education, but education varies significantly within the livestock pro-

ducers. Specifically, 50% of livestock producers in the performance segment had a bachelor's degree or more. This proportion declines to 31% for the Price segment, 22% for the Balance segment, and 9% for the Convenience segment. This means livestock producers in the Balance and Convenience segments have significantly fewer years of education than their crop counterparts. As for age, livestock producers in the Convenience segment are slightly younger (50.6 years old versus 53.7 years old) than crop producers.

For marketing managers, demographic information about the four segments has several implications. First, the Balance segment is quite large for both the crop and livestock sectors. This implies that there are significant opportunities for marketers who want to consider targeting this segment. Yet, the preferences of this segment are complex because these buyers are motivated similarly by all value bundle characteristics – price, performance, convenience, customer service, and support services. The support services aspect of the value bundle may offer marketers the most opportunity for developing a differentiated offering that targets this segment. The Balance segment cares about support services more than any other segment. Along with their older age, this group wants to have confidence that the company they buy from will maintain and service the equipment they sell. This is a revenue opportunity for capital equipment sellers.

Beyond the Balance segment, it is worth noting the role that customer service plays. This factor was ranked first or second for all but the Performance segment. Customer service activities support the relationship with the customer, in contrast to support services which focus on products and implementation. Marketers and sales people would do well to recognize that interaction with customers before and after the sale may influence the buying decision. For marketing strategies that do not clearly indicate a price or performance dimension, customer service and the role of local sales and technical staff may be an area worth considering as a key point of differentiation.

Information Characteristics

Respondents were asked to rate the usefulness of information sources and communication medias (Table 3). Respondents rated local dealer sales/technical people to be the most useful information sources on average, followed by other farmers, manufacturer salespeople, extension service, and lenders. Manufacturer technical specialists and independent paid consultants were rated the least useful. This finding suggests that manufacturers of capital items should consider increasing the training they offer local dealers representatives, rather than sending their own representatives to producers. The high rating of other farmers confirms the results of Kool et al. (1997) who stated that "presence [of the product] in the evoked set of farmers is vital to the market success of a product". Capital items are a major investment for producers, and producers gather information about an item before purchase to reduce the risk that they make a poor investment. Buying a product that they have observed another producer use or that is recommended by other producers lowers the risk associated with the investment. Therefore, if a manufacturer wishes to succeed in a new market, promoting at trade shows with current customers who can provide testimonials either in person or through videos, and offering leasing opportunities where producers can test the capital item before purchase may lower producers' perception of the risk associated with a major investment.

Table 3. Information Characteristics

Information Characteristics	Definition/Categories	Balance	Convenience	Price	Performance	Prob of No Assoc.
Mean Usefulness of information sources (1=never useful, 5=always useful)	Extension service	2.63	2.61	2.70	2.68	0.51
	Manufacturer salespeople	2.80	2.66	2.84	2.87	2.44*
	Manufacturer technical specialists	2.34	2.14	2.34	2.51	5.52***
	Independent, paid consultants[3]	2.44	2.27	2.43	2.47	0.71
	Local dealer sales/technical people	3.21	3.14	3.09	3.19	1.62
	Lenders	2.55	2.50	2.45	2.37	1.86
	Other farmers	3.05	2.97	3.09	3.10	0.97
Mean Usefulness of communication media (1=never useful, 5=always useful)	General farm publications	3.33	3.25	3.33	3.33	0.56
	Crop/livestock specific publications	3.10	2.95	3.08	3.15	1.82
	Agricultural newspapers	3.01	2.90	3.04	3.02	0.91
	Agricultural newsletters	2.87	2.76	2.90	2.93	1.33
	Farm shows	2.82	2.66	2.73	2.77	2.56*
	Direct mail	2.62	2.48	2.63	2.63	1.39
	Supplier's meetings	2.69	2.57	2.76	2.71	1.99
	Agricultural websites	2.44	2.14	2.51	2.51	6.20***
	Field days	2.74	2.60	2.75	2.75	1.55
	Agricultural radio programs	2.46	2.40	2.41	2.54	0.95
	Agricultural TV programs	2.29	2.30	2.37	2.33	0.65
	Telephone contact	2.16	2.15	2.26	2.23	1.26

There are only a few statistically significant differences in how segments rate the usefulness of information sources. The Performance segment is significantly more likely to consider manufacturer salespeople and technical specialists to be useful than the other segments, while the Convenience segment rates them less useful. Performance buyers who are seeking optimum performance of the product value the more detailed information that can be provided by the manufacturer technical specialists. In contrast, Convenience buyers tend to place a low value on detailed information and would rather rely on the recommendation of the local dealer.

Producers were also asked to rate the usefulness of communication media, and on average they rated general farm publications the most useful, followed by crop/livestock specific publications,

[3] Usefulness of consultants was calculated only for the respondents who use environmental, crop, management consultants or nutritionists.

agricultural newspapers, agricultural newsletters, farm shows, field days, supplier's meetings, direct mail, agricultural websites, agricultural radio programs, agricultural TV programs, and telephone contact. Capital suppliers may wish to target their advertisements to these general farm publications and crop/livestock-specific publications when the target market of the publication matches the target market for their product. There are only a few statistically significant differences in how segments rate the usefulness of communication media. The Balance segments finds farm shows more useful than the other segments, while the Convenience segment finds them the least useful. For agricultural websites, Price and Performance buyers rate them as more useful than the other segments, and Convenience buyers rate them the least useful.

Decision-making Process

To sell effectively to producers, it is important for manufacturers and dealers to understand how their customers make decisions (Table 4). Although there are no significant differences across segments, slightly over half of the respondents make decisions without input from others. For these producers, it is important for technical representatives and salespeople to directly approach the primary decision-maker. The second largest set of respondents make decisions after extensive discussions with other family members and/or employees. For these producers, it is important for technical representatives and salespeople to engage more members of the operation. As sales representatives think about their strategy, they first need to determine how each of their customers make their purchasing decisions and respond accordingly.

Table 4. Decision-making Process for the Purchase of Capital Items

Percentage of respondents	Balance	Convenience	Price	Performance	Prob of No Assoc.
Made by me with very little input from family members and/or employees	48.60%	58.40%	49.60%	51.50%	
Made by me after extensive discussions with other family members and/or employees	34.70%	24.80%	36.40%	31.30%	
Made by the person responsible for using the item after extensive discussion with others on the farm.	9.60%	8.80%	8.10%	7.60%	17.655
Made by the person responsible for the item with little input from anyone else.	5.20%	6.50%	4.10%	6.90%	
Made by a purchasing agent hired by our farm.	1.80%	1.50%	1.80%	2.70%	

When it comes to attitude towards price, producers tend to somewhat disagree with the statement "when buying capital items, I usually purchase the lowest priced products" (Table 5). The Performance segment is the most likely to disagree that they purchased the lowest priced products, which is consistent with their focus on product performance and not on price. Interestingly, the Convenience segment, and not the Price segment, is the least likely to disagree, i.e. more Convenience buyers agree with this statement than Price buyers. It is possible that the Convenience segment trusts their local dealer to consistently provide the best prices, or this segment simply

sees the travel and shopping requirements to work with non-local dealers as adding to the costs. This area warrants more study.

Even with these differences, producers overall do not emphasize price when purchasing capital items, which suggests that salespeople need to focus primarily on attributes other than price when communicating with potential customers. Producers tend to agree with the statement "for capital items, there are often significant price differences for similar products from one supplier to another" (Table 5). While there are no significant differences across segments regarding this statement, Price buyers are slightly more likely to notice price differences.

Table 5. Producers' Opinions about Price

Price Characteristics	Balance	Convenience	Price	Performance	Prob of No Assoc.
Mean of Attitudinal Questions *1 being "strongly disagree" to 5 being "strongly agree"*					
When buying capital items such as equipment, I usually purchase the lowest priced products	2.40	2.53	2.47	2.27	2.588*
For capital items such as machinery, there are often significant price differences for similar products from one supplier to another	3.41	3.41	3.49	3.39	0.55
Attitudinal Questions *Percentage of respondents selecting with a 4 ("agree") or a 5 ("strongly agree")*					
When buying capital items such as equipment, I usually purchase the lowest priced products	17.00%	21.00%	20.40%	13.40%	7.7*
For capital items such as machinery, there are often significant price differences for similar products from one supplier to another	47.00%	46.20%	50.60%	47.30%	1.851

Brand Loyalty

Consistent with Walley et al. (2007) and Harbor, Martin and Akridge (2008) producers on average consider themselves to be loyal to brands of capital items. However, there are significant differences between market segments (Table 6). Balance buyers are the most likely to report that they are brand loyal. Price buyers are the least likely to report they are brand loyal which is consistent with Harbor, Martin and Akridge (2008) who find that price sensitive buyers are less brand loyal. We also tested whether respondent's brand loyalty was correlated with their socioeconomic characteristics such as gross sales, respondent's age, and level of education. We found that there was no significant correlation with these socioeconomic characteristics, which provides support for defining market segments based on buying behaviors rather than socioeconomic characteristics. Brand loyalty was weakly and positively correlated with dealer loyalty (correlation of 0.2 to 0.3).

Table 6. Producers' Brand Loyalty

Distribution Characteristics	Balance	Convenience	Price	Performance	Prob of No Assoc.
Mean of Attitudinal Questions *1 being "strongly disagree" to 5 being "strongly agree"*					
I consider myself loyal to the brands of capital items (equipment, etc) I buy	3.49	3.32	3.25	3.32	4.597***
Attitudinal Questions *Percentage of respondents responding with a 4 ("agree") or a 5 ("strongly agree")*					
I consider myself loyal to the brands of capital items (equipment, etc) I buy	54.00%	49.20%	45.30%	47.30%	11.50***

Dealer Loyalty and Distribution Channels

Producers tend to be loyal to their primary local supplier of capital items, with Balance and Convenience buyers being significantly more loyal than Price and Performance buyers (Table 7). Balance and Convenience buyers also prefer to buy their capital items from one supplier, which means that local dealers who win the business of Balance and Convenience buyers have the opportunity to win lifetime customers.

One way capital item suppliers can differentiate themselves is through the quality of services they provide. Performance buyers are the most likely to notice differences in the quality of services provided by local suppliers, followed by Balance buyers. While Performance buyers notice this difference, recall from Table 1 that these issues do not weigh heavily in purchase decisions for this segment.

Respondents were asked whether they finance their purchases of capital items through their dealer/supplier or a traditional lender (Table 7). Slightly over half of the respondents indicated that they use their dealer/supplier's financing options, i.e., at least some of their financing comes from their dealer/supplier. About a quarter of respondents use their dealer/supplier financing options for less than a quarter of their total financing, while roughly 15% of respondents use their dealer/supplier financing options for over half of their total financing. This was true for all segments without significant differences among segments. Given the high dollar expenditures for capital items, financing options are important to producers and may provide an alternative source of revenue for manufacturers or dealers who offer them. Dealer or manufacturer financing may be particularly appealing to Convenience buyers, as it saves them time, although this buying behavior may carry over to the purchase of financing from convenient local banks as well. To the extent that dealers or manufacturers can bundle attractive financing with the product, financing through the capital equipment supplier may be appealing to the Price segment as well.

Most producers are not opposed to buying their capital items from different suppliers. This suggests that providing financing, high quality services and a variety of equipment to match producers' needs in one stop may be a good strategy. Not surprisingly, the Convenience segment and to some extent, the Balance segment are less willing to purchase from multiple dealers.

Table 7. Producer Preferences for Distribution Channels

Distribution Characteristics		Balance	Convenience	Price	Performance	Prob of No Assoc.
Mean of Attitudinal Questions *1 being "strongly disagree" to 5 being "strongly agree"*						
I consider myself loyal to my primary local supplier of capital items		3.6	3.69	3.31	3.37	9.656***
I prefer to buy most of the capital items (equipment, etc) I need from one supplier		2.98	3.18	2.76	2.78	7.912***
There are often significant differences in the quality of services from one local supplier to another		3.67	3.49	3.59	3.74	2.852**
There are often significant differences in the quality of information from one local supplier to another		3.40	3.29	3.31	3.40	1.2500
In the next five years I want a more direct relationship with manufacturers of capital items		2.95	2.99	2.92	2.90	0.3050
On average, what percentage of your total financing needs are met through the financing options provided by your dealer/supplier versus a traditional lender (Bank, Farm Credit, Others)?						
Percentage of respondents	0%	41%	44%	46%	44%	8.169
	1-25%	27%	22%	26%	26%	
	26-50%	17%	17%	17%	16%	
	51-75%	6%	7%	5%	6%	
	76-100%	9%	10%	7%	8%	

Conclusion

For managers who are seeking to develop more effective approaches to reaching capital item purchasers, understanding their customers' preferences and behaviors is crucial to success. This information is useful in developing strategies for attracting customers in an evolving agricultural marketplace.

Our research shows that buying decisions are based on a variety of influences. We identified four distinct market segments for capital purchases among U.S. crop and livestock commercial producers: Balance, Price, Convenience, and Performance. We described each of the four segments' attitudes toward information, their decision making processes and influences, factors that affect their loyalty and their perspectives about local dealers and manufacturers. Dividing the marketplace based on the four segments will help marketers use their resources to reinforce aspects of the value bundle that are most meaningful to the segments they choose to target. Recognizing that the Balance segment represents the majority of farms and that this group has a high affinity for customer service relative to other segments allows marketers to tailor offerings that may be uniquely appealing to this segment. Training salespeople to discover nuances of individual preferences among producers in this category so that they can tailor their offering to them may be advisable as well. Livestock producers who buy capital items in the Convenience segment tend to be less educated, which reinforces the value local dealers play in providing valuable infor-

mation to those customers. Understanding that Price and Performance segments tend to be larger, younger and more educated allows salespeople to know where to begin their discovery of individual producer preferences. These two groups tend to value manufacturer's resources. Local dealers who want to serve these segments should manage access to manufacturers or work to enhance the expertise of their staff who serve these demanding groups of buyers.

Capital item marketers should be aware of several behaviors of the commercial producers they serve. Farm shows seem to be good venues for reaching Balance buyers, but websites are somewhat more useful to the Price and Performance segments. However, none of the traditional means of providing information are valuable to any segments. Given the complexity of technology being used in many capital items, particularly equipment, marketers must do a better job of crafting information that will be useful to customers. At the same time, price does not weigh heavily in purchase decisions for any segments. Perhaps marketers should consider whether attractive pricing or useful information provides better marketing outcomes. There is some brand loyalty, most among Balance buyers, and loyalty to local dealers is a little higher, but most producers buy from more than one dealer. This represents an opportunity for marketers to focus on customer retention by providing differentiated services and information that discourage buyers from shopping for undifferentiated products elsewhere and researchers to consider which dealer activities are most likely to lead to loyalty. Buyers in all segments see differences between dealers in terms of service quality, which reinforces the opportunity for differentiation where service is a strength.

There are several questions raised in this study that warrant further inquiry as to the motivations for segment membership. It could be that Balance buyers, the oldest segment, have simply learned from experience to include several factors in their selection process; or it could be that having less education as the Convenience buyers do, leads to placing more trust in working with suppliers who are easily accessible. Demographic differences are often easily measurable and understanding the relationships between demographic variables and behavior could provide clearer direction to field sales and service professionals. Similarly, understanding the reasons that larger buyers tend to be Price buyers could help equipment sellers better position their offers. Whether larger buyers weigh price higher because they believe they will receive preferential service or because they possess service capabilities in their own operations is an interesting question for future research to address. Although not directly measured in this study, the broader impact of trust and commitment within relationships between equipment dealers and their large farm customers could explain some of the attitudes toward loyalty and relationship warrants attention as well.

Future research should focus on how to implement a targeted marketing plan when there is one dominant segment and three other distinct segments. How should a capital items firm tailor their marketing to these segments? Can a single marketing plan targeted at the Balance segment also serve the other segments that are more focused on a single attribute such as price or service? Should there be separate marketing plans for each or can some of these segments be combined? Perhaps most importantly, researchers should work to uncover the information content and mode of delivery that is most meaningful to buyers. Given how much money manufacturers and dealer invest in advertising, farm shows, and websites the general lack of usefulness of this information across all segments is disturbing. Less disturbing is the value placed on information that comes

from dealer and manufacturer staff, but if willingness to shop at a variety of locations continues to grow, even those resources must continue to be challenged to improve their skills and knowledge.

From an academic perspective, one hole in the market segmentation literature is understanding the causal factors that motivate farmers to choose a particular buying behavior. The economics literature offers several theoretical foundations such as search cost, opportunity cost, and risk aversion that could offer additional insight into how a particular farmer's buying behavior evolves.[4] In future iterations of the Large Commercial Producer project, we intend to develop questions about farmer motivations for their buying behaviors.

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Management System for Harvest Scheduling: The Case of Horticultural Production in Southeast Spain

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Abstract

This article analyzes the programming of farm production, understood not only as the choice among several crops, but also as their temporal distribution. The empirical study takes as a reference the horticultural sector in southeast Spain, since this area constitutes the highest concentration of small-scale farm production in Europe, where the climatic conditions allow the possibility of several harvests in year-round production, as well as several alternative crops. Firstly, we study the production programming for an individual farmer, under the assumption that their decisions do not affect the balance of market prices. In this case a modified Markowitz model is used for the scheduling of crop marketing. Secondly, we study the sales arrangements for a farming-marketing cooperative, under the assumption that their sales volume is such that the entity is capable of altering the market balance. A model of monthly revenues and margins is proposed, and the results show a clear improvement in both margins and revenues if the harvest is programmed in this way.

Keywords: horticultural farmer, optimization, planning, mathematical programming, marketing, cooperative

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Introduction

Production planning, seen from an operational point of view, implies making decisions about the choice of crops and programming harvests over time. Doing this properly will avoid decreases in prices (revenues) as the demand in the agricultural market is usually rigid. In other words, it does not absorb unexpected increases in supply, particularly over short periods of time and with perishable products. For this reason prices and revenues experience disproportionate decreases. This has been a very common situation in recent years for the Spanish fruit and vegetables sector (De Pablo and Pérez-Mesa 2004) in which price fluctuation is very high (Galdeano-Gómez 2007). For example, during the 2008/09 growing season there was a 10% production increase which led to price drops of over 19% among key products such as cucumber, pepper and tomato (AFAC 2010).

The traditional agricultural systems in Spain are located mainly in the Mediterranean areas, and southeast Spain currently represents the main horticultural concentration of the country. Production is based on greenhouses (over 26,000 hectares[1]) and over 13,500 small family farms with an average of 2 hectares of land (Galdeano-Gómez et al. 2011). The climatic conditions and technology allow harvesting during most of the year, and farmers can alternate different horticultural crops; mainly pepper, tomato, cucumber, zucchini, eggplant, melon, watermelon, green bean, and lettuce. Over 95% of total production is marketed within the European Union, and exports represent about 65% of total sales.

In this horticultural sector not all variations can be attributed to programming deficiencies alone, as climatic factors are also involved. The lack of organization related to supply is due to a production system comprised of small-scale farms, which makes coordination very difficult. The low level of organization is also a result of the duality of the marketing systems: cooperatives market 60% of total produce and are also closely related to farmers' programming; the remaining 40% of produce is wholesale auctioned, which complicates crop scheduling (Pérez-Mesa 2007).[2]

The present study focuses on harvest programming and aim to put forward several management systems to improve the decision making of both individual farmers and cooperatives. To this end, certain challenges and considerations must be taken into account. In particular, in order to correct the deficiencies in programming, the optimum production for a given system must be determined, i.e. the quantity that should be supplied to the market so that profits and revenues are maximized. This proves difficult to calculate, since there is essentially only one reference variable: the price. As a result, production programming will ultimately depend on a sampling of prices which are subject to high variability for the following reasons: the existence of complementary supplies unrelated to those which we intend to plan, climatic factors (either seasonal changes in demand, when planning production for periods of under one year) or structural changes (considering variations in consumption habits). Furthermore, when programming for operators that

[1] This represents the highest concentration of greenhouses in the world (UNEP 2005).

[2] We are analyzing a sector with many types of small-scale farm traditionally using two kinds of marketing. In the first, the farmers themselves auction their goods and also follow their own individual programming system. In the second, farmers are members of a cooperative which markets goods collectively. In addition, the presence of high sales margins has often made it difficult to impose any strict scheduling on growers, even in the case of cooperatives. In fact, many cooperatives merely go as far as suggesting scheduling, without ever imposing it. Altogether, these factors cause a relative lack of supply planning.

control a substantial percentage of the sector and are therefore capable of altering the market balance, this fact must also be included in order to maximize their margins and revenues.

Several studies have tackled these questions by implementing different methodologies. The classic method for production programming is the mean-variance quadratic equation (M-V) developed by Markowitz (1952), applied by several researchers to schedule crops efficiently (e.g. Alejos and Cañas 1992; Gómez-Limón and Arriaza 2003). Other programming models utilized in the farming sector include MOTAD (Minimization of Total Absolute Deviation) and Target MOTAD. The objective of these methods is to minimize absolute deviations for a sector of activities using a risk aversion parameter which is subjective for each decision-maker (Romero and Rehman 2003). Another model is Mean-SAD, which uses Semi-Absolute Deviation as a risk estimator to study variable values, with respect to a fixed goal (see e.g. Berbel 1988, 1989).

Advances in non-linear programming techniques should also be mentioned. The following are particularly noteworthy (Ahumada and Villalobos 2009): Direct Expected utility Maximizing non-linear Programming (DEMP) developed by Lambert and McCarl (1985), Utility Efficient Programming (UEP) by Patten et al. (1988) and the combination of both (DEMP-UEP) proposed by Pannell and Nordblom (1998).[3]

The present study has several objectives. The first is to develop a harvest programming model which can easily be applied by grower-marketing entities, i.e., cooperatives, and utilized for both the selection of crops and their distribution throughout the growing season. The second, proposes the creation of a programming optimization method that can be employed by large-scale operators with the capacity to alter the price balance. In order to achieve the first objective it is proposed that the M-V model be modified so as to adapt it to the requirements of programming over time, as well as to include commercial aspects in its formulation. To attain the second objective we develop a multi-equation model for revenue and margin maximization using a monthly system of simultaneous equations.

The rest of the paper is structured as follows. Section 2 outlines the management system of programming production for an individual farmer (M-V model) and shows an empirical application. Section 3 presents a model of management decision considering a monthly program. Section 4 shows the application to a large-scale producer or cooperative. Section 5 outlines the discussion of the results. Finally, conclusions are drawn in Section 6.

Programming Production for an Individual Farmer

Framework and Markovitz Model

Decisions in the horticultural sector are rarely based on certainty due to price variation alone and usually include technical and climatic factors. When we are incapable of predicting or quantifying the future, we find ourselves in a context of uncertainty. When it is possible to calculate the probabilities of those events relevant to our decision, we are in a context of risk. In the present analysis, we consider that decisions will be made in a context of risk. Indeed, several studies

[3] It is important to point out that all the models, including M-V, have the same drawback, which is the 'subjective' selection of the mathematical expression of the utility function.

suggest that the decision making process in the agricultural sector is subject to risk aversion (e.g. Pannell and Nordblom 1998; Hardaker et al. 1991, 1997). When faced with this type of situation, farmers will normally try to diversify, either by introducing new crops or by modifying their production calendars (Pannell and Nordblom 1998).

The present study implicitly assumes that individual farmers are profit maximizers, and that in a situation of risk they behave following the postulates of the Expected Utility Theory (EUT) according to Von Neumann and Morgenstern (1947). At the same time, through empirical studies evaluating different criteria, various authors have revealed the complexity of decision making for farmers (Willock et al. 1999; Costa and Rehman 1999; Solano et al. 2001; Gómez-Limón et al. 2003, 2004). These studies share the same conclusion, namely that when the time comes to make decisions on production, in the farmer's mind, besides the hope of profit, there are a series of considerations related to their economic, social, cultural and environmental surroundings. As a result, they will try, insofar as it is possible, to satisfy all of these objectives simultaneously. Despite this series of drawbacks, the overall approach followed is considered adequate because it is a plausible correct approximation given the highly competitive system which characterizes intensive farming in southeast Spain. In fact, if there were any growers who deviated from this type of behavior which seeks maximum profit, they would be quickly expelled from the market.

In the case of an individual farmer, we propose the Markowitz model (1952) for its simplicity and easy iterative resolution[4]. Furthermore, this model offers an intuitive analysis system that is easy to understand with respect to other programming methods insofar as it does not require prior knowledge about how to apply the expected utility theory (Duval and Featherstone 2002). This also makes it that much easier for farmers to implement. The general formulation of the model has been improved in order to program on a monthly basis and to select among a wide variety of products. Moreover, this makes it possible to introduce commercial criteria when deciding on a production-marketing plan:

(1) $$\text{Min } V(x) = \sum_{s}^{p}\sum_{c}^{p}\sum_{i}^{n}\sum_{j}^{n}\sigma_{ij}^{sc} X_i^s X_j^c$$

Subject to constraints:

(2) $$\sum_{c}^{p}\sum_{i}^{n} M_i^c X_i^c = M_0$$

(3) $$\sum_{c}^{p}\sum_{i}^{j} X_i^c = N$$

(4) $$X_i^c \geq 0 \text{ with c = 1...p; i=1...n}$$

where:

[4] For example using an Excel spread sheet by means of the option 'solver'. Although some authors criticize that a quadratic utility function is rarely observed in reality (Meyer and Rasche 1992), Kroll et al. (1984) demonstrated that the E-V analysis is a good approximation to reality even when these conditions are not met.

X_i^c = Production that will be marketed of crop *c* for month *I*, which is, therefore, the decision variable.

M_i^c = mean gross unit margin of crop *c* for month *i*; meaning, the arithmetic mean, for the years considered in the series, of the difference between variable prices and costs (which are considered fixed for a given month) expressed in euros/kg:

(5) $$M_i^c = Px_i^c - Cx^c$$

N = Total production by farmer. N = 1 is normally utilized (this will allow us to deal with percentages).

σ_{ii}^{cc} = Variance of gross margins obtained during different years for crop *c* for month *i*.

σ_{ij}^{sc} = Covariances of gross margins obtained during different years between crop *c* and crop *s* for months *i* and *j*; or between crops *s* and *c* for month *i*.

Expression (1) will be the variance for the marketing plan, which will measure the risk assumed, which is nothing more than the sum of the variances and covariances of the gross margins weighed by production-marketing dedicated to each crop in a given month. Equation (2) shows the expectations of the production-marketing plan as the sum of the mean gross margins multiplied by the amount. This restriction is parameterized. By varying M_o, specific plans will be attained which satisfy the economic expectations. In short, the calculated plans will minimize the variance-risk (1) for the value of the expectations (2).

The proposed model will make it possible for a company to decide what to market and at what time of year. Nevertheless, reality tends to be more complicated:

> It is possible that the production capacity is such that it does not permit substituting one crop for another; for example, only two types of farming machinery are owned, one used for peppers and the other for tomatoes, meaning the products cannot be switched. In this case two models can be calculated, one for each crop. If we decided to include this in only one model, we would introduce the following restriction substituting (3):

(6) $$\sum_i^n X_i^c = \frac{h^c}{N} \quad \text{with} \quad \sum_c^p h^c = N$$

where h^c is the production of crop *c* which can be managed by the production capacity. For example, let us suppose that a company has only two pieces of farming machinery at its disposal (crop specialized and with equal working capacity), one for tomatoes and the other for peppers. As a result, half of all commercialization will necessarily be dedicated to peppers and the other half to tomatoes, meaning, (with N=1) $h^{Tomato} = 0.5$ and $h^{Pepper} = 0.5$.

On the other hand, if a farmer has programmed commitments with customers, a new restriction will be introduced that will imply the existence of a production *n* designated for a specific product and fixed date:

(7) $$X_i^c \geq n_i^c$$

If the farmer has a maximum monthly capacity *m* available per crop, we will add the restriction:

(8) $$X_i^c \leq m_i^c$$

If we consider that a farmer must cover fixed monthly costs *CF*, we will introduce the restriction:

(9) $$X_i^c \cdot M_i^c \geq CF_i$$

Should we be interested in studying in greater depth the relationship between risk (variance) and profitability (margin), the starting point would be to reformulate the classic M-V problem using the compromise-programming approach[5] (Duval and Featherstone, 2002):

(10) $$\text{Min } L(x) = w_M \frac{M^+ - M(x)}{M^+ - M^-} + w_V \frac{V^+ - V(x)}{V^+ - V^-} = M(x) - \frac{w_V (M^+ - M^-)}{w_M (V^+ - V^-)} \cdot V(x) + C$$

subject to restrictions (3) to (9) and $w_M + w_V = 1$

Where $M(x) = \sum_c^p \sum_i^n M_i^c X_i^c$; C = a constant; M^+ = the maximum portfolio margin possible, M^- = the minimum margin possible, V^- = the minimum portfolio variance possible, V^+= the maximum variance possible, and w_M and w_V are weights (or coefficients) on the margin and the risk, respectively. Solutions to (10) satisfy the following first order condition (11) which means that for any result there is a stable relationship between the program variance and its expected margin, which depends on the weights attributed to the margin and risk (i.e., the value of ϕ):

(11) $$M(x) = \phi V(x); \quad \phi = \frac{w_V (M^+ - M^-)}{w_M (V^+ - V^-)}$$

As can be seen in (11), varying the weights, w_M and w_V, we can trace out the EV efficient set, as occurs in the original problem defined by (1) to (9), since, according to Duval and Featherstone (2002), the compromise programming approach is a generalization of the traditional M-V models. Taking (11) as the starting point and knowing the values of ϕ calculated, we can ascertain the values of w_V and w_M. This approach provides an intuitive view for the decision maker,

[5]For an introduction to compromise programming in agricultural economics literature see Romero and Rehman (2003) and Ballestero (1997).

who can easily check the weighting of risk and profitability that is being assumed in each case without understanding the concept of utility. In order to interpret the weights it must be taken into consideration that w_M, according to (10), ponders the degree of drift from the desired margin in relation to the maximum margin; and that w_V is the degree of drift from the desired variance in relation to the maximum variance. Therefore, an elevated value for w_M and a low value for w_V will provoke a "high risk" position.

Example of Application

In the example, for the sake of simplicity in estimations, we assume that there is a farmer who produces and markets two products via a cooperative: tomatoes and peppers. These two products were chosen because in the study area (southeast Spain) tomatoes and peppers represent nearly 50% of all production and marketing (Figure 1).

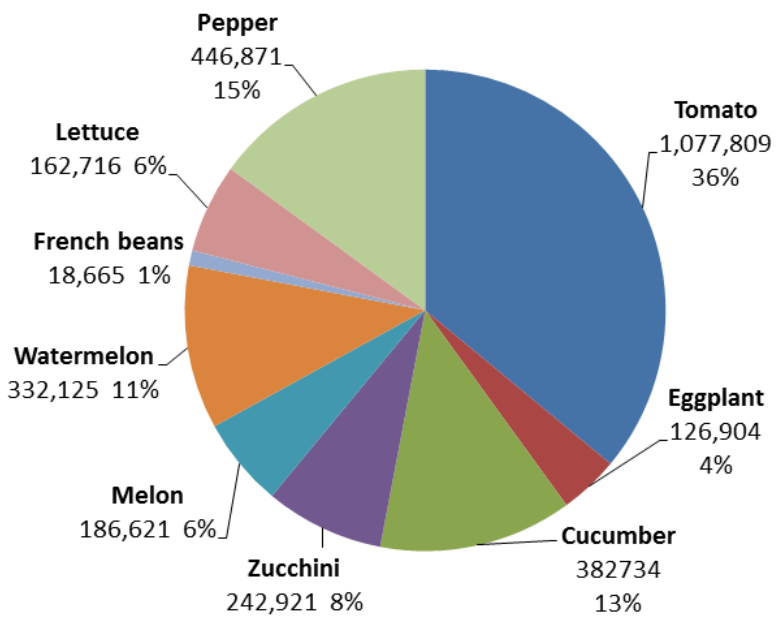

Figure 1. The most important crops produced and marketed in southeast Spain.
Tons. 2007/2008 Season.
Source: Pérez-Mesa, Galdeano-Gómez and Aznar-Sánchez. Created using data from the Agricultural Ministry of Andalusia

For our analysis we use the following data:

1. Spanish export prices to the European Union (FOB) expressed in euros/kg were collected from Eurostat.[6] Bear in mind that southeast Spain represents 71% of Spain's annual pep-

[6] The FOB prices maintain a relationship with the payment price given to the farmer in a cooperative. At the same time, a relationship exists between these prices and the exchange prices as the cooperatives have to follow auction prices to establish their payment price (as these are the only references available on site); otherwise they could lose their members. For a detailed description of the relationship between Cooperatives and Exchanges see e.g. De Pablo and Pérez-Mesa (2004).

per exports (De Pablo and Pérez-Mesa 2004). We have a seven-year series of data for the months that comprise the typical growing season in southeast Spain:[7] September-May. The prices have been deflated and expressed in 2007 monetary terms.

2. In order to calculate the monthly commercial margins, we deduct from the prices per kg the sum of the variable production and marketing costs[8]: 0.51 euros/kg for tomatoes and 0.64 euros/kg for peppers.

The description of the calculated margins can be seen in Table 1. It should be remembered that this margin must include a hypothetical profit attributed to the member-farmer[9] and the company, as well as the fixed costs of both.

Table 1. Monthly and total margin for tomato and pepper crops. Jan 1999 to Dec 2005. Data used for the Markowitz model.

	Tomato			**Pepper**		
Month	Average €/kg	Standard Dev.	Var. Coef.	Average €/kg	Standard Dev.	Var. Coef.
September	0.19	0.13	0.70	0.26	0.08	0.28
October	0.37	0.19	0.51	0.34	0.09	0.25
November	0.37	0.14	0.38	0.46	0.21	0.44
December	0.48	0.12	0.25	0.64	0.21	0.31
January	0.47	0.15	0.32	0.68	0.19	0.26
February	0.52	0.21	0.40	0.70	0.23	0.31
March	0.59	0.30	0.51	0.77	0.19	0.24
April	0.57	0.25	0.44	0.70	0.22	0.30
May	0.19	0.13	0.70	0.64	0.22	0.33

Source: Pérez-Mesa, Galdeano-Gómez and Aznar-Sánchez.

As this is an example, an unrestricted model is applied (Table 2, See Appendix), which means no kind of restriction is imposed. This model chooses between the two crops; for example, for the most conservative distribution (expectation of 0.38 euros/kg) 49% tomatoes would be produced (with peaks in the months of October, December and April) and 51% peppers (concentrated in the months of September and October); for the distribution with the highest risk (expectation of 0.77 euros/kg), only peppers would be produced in the month of March[10]. The scenario which offers the lowest risk per margin unit (expectation of 0.50 euros/kg), in other words, with the smallest variation coefficient, would be that which produces 62% tomatoes (with peaks in December and April) and 38% peppers (with peaks in February and April).

[7] For peppers, there is a sampling that extends from January 1995 to December 2005 (11 years). In this section we will use the shorter sampling for both peppers and tomatoes (7 years).

[8] The updated costs have been calculated based on Salinas and Palao (2002). They include the variable production costs assumed by the farmer-member: manual labor and maintenance. Marketing costs are: packing, handling (including manual labor), overheads and transport costs. Fixed monthly costs are established (per year) as a great deal of costs only receive annual survey (e.g. manual labor of the farmer that affects production costs; and manual labor for packing and handling that influences marketing costs). This hypothesis is used to simplify modeling.

[9] The payment price of the product weight the farmer brings to the cooperative could have been considered a cost, later adding the marketing costs of the company.

[10] In this item it is worth pointing out that the optimum solution chosen for each farmer and company will depend on their 'absolute' and 'relative' aversion to defined risks respectively, by Pratt (1964) and Arrow (1965).

Subsequently, we assume that there exists a fixed production capacity which permits management of 65% tomatoes and 35% peppers (Table 3, See Appendix). This system is equivalent to applying the model independently to later distribute marketing in the proportion deemed appropriate: the results show a conservative distribution (0.41 euros/kg margin) concentrated in the months of October, December and April for tomatoes; and in September for peppers. The highest risk model (0.64 euros/kg) would mean marketing tomatoes in April and December and peppers in March. The scenario which offers the lowest risk per margin unit (expectation of 0.50 euros/kg) would mean marketing mainly tomatoes in the months of October, December and April, and selling the majority of peppers in October, February and April.

Figure 2 shows the actual distribution and those programs with the lowest variation coefficient, that is, those with a lower risk-margin ratio. The actual distribution is softer than the rest and it underlines the difficulty in achieving efficient programs, even in those cases which include restrictions which are in agreement with the observed distribution of production (pepper = 35% of production; tomato = 65%). It can be seen that the actual distribution is no more than a program that is severely restricted by external and internal factors (for instance, demand, production capacity, climate, etc).

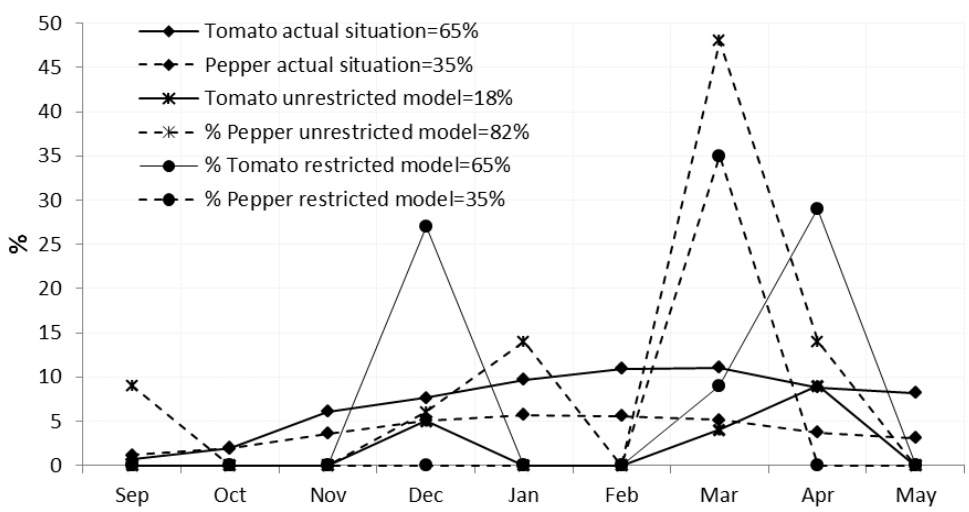

Figure 2. Distribution of pepper and tomato production-exports. Sampling average (actual situation) and calculated closest optimal distributions.
Source: Pérez-Mesa, Galdeano-Gómez and Aznar-Sánchez

From the calculated weights[11] (Tables 2 and 3), w_V and w_M, it follows that at all the points on the efficient frontier M-V the weighting of the risk is very much lower than that of the margin. Using these weights, the decision maker can easily see that even in the case of programs with higher variances, excessive risks are not being taken. Moreover, the weights for actual distribu-

[11] The value of ϕ will be equal to the ratio between margin and variance calculated in Tables 2 and 3. The maximums and minimums of the margin and the variance (M^+, M^-, V^+ *and* V^-) will be the same as those in Tables 2 and 3. Moreover, knowing that $w_M + w_V = 1$ we can clarify the value of w_V and w_M.

tion of the production show that the average horticultural farmer in southeast Spain is not conservative but nor do they assume excessive risk when temporarily programming their farming production. Nonetheless, farmers may not want to implement the optimal plans (although they imply lower risk) as they mean reducing the possibility of obtaining the highest revenues.

Production Programming for a Large-Scale Producer: Cooperative

Monthly Model

The problem now at hand is how to program the production of a cooperative which has the capacity to alter market balance as a result of its marketing volume. European Union regulations allow a group of companies (Associations of Fresh Fruit and Vegetables Producer Organizations) to collaborate in programming harvesting, that is, adapt their supply to the demand. Let us suppose there is a company or group of companies (Associations of Fresh Fruit and Vegetables Producer Organizations) with a high percentage of marketed production and we apply the Markowitz model described above. As expected, although its function is optimal, prices suffer because the crop is concentrated into a few months[12] since the distribution of production will alter the market balance prices which will be static as occurred in the Markowitz model.

An alternative approach to the programming model, which tries to resolve the above-mentioned problem set, would consist of estimating a function for demand per crop[13]

$$(12)\quad X = f(Px)$$

which would relate the monthly marketed amounts with their corresponding prices (Px) for the total sampling of years available[14]. Multiplying (12) by Px, we would obtain the revenue $IT(Px) = Px \cdot f(Px)$, calculating with respect to the price and equaling it to zero

$$(13)\quad IT' = f(Px) \cdot \left[1 + f'(Px) \cdot \frac{Px}{f(Px)} \right] = 0$$

we would attain a value of an optimum price (Px_{opt}) that would maximize revenue and entail an optimum quantity of monthly commercialization. Bear in mind that the second part of the brackets in (11) corresponds to the price elasticity of the estimated function (which requires that ε_{Px} = -1 so that the derivative is equal to zero). Also, taking into consideration that the total margin $MT(Px) = (Px - Cx) \cdot f(Px)$ could have been maximized; obtaining the optimum price by means of: $MT' = f(Px) + (Px - Cx) f'(Px) = 0$; and later finding X_{opt} of (12).

Example of Application

[12] We find ourselves before a spider's web effect, but with additional complications as we analyze not only the total annual variation of the production but also its distribution throughout the year.
[13] The superscript *c* is omitted in the notation. Also, it is assumed no relationship exists between different crops.
[14] This analysis could have been complicated by introducing other explanatory variables along with price; on the other hand, when using periods of data of less than one year price plays a more important role against other variables (e.g., income).

In this section we will utilize the monthly series of prices and export amounts for Spanish peppers in the EU (between January 1995 and December 2005) to obtain a marketing distribution which maximizes monthly revenue and margin. A summary of the data utilized can be seen in Table 4.

Table 4. Prices and export amounts for Spanish peppers to the EU. Jan 1995 to Dec 2005. Data used for the revenues and margins maximization model.

Month	Average Prices (€/kg)	Average Exports (tons)	Standard Dev. Prices	Standard Dev. Exports
September	0.95	9,927	0.09	1,974
October	1.00	16,174	0.12	3,242
November	1.08	30,469	0.22	3,961
December	1.26	43,354	0.21	6,167
January	1.35	48,715	0.20	4,814
February	1.33	47,673	0.23	5,759
March	1.10	43,948	0.18	3,212
April	1.36	31,394	0.25	3,857
May	1.25	26,020	0.23	2,979

Source: Pérez-Mesa, Galdeano-Gómez and Aznar-Sánchez.

We will concern ourselves only with the typical growing season in southeast Spain from September to May (n=8), for which we will use the following model. The estimation made is:

$$X_{it} = \alpha + \beta\, Px_t + \sum_{i}^{n-1} \theta_i D_{it} + \varepsilon_{it} \tag{14}$$

where D_{it} will be a dummy variable that will take a value of 1 for the corresponding month (n) and zero for all other cases. The original remainders ε_{it} will be modeled using:

$$\varepsilon_{it} = \delta\varepsilon_{it-1} + \mu_{it} \tag{15}$$

Therefore, model (13) would equate to the estimation of n-1 equations[15], one per month (i) which would take the following structure:

$$X_{it} = (\alpha + \theta_i)(1-\delta) + \beta Px_{it} - \delta\beta Px_{it-1} + \delta X_{it-1} + \mu_{it} \quad \text{with } i=1\ldots n\text{-}1 \tag{16}$$

Where μ_{it} are the remainders of the final model. Modelling (15) would serve to test the possibility that amounts marketed are influenced by the results of previous years, as can be seen in equation (16). We should bear in mind that the model assumes no production capacity restrictions and no substitution in production among commodities.

[15] Note that we use n-1 dummies to avoid multi-collinearity.

The results of the model (14) including the modelling of the residues (15) can be seen in Table 5. The estimations are carried out following linear and logarithmic models, obtaining similar results[16]. The calculated models show a high significance. The logarithmic estimation considers the existence of a single price elasticity (value of β) irrespective of the month in question. In this particular case $\beta < 1$, and so the short-term price variations will produce changes that are less than proportional to the amount sold. Nevertheless, it is considered that a single elasticity (logarithmic model) may lead to results that are unrealistic, and so price elasticities are calculated monthly using the linear model (Table 6).

Table 5. Estimation of models

Variable	X_t	$\ln(X_t)$
α	58,581.730 (0.000)	12.452 (0.000)
β	-140.980 (0.000)	-0.554 (0.000)
D_{Jan}	4,724.302 (0.000)	0.107 (0.001)
D_{Feb}	4,163.992 (0.011)	0.097 (0,058)
D_{Mar}	2,569.409 (0.130)	0.074 (0.154)
D_{Apr}	-9,959.225 (0.000)	-0.230 (0.000)
D_{May}	-17,874.34 (0.000)	-0.481 (0.000)
D_{Sept}	-39,592.31 (0.000)	-1.634 (0.000)
D_{Oct}	-32,168.60 (0.000)	-1.098 (0.000)
D_{Nov}	-15,033.13 (0.000)	-0.390 (0.000)
δ	0.449 (0,000)	0.419 (0.000)
R^2	0.946	0.961
H-Durbin	1.808	1.821
F	165,34 (0,000)	234,668 (0,000)

Source: Pérez-Mesa, Galdeano-Gómez and Aznar-Sánchez.

Observing the results and speaking in terms of total levels (Table 6), there is currently a calculated 40% supply excess in respect of maximum revenue and 73% in respect of maximum margin. January to March is the period in which the most substantial excess can be seen (Figure 3). These months coincide with the period of greatest production and the highest prices of the whole season. What the marketer cannot know is that prices could increase even more if the amount produced were reduced. At the start of the campaign (September-October), the potential for price increase by regulating production is moderate due to the existence of other areas of

[16] Estimations have also been made including dummy variables on slope (β) of equation [13], but without significant results.

production (e.g. Holland). Generally speaking, it seems that companies in southeast Spain are only interested in sales, and they neglect the temporal programming of their production.

Table 6. Optimum quantity distribution using the Linear Model.

	Sept	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Total
				Actual Situation						
Average X (t)	9,927	16,174	30,469	43,354	48,715	47,673	43,948	31,394	26,020	**297,674**
Average Px (€/100 kg)	95	100	108	124	130	133	140	136	125	***119**
Total Revenue (Mill. €)	9.4	16.2	32.9	54.8	65.9	63.4	48.3	42.7	32.5	**366.1**
Total margin (Mill. €)	3.1	5.8	13.4	27.0	34.7	32.9	20.2	22.6	15.9	**175.6**
ε_{Px} Short-term	-1.349	-0.872	-0.500	-0.411	-0.392	-0.393	-0.353	-0.611	-0.677	
ε_{Px} Balance	-0.743	-0.480	-0.275	-0.226	-0.216	-0.217	-0.194	-0.337	-0.373	
				Max Revenue						
Px (€/100 kg)	67	94	154	208	225	223	217	172	144	***167**
Quantity (t)	9,495	13,207	21,774	29,291	31,653	31,373	30,576	24,311	20,354	**212,033**
Total Revenue (Mill. €)	6.4	12.4	33.5	60.9	71.2	70.0	66.3	41.8	29.3	**391.9**
Total margin (Mill. €)	0.3	4.0	19.6	42.2	51.0	49.9	46.8	26.3	16.3	**256.2**
				Max Margin						
Px (€/100 kg)	99	126	186	240	257	255	249	204	176	***199**
Quantity (t)	4,983	8,695	17,263	24,780	27,142	26,862	26,064	19,800	15,842	**171,431**
Total Revenue (Mill. €)	4.9	11.0	32.1	59.5	69.8	68.5	64.9	40.4	27.9	**378.9**
Total margin (Mill. €)	1.7	5.4	21.1	43.6	52.4	51.3	48.2	27.7	17.7	**269.2**

(*) Average.
Source: Pérez-Mesa, Galdeano-Gómez and Aznar-Sánchez

Equation (16) shows that there exists a lagged price in one period which means we must identify two types of elasticity: one is short-term[17] (all, except September, are inferior to the unit, which demonstrates that price is losing importance in favor of quality and service issues); and the other is balance elasticity, which we calculated for equation (17) utilizing:

$$(17) \qquad \varepsilon_{Px-Balance} = f'(Px)\cdot\frac{Px}{f(Px)} = \beta(1-\delta)\cdot\frac{Px}{f(Px)}$$

with price and amounts being the averages of the sampling[18].

[17] Calculating as: $\varepsilon_{Px-Short} = f'(Px)\cdot\frac{Px}{f(Px)} = \beta\cdot\frac{Px}{f(Px)}$, using the average values per month of amounts and prices. For example, for September $\varepsilon_{Px-Short} = -140.580\cdot\frac{95}{9{,}927} = -1.349$

[18] For September, $\varepsilon_{Px-Balance} = -1.349\cdot(1-0.449) = -0.743$

The balance elasticity is composed of a short-term elasticity and a long-term one. Therefore, the price elasticity will depend on two circumstances: i) pricing strategy, in the short-term, which is something that will indeed be controllable and with which we can influence demand; ii) whether products are marketed in function of the prices and amounts of the previous season (which is equivalent to $\delta \neq 0$). The estimation of δ (Table 5) shows that the decision maker takes into account the prices and amounts marketed during the previous cycle when scheduling crops. This may prove hazardous, as it may result in major fluctuations in prices and amounts marketed from one season to the next.

From our perspective, our mission should be to influence the system so $\delta = 0$, in other words, provoke a structural change (something that logically cannot be achieved in the short or medium-term). Consequently we focus our interest on the short-term elasticities, which we will utilize to maximize revenue and margin. In this case $\delta \neq 0$ and the equilibrium price elasticity is lower than that in the short-term, which indicates that when growers plan their marketing they place more importance on the volumes from past years than on price.

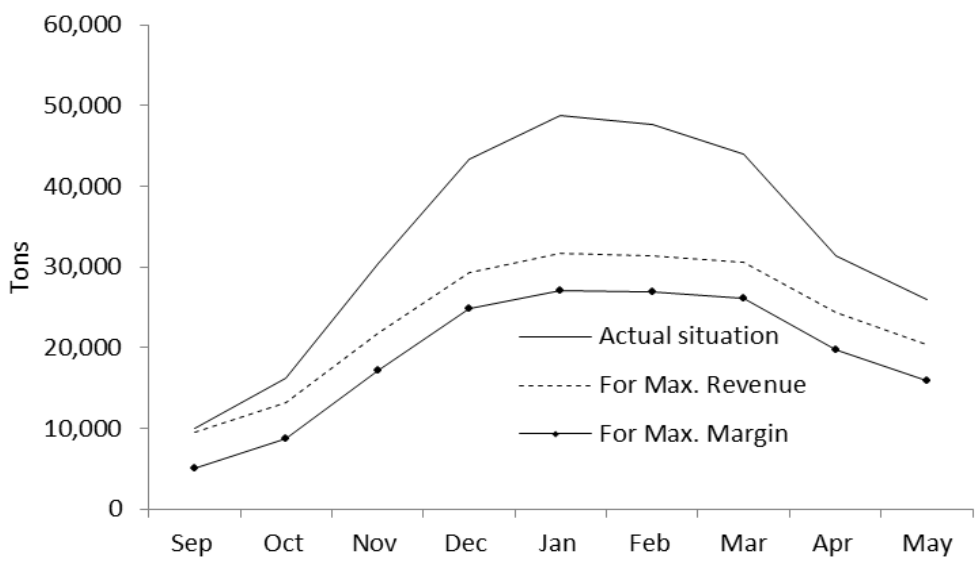

Figure 3. Distribution of pepper production-exports
Source: Pérez-Mesa, Galdeano-Gómez and Aznar-Sánchez

In accordance with Table 6, the average price obtained as a result of revenue maximization would be 1.67 €/kg, meaning there is a price increase upward of 40% with respect to the actual price. The average price obtained as a result of margin maximization would be 1.99 €/kg; a 67% price increase in relation to the actual price. Maximizing the total revenues would obtain 391.1 million euros; a 7% increase with respect to the actual revenue. The maximum margin calculated would be 269.2 million euros (a 53% increase with respect to the actual margin).

Discussion

In general, there is a significant improvement observed in the results, which is a consequence of reducing the amounts of the produce marketed; primarily in the months with the highest sales.

This problem would be easy to solve for an individual company programming its dates for planting . In southeast Spain there are more than 110 cooperatives (Galdeano et al. 2011) that market fruit and vegetables. As individual entities they have no bargaining power with their customers (large distribution chains), but if they sold together (for example through an Association of Producer Organizations) they would have a substantial market share that would boost their market power. Figure 4 displays southeast Spain's market share in relation to all the tomatoes and peppers marketed in the EU.

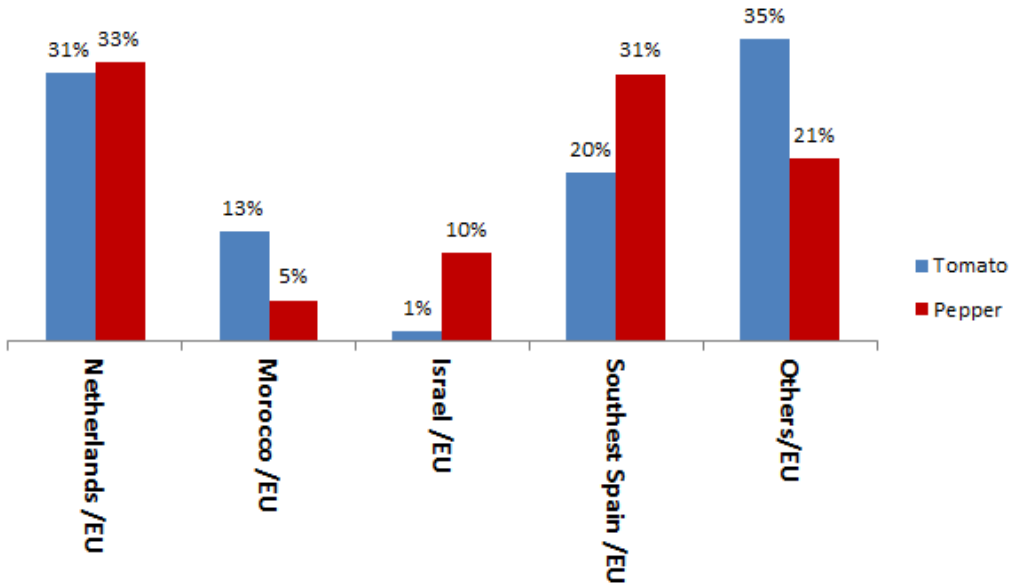

Figure 4. Market Share of each exporting region over the amount purchased by the 27 members of the EU. Tons.
Source: Pérez-Mesa, Galdeano-Gómez and Aznar-Sánchez. From Euostat, 2010.

In addition, by way of example, we would like to highlight that the approach of the monthly demand model could be compatible with the Markowitz model if we supposed that the monthly variance between years would remain constant. Then, by transferring the data to a spreadsheet, which in this case is the distribution in terms of percentages which maximizes margin, we could automatically get an idea of the risk involved, which would be the same as the variance of the proposed program (according to equation 1). Therefore, in the case of peppers, applying the Markowitz model to the distribution calculated according to (13) which maximizes revenues, we would obtain a margin of 0.67€/kg and a variation coefficient of 0.22. If we apply the same process to the distribution of marketing that maximizes the margin, we would obtain a variation coefficient of 0.21 and a unitary margin of 0.68€/kg. In short, this would mean making decisions with more information in different scenarios.

These results also demonstrate that a maximization strategy for revenues and margins need not be optimal from the point of view of risk minimization. Caution should be taken, however, when making any comparison of the M-V model and the optimization model calculated by regression, as they are based on different assumptions.

Conclusions

This paper provides an analytical framework on harvesting programs for horticultural production. The empirical analysis takes as a reference the case of farmers and cooperatives in Southeast Spain.

The results show that the Markowitz model (improved to facilitate provisional planning for harvest and also to include commercial aspects) can be easily utilized for the monthly production programming of an individual farmer. However, by assuming static prices, it is assumed that the decisions made by the farmer will not affect the general balance of the system. In order to avoid this drawback, we have developed a model for maximum monthly revenue (or margin), which helps to program production for a cooperative which has a significant presence in the sector and can therefore alter the market balance.

Through empirical applications we obtained different results when considering a M-V model and a monthly model. Nevertheless, an improved Markovitz model and the monthly model are compatible under the assumption of constant variance. Aside from concrete numbers, a clear improvement is observed due to the process of trying to program production: something which is impossible to do without improving the coordination mechanisms between production and marketing within companies.

For southeast Spain, crop scheduling with the objective of maximizing prices and margins is complicated; given the current situation of multiple and small businesses. It would imply coordinating a very large number of companies. However, if the scheduling was coordinated, profits could increase substantially, as shown in the model estimations.

Finally, this article hopes to serve as an incentive to promote a debate concerning the most appropriate methodology to utilize in the search for a method for seasonal programming of agricultural production. To date, books and studies have focused more on the selection of different crops than on the seasonal distribution of marketing over time.

Acknowledgments

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Appendix 1.

Table 2. Results of unrestricted model

					% Tomato									% Pepper										
Mean Euros/kg	*Variance*	*Var. Coef.*	w_M	w_V	*Sep*	*Oct*	*Nov*	*Dec*	*Jan*	*Feb*	*Mar*	*Apr*	*May*	*Sep*	*Oct*	*Nov*	*Dec*	*Jan*	*Feb*	*Mar*	*Apr*	*May*	*% Tomato*	*% Pepper*
0.38	0.0029	0.14	0.92	0.08		0.13	0.07	0.17				0.12		0.31	0.16						0.03		50	50
0.41	0.0030	0.13	0.92	0.08		0.14	0.05	0.20				0.12		0.22	0.19				0.03		0.04		51	49
0.45	0.0032	0.13	0.92	0.08		0.16	0.03	0.24				0.13		0.08	0.24				0.07		0.05		56	44
0.50	0.0039	0.12	0.92	0.08		0.17		0.30				0.15			0.17		0.01	0.03	0.08	0.02	0.08		62	39
0.60	0.0075	0.14	0.87	0.13		0.08		0.27				0.15					0.07	0.10	0.04	0.16	0.13		50	50
0.70	0.0189	0.20	0.76	0.24				0.05			0.04	0.09					0.06	0.14		0.48	0.14		18	82
0.77	0.0370	0.25	0.65	0.35																1.00			0	100
*0.55	0.0105	0.18	0.82	0.18	0.01	0.02	0.06	0.08	0.10	0.11	0.11	0.09	0.08	0.01	0.02	0.04	0.05	0.06	0.06	0.05	0.04	0.03	65	35

Table 3. Results of restricted capacity model (35% pepper, 65% tomato)

					% Tomato									% Pepper									
Mean Euros/kg	*Variance*	*Var. Coef.*	w_M	w_V	*Sep*	*Oct*	*Nov*	*Dec*	*Jan*	*Feb*	*Mar*	*Apr*	*May*	*Sep*	*Oct*	*Nov*	*Dec*	*Jan*	*Feb*	*Mar*	*Apr*	*May*
0.41	0.0031	0.14	0.92	0.08	0.05	0.16	0.08	0.21				0.15		0.23	0.11						0.01	
0.45	0.0032	0.13	0.92	0.08		0.18	0.07	0.25				0.15		0.14	0.15				0.03		0.03	
0.50	0.0036	0.12	0.92	0.08		0.18	0.02	0.30				0.15			0.20			0.02	0.07		0.07	
0.60	0.0067	0.14	0.89	0.11		0.11		0.35				0.19					0.02	0.04		0.25	0.04	
0.62	0.0090	0.15	0.86	0.14		0.04		0.39				0.22								0.35		
0.64	0.0146	0.19	0.79	0.21				0.27			0.09	0.29								0.35		
*0.55	0.0105	0.18	0.82	0.18	0.01	0.02	0.06	0.08	0.10	0.11	0.11	0.09	0.08	0.01	0.02	0.04	0.05	0.06	0.06	0.05	0.04	0.03

(*) Actual distribution of production.

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The Triple Bottom Line: What is the Impact on the Returns to Agribusiness?

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Abstract

The objective of this research is to examine the share values of publicly traded U.S. agribusiness firms to determine if they are influenced by the adoption of Corporate Social Responsibility (CSR) practices. Adoption of sustainability initiatives that are in line with the requirements of CSR were made based upon a firm's inclusion on a Dow Jones Sustainability Index (DJSI). To accomplish this task, we utilize an event study methodology. Typically, we find that the share values of agribusinesses react negatively, at least in the short-term, when the announcement is made that the firm will become a member of the DJSI.

Keywords: event-study, sustainability, profitability, corporate social responsibility, Dow Jones Sustainability Index

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Agribusinesses and the Triple Bottom Line

Food and agribusiness firms may choose to adopt socially responsible practices to improve their images among consumers and stakeholders (Saes et al. 2003). In fact, the growth of ethical investing indicates that investors are seeking out companies that are engaged in sustainability initiatives (Waddok and Graves 1997; Lo and Sheu 2007). This effect is motivated by both the increasing public sensitivity to environmental effects of business operations and the impacts of environmental groups to lobby the government for change and raise public awareness (Conejero and Farina 2003; Rodriguez et al. 2006; Sam et al. 2009; Doh et al. 2010). Moreover, international institutions including the OECD and the United Nations are beginning to lobby multinational corporations to adopt common standards of conduct as they relate to sustainability (Rodriguez et al. 2006).

Agribusiness economists might argue that firms should adopt socially responsible practices only if the practices contribute positively to the profits of the firm. Corporate social responsibility (CSR) is a decade's old notion that firms need to meet profitability expectations of investors while also acting legally, ethically, and as a good citizen of their neighborhoods. Indeed Orlizky et al. (2011) indicate that the adoption of CSR activities should enhance a firm's competitiveness and reputation, which ultimately results in better economic and financial performance. Although the concept of CSR is well established, there is relatively little research on sustainability with respect to food and agribusiness firms.

The current problem is that agribusiness decision-makers are not aware of how the market will react to the adoption of CSR practices. If the market readily values these practices, then those food and agribusinesses that have not adopted CSR practices would be wise to do so. If the market does not value CSR practices, those managers that see value in them, i.e. those managers that have adopted CSR practices in their business might need to do a better job of communicating that value. Thus, this paper aims to assess how inclusion of an agribusiness firm in a Dow Jones Sustainability Index (DJSI) influences the market's assessment of that firm.

Using a sample of 36 publically traded, international food and agribusiness firms, we employ an event study methodology to assess the impact of being listed with the DJSI on a firm's market value. Results indicate that, at least in the short-run, the market does not see value on the days when the DJSI announces it will include food and agribusiness firms. Both on the day when it is announced firms will join the index and on the day it actually joins the index, there are statistically significant negative returns relative to a random market portfolio around those days.

Announcement of changes to DJSI, come in the form of a press release, and typically occur a couple of weeks prior to the additions or deletions to the index actually becoming effective. Moreover, these press releases often provide limited information about additions and deletions to the DJSI. For example, the 2009 press release announcing the results for The Dow Jones Sustainability World Index, only mentions the three largest additions and deletions, even though thirty-three new firms joined the index. For this reason, we also measure results around the day the firm actually begins trading in the index.

Corporate Social Responsibility

The idea that businesses should not merely be geared toward profit at the expense of fulfilling their responsibilities to employees, society, and the environment has been established in the literature for nearly 60 years. Published in 1953, *Social Responsibilities of the Businessman* by Howard Bowen was a seminal work in the area. Bowen defined the social responsibilities of businesspersons as such: "It refers to the obligations of businessmen to pursue those policies, to make those decisions, or to follow those lines of action which are desirable in terms of the objectives and values of our society" (p. 6).

More recently, Carroll (1999) has developed four types of social responsibilities that compose the entire concept of corporate social responsibility (CSR). He depicted his four types of social responsibilities as a pyramid with the economic (profitability) responsibilities as the base (Figure 1). Carroll notes that the depiction is not meant to indicate that the four types are to be filled sequentially, but are to all be filled at the same time.

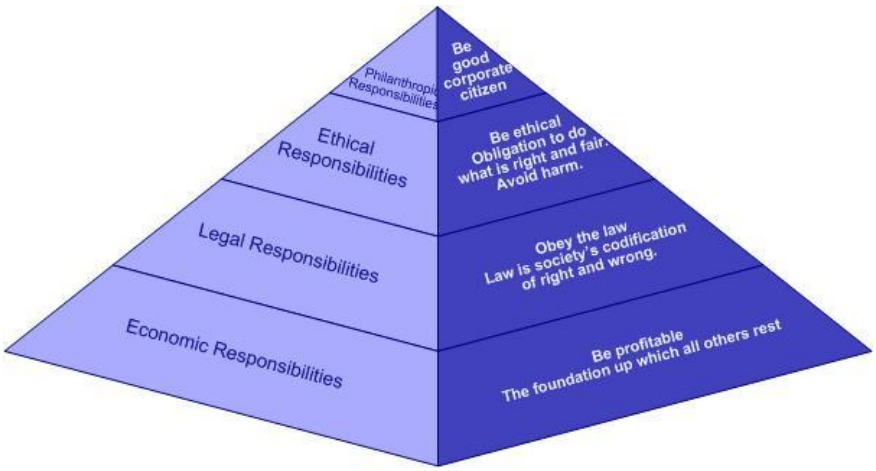

Figure 1. Carroll's Corporate Social Responsibility Pyramid

Essentially, Carroll sees profitability as the foundation of the corporation's ability to accomplish anything. From there, corporations should consider three other types of social responsibility: legal, ethical, and philanthropic responsibilities. CSR requires that businesses behave in a manner consistent with all laws in the societies in which they operate. Even though some actions fall within the bounds of the law, the actions might not be ethically prudent. Thus, firms should also consider the obligation to avoid harm to their neighboring communities. Certainly, environmental considerations would be part of both legal and ethical responsibilities. Finally, firms should be good corporate citizens by providing aid to neighboring communities. While Carroll views the environment as an aspect in each of his four types of social responsibility, others define CSR on the following three dimensions: social, environmental, and economic (Hansford et al. 2003).

These three dimensions are the same dimensions the Dow Jones Sustainability Index uses to define sustainability (Table 1). Consequently, you will often see sustainability and CSR used interchangeably concerning corporations. Irrespective of which classification one chooses to follow,

they both communicate the same message: CSR and/or sustainability allow a life in dignity for the present without compromising a life in dignity for future generations or threatening the natural environment and endangering the global ecosystem (Häni et al. 2003).

Table 1. Dimensions of the Dow Jones Sustainability Indexes

1. Economic Dimension
    a. Corporate Governance
    b. Code of Conduct, Compliance
    c. Risk & Crisis Management
    d. Customer Relationship Management
    e. Innovation Management
2. Environmental Dimension
    a. Environmental Management System
    b. Environmental Performance
    c. Climate Strategy
    d. Biodiversity
3. Social Dimension
    a. Human Capital Development
    b. Talent Attraction & Retention
    c. Occupation Health & Safety
    d. Stakeholder Engagement
    e. Social Reporting

Who decides if a Firm is Sustainable?

Knoepfel (2001) indicates that investors are the most likely group to drive managers of food and agribusiness firms to adopt CSR practices. The means by which investors most often do this is by creating ethically screened investment funds composed solely of the stocks of firms that engage CSR practices. Investors seek out signals regarding a firm's commitment to socially responsible practices. Some investment funds have their own screening criteria, but some have adopted the Dow Jones Sustainability Index as a measure of a firm's commitment.

The Dow Jones Index (2011) conducts an annual review of firms eligible for inclusion in one of the DJSI indices. The Dow conducts this review based on a thorough analysis of corporate economic, environmental and social performance, assessing issues such as corporate governance, risk management, branding, climate change mitigation, supply chain standards and labor practices. Furthermore the review takes into account both general and industry specific sustainability criteria for each of 58 the sectors defined according to the Industry Classification Benchmark (ICB). To facilitate this process companies are asked to complete an annual questionnaire that consists of approximately 100 questions, which focus on the aforementioned factors. Each of the 58 sectors has its own unique questions (approximately 50 percent of the questions cover industry-specific risks and opportunities). It should be noted that all companies in the eligible universe receive a copy of the questionnaire.

In conjunction with a questionnaire, a Media and Stakeholder Analysis (MSA) used to identify and assess issues that may present financial, reputational, and compliance risks with those com-

panies completing the questionnaire. To accomplish this, environmental and social dynamic data supplier *RepRisk* provides the DJSI with information on media coverage, stakeholder commentaries, and other publicly accessible sources as it relates to the three dimensions of sustainability. Finally, analysts personally contact companies to clarify information related to the questionnaire and/or the MSA. Information that is more detailed can be found in the Dow Jones Sustainability World Indexes Guide Book (2011).

The Dow Jones Sustainability World Index (DJSI World) was launched in 1999 and includes the top 10% of the largest 2,500 companies in the Dow Jones Global Total Stock Market Index based on long-term economic, environmental, and social criteria. Later Dow Jones would launch the STOXX Sustainability Index (DJSI STOXX), which represents the top 20% of the largest 600 European companies in the Dow Jones Global Total Stock Market Index based on the three dominions of sustainability. Finally, in 2007, the Dow Jones Sustainability Index North America (DJSI NA) was launched and it contains the top 20% of the largest 600 North American companies in the Dow Jones Global Total Stock Market Index based on long-term economic, environmental and social criteria.

Is Adopting Sustainable Practices Valuable?

Recent general management research has focused on identifying if the adoption of CSR practices has an impact on a firm's operations, valuations, and customer perceptions. The results have been mixed. For example, Lopez et al. (2007) observe negative, short-term impacts on firm performance when they adopt socially responsible practices. Lo and Sheu (2007), however, found in their study of a subsample of large US firms belonging to the S&P 500 from 1999 to 2002, that they are rewarded in the market for incorporating sustainability strategies into their business plan. Waddok and Graves (1997) also found that CSR is positively related to future financial performance. Knoepfel (2001) notes that the firms on the Dow Jones Sustainable Group Index as a group outperformed firms on the Dow Jones Global Index from 1993 to 2000. Finally, McWilliams and Siegel (2011) indicate that CSR can be a source of a sustainable competitive advantage (SCA).

Why Should Agribusiness Firms Care?

It is likely that food and agribusiness firms are under pressure to operate in a sustainable manner. For example, the film Food Inc. critically evaluated the role of Cargill, Monsanto, Perdue Farms, Smithfield Foods, Tyson Foods, Wal-Mart and other companies in the global food supply chain. The film decried current food production as unsustainable. Films like this make it clear that no broad sector of the economy stands to benefit from CSR practices as the food and agribusiness sector. Agriculture production is tied inherently to the long-term sustainability of crop and livestock production, while also working to feed a growing global population.

Interestingly, sustainability in agribusiness, especially in food products and beverage, often starts with small to medium size enterprises seeking to differentiate themselves from their larger competitors (Kilian et al. 2004). These results are supported by McWilliams and Siegel (2001) who found that industries with lots of product differentiation i.e. food are likely to engage in sustainability to create a source of competitive advantage. A good example of differentiation can be

found in Satimanon and Weatherspoon (2010). They established that consumers were willing to spend 3.57 cents more per egg for welfare-managed eggs (free-range eggs and free-cage eggs) as compared to regular eggs, an attribute that many consumers deem sustainable.

Although CSR must start at the firm level, it is highly likely and perhaps just as important that sustainability will need to span the agricultural supply chain if agribusinesses want to maintain the firm level competitive advantages sustainability gives them. Research by Moulton and Zwane (2005) into the California Sustainable Winegrowing Practices (SWP) project, shows that an integrated approach starting from the beginning of the supply-chain, to the end, while including interest groups at all levels of the chain is perhaps the most efficient and effective solution. Häni et al., (2003) recognizing the importance of sustainability at the farm level, developed an assessment tool for analyzing the sustainability of farms and the need for such an assessment tool for the entire supply chain. While the coordination of a sustainable agricultural supply-chain is a difficult process, as demonstrated by Chaddad's (2010) study of the Brazilian Sugarcane Industry, it is one that must be addressed in the global food supply chain.

Food firms in particular need to be concerned with their brand images, especially since investors are learning to think long term i.e. they are becoming more aware of a firm's sustainable development strategies (Lo and Sheu, 2007). Food and beverage brands are among the recognized in the world (e.g. Coca-Cola, KFC, Kraft, McDonalds, Nestle, Pizza Hut, etc…) and therefore the most susceptible to reputation damage (Interbrand 2010). Food scares, for example, can have detrimental impacts for food and agribusiness firms as evidenced by Hudson Foods Company's recall of 25 million pounds of ground beef in 1997, which eventually led to the buyout of the firm by Tyson Foods (USDA 1997). Food scares also influence entire sectors of agriculture. For example, the recent *E. coli* outbreak in Europe is threatening to devastate the profits of the vegetable production sector there. Many agricultural input suppliers also have strong brands (e.g., John Deere and Dow Chemical's Pioneer brand seed). Sustainability investments should only increase the strength of the brand if CSR practices are important to consumers and investors. Moreover, McWilliams and Siegel (2001) found that large firms in mature industries are likely to engage in CSR as a method of establishment of a differentiated competitive advantage.

Sustainability as a research area in agribusiness is a relatively recent phenomenon, even in the general management literature this research is still in its infancy (Rodriguez et al. 2006; McWilliams et al. 2006).The first mention of sustainability in an *International Food and Agribusiness Management Review* (*IFAMR*) article title was in 2002 (Conejero and Farina 2002). It is notable, however, that the conference theme for the International Food and Agribusiness Management Association's 2004 Symposium and Forum was "Sustainable Value Creation in the Food Chain," which was followed up in 2011 with "The Road to 2050: Sustainability as a Business Opportunity." To date, only eight *IFAMR* articles have appeared with sustainability in their titles, surprisingly few for such an important topic for agribusiness.

Given, the lack of depth of research on sustainability in agribusiness, especially as it relates to the performance of the firm, this research begins to bridge this gap. By employing an event-study methodology, we examine the impact of sustainability on the value of agribusiness firms. In the next section, we outline the event-study methodology and the tests used to measure for the presence of abnormal returns, as well as the data used in this analysis.

Data and Methodology

The USDA's Economic Research Service (ERS) provides a listing of industries closely tied to production agriculture by SIC code (USDA 2006). SIC codes aggregate industries into related groups: farm production; agricultural services, forestry, and fishing; agricultural input industries; agricultural processing and marketing industries; wholesale and retail trade of agricultural products; and indirect agribusinesses. ERS defines farm and farm-related industries as those industries generally having 50 percent or more of their national work force employed in providing goods and services necessary to satisfy the final demand for agricultural products. We chose to include only firms from one of the DJSI indices that were in these industries as eligible for the sample.

In addition, stocks had to have daily return data for 250 trading days prior to the announcement date of the firm being included in one of three Dow Jones Sustainability Index and 5 trading days after the announcement date. Return data for those firms traded on the NYSE, NASDAQ, and AMEX are obtained from the Center for Research in Security Prices (CRSP) database. We used daily returns because they provide a more accurate measure of market efficiency relative to monthly returns (Henderson 1990; Armitage 1995; MacKinley 1997).

The initial list of unique firms eligible for inclusion for this study that have been a member in one of the three DJSI since their inception is approximately 900. Of those 900 about 4% of these firms (36) have primary SIC codes related to agriculture and are traded on the NYSE, NASDAQ, or AMEX. The agribusiness firms included are listed in the Appendix.

To identify the impacts that a sustainability initiative has on an agribusiness firm returns, we use an event study methodology that follows Campbell, Lo, and MacKinley (1997). By examining stock price behavior around the announcement of an event, we can begin to understand the influence the announcement that a firm has committed to CSR practices has on agribusiness returns (Binder 1998).

Event studies utilize a control period that occurs prior to the announcement date of the event, typically, 250 trading days or 1 calendar year. An OLS market model is estimated by regressing stock returns for a firm on the rate of return for the market for those 250 days (Armitage 1995). This allows for the identification of abnormal returns during the event period (dates surrounding the event window). To avoid biased parameter estimates attributed to the disturbance in the regression model, the two periods do not overlap (Binder 1998). The event window should involve small intervals surrounding and including the event date; with the two-day event windows being used when the event can be determined with certainty (Armitage 1995). The computation of abnormal returns for each farm bill in this study is done for the following three event windows: $T = [-5, +5]$, $T = [-2, +2]$, and $T = [-1, +1]$. Negative numbers in the brackets represent days prior to the announcement date ($T = 0$), and positive numbers are days after the announcement date. The event windows began prior to the announcement date to account for information leakage (Senchack and Starks 1993). Abnormal returns are calculated for a given trading day during these event windows by subtracting the actual stock return from the OLS market model predicted stock return.

We use the corrected Patell test statistic to test for the presence of abnormal returns because it corrects for serial correlation (Mikkelson and Partch 1988; Salinger 1992; Cowan 2005). In addition, a non-parametric generalized sign test is also used to test the fraction of firms who exhibit a positive abnormal return. The benefit of this test is that it does not require the assumption of normality implied by the average abnormal returns; it does not require the restrictive assumption that 50-percent of the sample has a positive return; it is well specified under a variety of conditions, and it is robust to variance increases on the even date (Cowan 1992; Campbell, Lo and MacKinley 1997; Cowan 2005). For a detailed derivation of the corrected Patell test and the nonparametric generalized sign test see Detre et al. (2009).

The event study analysis in this study is implemented using the software package Eventus. This software package follows the event study methodology discussed above, and it retrieves the data used in this analysis from the CRSP data set (Cowan 2005).

Results

Table 2 and Table 3 present the Cumulative Abnormal Returns (CARs) and the statistical significance for the day the DJSI announces changes to an index for the upcoming year and the day an agribusiness firm begins trading on one of the DJSIs. Both tables indicate that the news of an agribusiness company has implemented sustainability initiatives necessary for inclusion in one of the three DJSIs negatively influences share value. Thus, the results indicate that, at least in the short-run, investors feel a sustainability initiative is going to hurt the returns to the agribusiness. In particular, the costs of revamping business operations to meet CSR requirements necessary for inclusion in the DJSI index, is likely to be quite high and perhaps unwelcomed by investors in the short run.

Table 2. Market model for the day the DJSI announces changes to the index

Days	N	Mean Cumulative Abnormal Return	Precision Weighted CAAR	Percent Negative	Patell Z	Generalized Sign Z
(-5,+5)	36	-4.09%	-3.26%	80.00%	-2.701**	-2.851**
(-2,+2)	36	-0.93%	-0.30%	56.00%	-0.378	-0.450
(-1,+1)	36	-0.08%	0.00%	60.00%	-0.006	-0.850

* Denotes significance at the 5% level
** Denotes significance at the 1% level

Table 3. Market model on the day the firm joins index, i.e. the first day the firm begins trading as part of the index

Days	N	Mean Cumulative Abnormal Return	Precision Weighted CAAR	Percent Negative	Patell Z	Generalized Sign Z
(-5,+5)	36	-1.66%	-1.61%	55.56%	-1.449	-0.419
(-2,+2)	36	-1.44%	-1.27%	61.11%	-1.706	-1.086
(-1,+1)	36	-1.68%	-1.54%	69.44%	-2.688**	-2.087*

* Denotes significance at the 5% level
** Denotes significance at the 1% level

While this announcement of changes to the DJSI is negatively significant for the eleven-day window[-5,5] , for both Patell and the Generalized Sign Test at the five percent level, no signifi-

cance is observed for the shorter two windows. Typically, the announcement is made a couple of weeks prior to the date the new agribusiness firm will enter the index. What is interesting about the press release, which makes the announcement, is that is typical for only the number of new additions and deletions to the index to be announced and not the names of the firms. Thus, over the course of the subsequent days following the official announcement of adjustments to the various DJSIs, at least some investors begin to learn which firms are going to become a new member on one of the DJSIs and begin to react, and in this case negatively.

For the day that the firm actually begins to trade as part of the index, statistical negative significance at the ten percent level for both of the aforementioned test statistics are only observed for the three-day window [-1,1]. This result indicates that stock investors actually incorporate the information of an agribusiness firm's inclusion in a DJSI index on the day it begins trading in the index. It also appears that the information is integrated into the market rather quickly.

While investors are becoming more environmentally and social conscientious, the results indicate that publicly traded U.S. agribusinesses are likely going to have to convince investors why CSR practices are both important and necessary if implementing them is to guarantee long-term profitability. Moreover, the DJSI believes that the assessment tools that they have developed to determine inclusion in their index deal directly with factors that have a long-term impact on a firms' future success, but are often overlooked by traditional financial analyses (Dow Jones Index, 2011). It is likely the case that CSR is going to become more commonplace in agribusiness companies as they sacrifice short-term shareholder profits to institute CSR in order to provide the firm with long-term competitive advantages. Moreover, given the increasing public intolerance of companies who damage the environment, treat their workers poorly, etc…, those companies that make investments in CSR sooner rather than later will likely be able to generate long-run payoffs that far exceed their short-run costs.

Conclusions

This research has examined the impact of the announcement by the Dow Jones Sustainability Index of a publicly traded U.S. agribusiness being included in one of its three sustainability indices on the stock values of these firms from 1999 to 2008. The results suggest that stock values of included agribusinesses have reacted to the announcement of becoming a member of the DJIS. Typically, share prices for agribusinesses react negatively on the day a firm joins on the index, i.e. an abnormal impact on agribusiness stock values on the event date. This finding likely reflects a short-term view by investors in the market, where investors were anticipating near-term decline in the value of the agribusiness firm because of the increased costs associated with CSR. As McWilliams and Siegel (2001), Paul and Siegel (2006), Siegel and Vitaliano (2007), and Orlitzky et al. (2011) note in their research, CSR adoption by a firm will only occur if CSR can maximize long-term profit for the firm, else they will not adopt. Their results combined with this research indicates that agribusiness companies must work with stakeholders to educate them on the ability of CSR practices to generate long-run pay offs that more than exceed short-run costs.

While the research sheds some light into the effects CSR has on the short-term financial performance of agribusiness firms, it is just the beginning of what is likely to be a burgeoning research field for agricultural economists. Future research might seek to quantify the size of the gain or

loss, as even small changes in percentage terms can cause large changes in the value of a company. For example, large cap stocks have a market capitalization value that exceeds $10 billion, which means a shift of just 3% results in a loss or gain of $300 million. In addition, a similar type of analysis would seek to examine how the returns of agribusiness on the DJSI compared to competitors that were not included in one of the indices. Moreover, we do not separate agribusiness firms by type or if the firm had previously been recognized on an international level for their commitment to one or more of the dimensions of sustainability. For example, if a firm has an established record in one of the sustainability dimensions, perhaps inclusion on the DSJI does not cause a negative reaction in firm value.

Even though all eligible firms receive the DJSI questionnaire, not all firms complete the application process for being included in a DJSI because it is rather extensive. Although it is unlikely that the market is aware that a firm will become a member of the index prior to the press release, it is possible the firm has made a public announcement that they will be taking part in the index application process. It is unlikely that a firm would make such announcement if they did not fill confident about their ability to become a part of the index. If this does occur, it is likely the market has already incorporated the information (Carter and Smith 2007). Future research should search press releases by agribusiness companies that announce their intent with respect to the DJSI.

This research also raises the question of what happens to shareholder value when a company is removed from an index. Is there actually a positive reaction, given the negative reaction observed here? Research by Doh et al. 2010 suggests that reaction to a deletion from an index is more intense than the addition to an index. Finally, while this research addresses short-term performance, it does not address long-term performance of being included in the DJSI and/or the adoption of CSR practices.

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Appendix

Exhibit 1. Food and Agribusiness Firms Included in Sample

3M, Allied Domeq, Amcor Ltd., Aventis, British American Tobacco, Cadbury Schweppes, Caterpillar, Coca-Cola, Coles Myer Ltd., Compania Cervecerias Unidas S.A., Diageo, Dr Pepper Snapple Group, Gap, General Mills, Groupe Danone, H.J. Heinz, Hanesbrands, Ito-Yokado, Kirin Holdings, Kraft Foods, Kubota, Limited Brands Inc, McCormick, McDonald's, Mead, Mitchells & Butlers, Molson, Nike, Novartis, PepsiCo, Potash Corp. of Saskatchewan, Reynolds American, Rhodia S.A., S.K.F.B, Safeway, Six Continents. Sonoco Products, Starbucks, Stora Enso, Syngenta AG, Temple-Inland, Unilever LTD, Unilever N.V., Weyerhaeuser Co., and Whole Foods Market.

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Analyzing the Competitive Performance of the South African Wine Industry

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Abstract

This article describes a methodology and a four-step framework to measure and analyze competitive performance of the South African wine industry. Competitive performance is viewed as the ability to sustain trade against the competition in the global market. The economic sustainability of the South African wine industry is found to be highly dependent on its trading performance, with more than 40 percent of production consistently being exported since 2005.

The views and opinions of South African wine executives through the *Wine Executive Surveys* of 2005 and 2008 are used to identify, describe and explain these competitiveness trends and to qualitatively comment on factors impacting on performance. The *Porter Diamond* is applied to derive the most important industry determinants of competitive performance. From this analysis changes in the "competitiveness space" of the South African wine industry are described and analyzed and a wine industry agenda is proposed to enhance competitive performance.

Keywords: South African wine industry, competitive performance and competitive space, relative trade advantage (RTA), wine executive surveys, Porter Diamond.

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Introduction

What determines the ability of an industry to perform competitively and sustain such performance?

How is competitiveness performance measured? How is it analyzed; and can such "industry intelligence" be used for the strategic positioning of an industry? What is the role of government viz-a-viz that of private firms to enhance competitiveness performance?

Answers to these questions are important as they provide the basis for understanding the evolving situation in an industry which needs to compete for survival and growth (Porter 1990; Masters 1995; Stroper 1995; Papanastassou and Pearce 1999; Veiyath and Zahra 2000; Lall 2001; and Sledge 2005). Such answers thus support the notion of comprehensive industry level strategic planning.

A four-step framework is developed and applied in this article to advance answers to these questions. The framework is used to measure and analyze competitive performance of the South African wine industry - an export based agri-industry that recently faced many strategic challenges of a political, economic, technical, and social nature.

The focus of the study is on the environment in which wine industry players make decisions. Wine firms and the industry will therefore constitute the level of analysis (Stroper 1995; Sledge 2005). The analysis is based on the initial approach advanced by the ISMEA Report in 1999 and on earlier work on the competitiveness of the South African agribusiness sector (Van Rooyen and Van Rooyen1998; Van Rooyen, Esterhuizen and Doyer 2000; ABC 2000; Esterhuizen 2006) and expanded on in the analysis of the wine industry by Esterhuizen and Van Rooyen in 2005 and 2007, SAWB, 2005 and Van Rooyen, 2007.

The research questions explored are:

- How competitive has the South African wine industry been over time and how can this be measured?
- Why did it perform as such and did the industry change over time?
- What are the factors determining this performance?
- How can such information be used to establish an industry agenda to promote greater competitiveness?

The next section gives a concise description of the South African wine industry and competitiveness is defined in section 3. A comprehensive four-step framework of analysis is then applied in section 4 to measure and analyses the competitive performance of the wine industry. Changes in the "competitiveness space" of the industry are considered and from this a wine industry agenda is proposed. Conclusions are drawn in section 5.

The South African Wine Industry at a Glance

The wine industry contributed an estimated R20 billion (around USD $ 1.6 billion) to the South African gross domestic product (GDP) in 2009. This figure rises to R23.5 billion when tourism is included. An amount of R4.2 billion per annum (2008) is contributed to government revenue via excise taxes and wine farm producers' income amounted to R3.32 billion in 2008. The industry sustains about 275,000 job opportunities (including around 20 percent through wine tourism), although some of this is seasonal in nature. Investment capital in 2008 is in excess of R50 billion (US$5 billion).

In 2008, 124,993ha were cultivated for wine production (93,889 ha in 1995). 3,839 producers and 870 cellars – mostly in the Western Cape Province, with some in the Northern Cape and Free State – produced 1,089 million liters of wine, brandy and grape juice concentrate. This was done from a harvest of 1.4 million tons of grapes, making South Africa the world's 7th largest wine producer. About 63 million liters of drinking wine were produced from this harvest, of which 38% was red and 62% was white wine, compared to a yield of 12% red wine and 88% white wine in 1995.

South Africa produces 3.7% of the world's wines and exports 54% of its wine production or 411.8 million liters in 2008 to the value of R6.27 billion (US$385 million). In 1994 only 50.7 million liters were exported or 12% of wine production. The South African wine industry is therefore characterized as highly trade oriented. In Figure 1 the long term export performance, in terms of value and volume is shown, noting the dramatic increase since the early 1990's. This feature is directly related to the competitive performance of the industry.

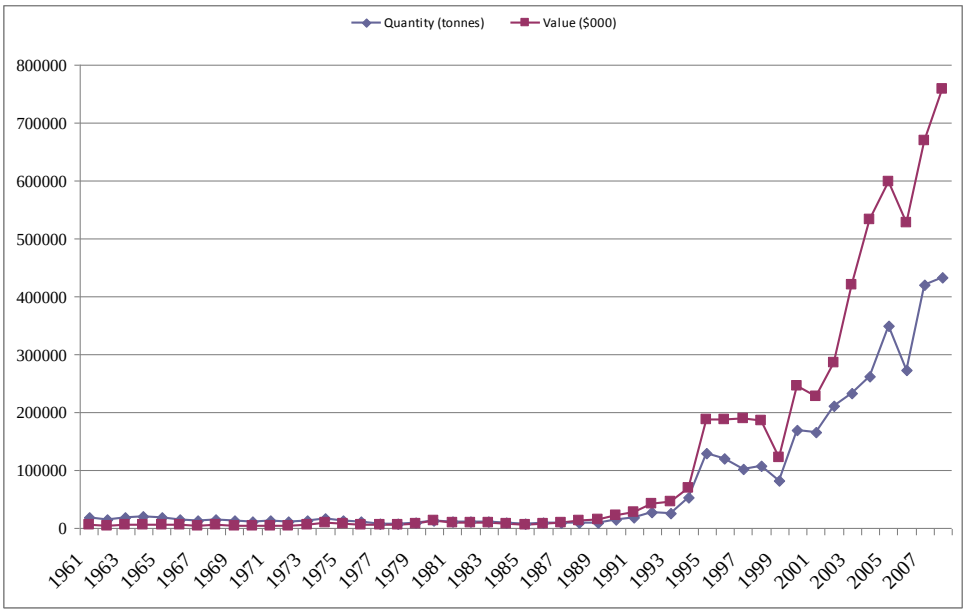

Figure 1. Exports of South African wine in quantity (tons) and value ($) – 1961 to 2008.
Source: FAOSTAT

The UK (27%), Germany (17%) and the Netherlands (7%) are currently the major export destinations for South African wines, with the African continent (Nigeria and Kenya) rapidly growing. Per capita consumption of wine in South Africa is stagnant at 7.5 liters in comparison with 53.9 liters in France, 22.4 liters in Australia, 28.1 liters in Argentina and 8.5 liters in the USA.

Comprehensive information on the South African wine industry can be obtained from the SA Wine Industry Directories, 1998 – 2011 and SAWIS (www.sawis.co.za).

Defining Competitiveness in the Wine Business Environment

Competitiveness has always been a somewhat difficult and controversial concept, and there is also disagreement about its measurement and the appropriate indexes to be used. Several studies argue that trade performance measures do not adequately reflect the state of competitiveness. However, despite these views, it is noted that competitiveness is most often associated with trade performance (Roa and Lempriere 1992; Arndt 1993; Frohberg and Hartman 1997; Ezeala- Harrison 2005; Esterhuizen 2006). In this view industries and firms are competitive when they are able to continue to grow their trade in today's global environment, through product offers – qualities, prices and services- that are as good as, or better than their competitors. This will enable the most competitive players to attract sufficient scarce production factors - capital, land, labor, technology and management- from competing economic activities to sustain and expand their performance (Freebairn 1986; Van Rooyen, Esterhuizen and Doyer 2000; Cho and Moon 2002; Esterhuizen & Van Rooyen 2005). Actions such as opportunistic, short term 'price wars and cost cutting' therefore seldom sustain competitive performance. Measuring long-term, sustained performances are thus relevant in analyzing competitiveness performance (Boehlje 1996; Cho 1994; Esterhuizen 2006). In short, to be competitive in today's world is to be in a position to continue to trade successfully relative to the competition i.e. to consistently outperform the competition. With the above in mind and in view of the importance of open global trade, competitive performance in the South African wine industry is strongly linked to trade performance and is defined as:

"*The ability to expand the trade of South African wines relative to their competitors, in order to attract investment and other scarce resources to achieve sustainable returns".*

A Four-Step Framework for Analyzing Competitive Performance

The following sequential steps are followed to measure and analyze competitive performance and is derived from work by Ismea, 1999; Van Rooyen, Esterhuizen and Doyer, 2000, Esterhuizen and Van Rooyen, 2005, 2007; and Esterhuizen, 2006 and van Rooyen, 2007. Each step takes full cognizance of the information gathered in previous steps i.e. an interactive process is followed during the data gathering and analysis processes.

Step 1: Measure competitive performance through the Wine Competitiveness Rating (WCR), based on trade performance as measured by the Relative Trade Advantage (RTA) method (Balassa 1989; Volrath 1991).

Step 2: Identify through interviews with industry experts and knowledgeable stakeholders and through the Wine Executive Survey (WES) the major factors impacting on competitive performance;

Step 3: Analyze these factors and establish the Determinants of Competitiveness (DC), through "new" competitiveness theory (Porter, 1990);

Step 4: Use the above information to identify and analyze changes over time in the "competitive space" of the SA wine industry and from this determine an industry agenda for enhancing competitiveness performance.

STEP 1: Measuring Competitive Performance of the South African Wine Industry

The Relative Trade Advantage (RTA) method: To measure how competitive the wine industry in South Africa performed, it is necessary to determine how successful this sector competed with other wine producing countries i.e. how South Africa traded its products over time in the local and global environment in comparison with its trade competitors. To this measure must be added the ability of the sector to compete with other business opportunities to attract the required scarce economic resources. The Relative Trade Advantage (RTA) method, as originally developed by Balassa (1989) and extended by Volrath (1991) is based on actual trade performance and measures such performances. This method was used by many scholars over recent years (Van Rooyen and Van Rooyen 1998; ISMEA 1999; Van Rooyen, Esterhuizen and Doyer 2000; Valentine & Krasnik 2000; Pitts and Lagnevic 1997; Pitts, O'Connell & McCarthy 2001; Ferto & Hubbard 2001; Esterhuizen 2006; SAWB 2005; Esterhuizen and Van Rooyen 2005, 2007) for the quantitative measurement of competitive performance.

In this quantitative method, using global trade flows of all the competing industries viz-a-viz the industry under consideration, it is argued that competitive advantage is indicated by relative trade performance i.e. the ability to trade in the global market because this effectively reflects all relative market costs as well as all non-competitive factors, government policies and other measures affecting actual trade patterns between competitors (Balassa 1989; Volrath 1991).
This method therefore determine the "revealed" comparative advantage, reflecting competitive performance and competitiveness under real world conditions. Other more restricted measures only describe certain aspects influencing competitiveness, such as factor productivity, product characteristics, unit production cost and profit ratios, organizational performance and bench marking or applied comparative advantages analysis (Porter,1990) as quoted by Ezeala- Harrison 2005; Augusto et al. 2005). Situations such as "uneven economic playing fields" due to distorted economies, protective trade policies and trade regimes impact directly on trade patterns and competitive performance, but are effectively accounted for in the RTA measure.
The RTA is formulated as:

$$(1)\quad RTA_{iv} = RXA_{iv} - RMP_{iv}$$

Where for (n + v) countries and (m + i) products,

$$(2)\ RXA_{iv} = [\ X_{iv} \ / \ \sum_{m=1}^{h} X_{in}\ ] \ / \ [\ \sum_{m=1}^{h} \sum_{n=1}^{u} X_{mv} \ / \ \sum \ \sum \ X_{mn}\ ]$$

$$(3)\ RMA_{iv} = [\ M_{iv} \ / \ \sum_{m=1}^{h} M_{in}\ ] \ / \ [\ \sum_{m=1}^{h} \sum_{n=1}^{u} M_{mv} \ / \ \sum \ \sum \ M_{mn}\ ]$$

Where X and M refer to exports and imports, respectively

The numerator in equations [2] and [3] is equal to a country's export (imports) of a specific product category relative to the exports (imports) of this product from all countries except for the country in consideration. The denominator reveals the exports (imports) of all products except for the commodity in consideration from the respective country as a percentage of all other countries' exports (imports) of all other products.

While the calculations of indices RXA and RMP are exclusively based on either export or import values, the RTA considers both export and import activities. This seems to be important in view of trade theory and globalization trends and due to the growth in intra-industry and/or entrepot trade, as this aspect is increasing in importance (ISMEA 1999). The level of these indicators represents the degree of revealed export competitiveness/import penetration and is based on the relative trade performance of all competitors. When this performance is measured over time the historical trend in competitive performance can be determined, viz-a-viz that of the competitors.

The Wine Competitiveness Rating (WCR) data is shown in Table 1 and trends from 1960 to 2008 are illustrated in Figure 2.

Table 1. The competitiveness rating of the wine industry in South Africa (2000 – 2008) based on the Relative Revealed Trade Advantage (RTA)

Product	RTA 2000	RTA 2001	RTA 2002	RTA 2003	RTA 2004	RTA 2005	RTA 2006	RTA 2007	RTA 2008
Wine	4.05	3.76	4.31	4.96	5.36	5.84	4.74	4.42	4.55

Source: Own calculation based on data from FAOSTAT; Esterhuizen and van Rooyen 2005, 2007.

From this graph it can be noted that South Africa's wines performed increasingly internationally competitive over the past two decades, reached a high point in 2005. Recently some decline is being recorded to levels just above 2002 levels. The impacts of the regulation period and political sanctions (until early 1990s) and the changes related to political liberation, deregulation of the wine industry and increased exports due to the open access to global markets since the early 1990's, are dramatically captured in the competitive performance of the wine industry. Events related to changing consumer preferences and style changes, trade policies, exchange rate fluctuations and technological innovation are also reflected in the WCR. These trends are analyzed in the Step 2.

In Figure 3 the general upward and relative "middle" position of South African is indicated. The recent decline is also shown. Countries with recent increasing performances are Argentina, New Zealand and particular the highly competitive Chile, after its considerable decline from 2000 to 2005.

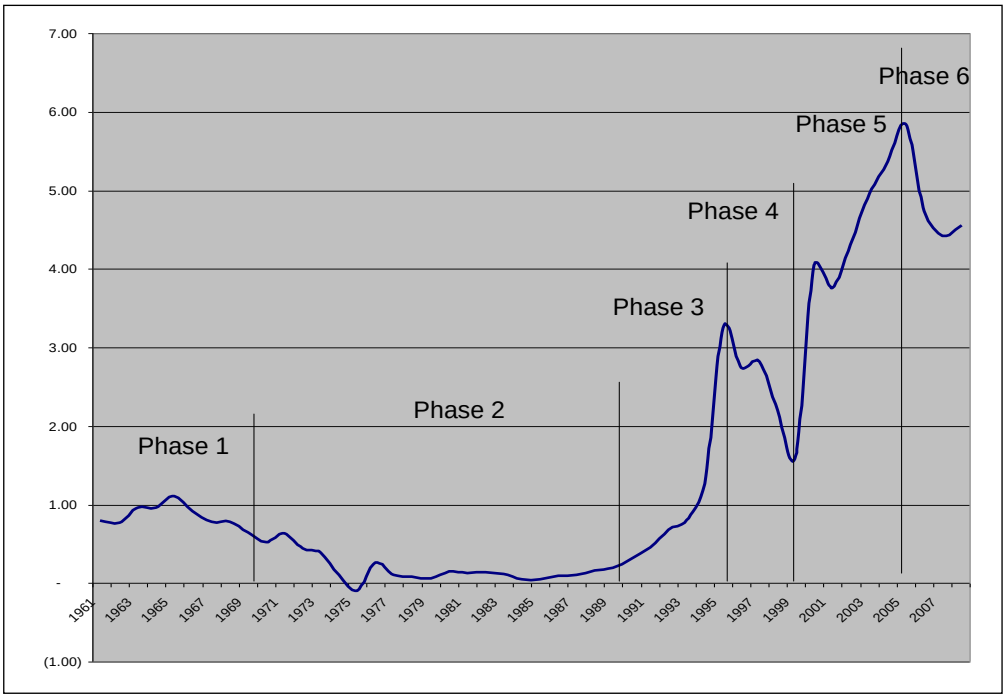

Figure 2. Competitive trends of the wine industry in South Africa (1960 – 2008)
Source: FAOSTATS
Notes: Competitive (RTA > 1), marginally competitive (1 > RTA > 0), not competitive (RTA < -0);

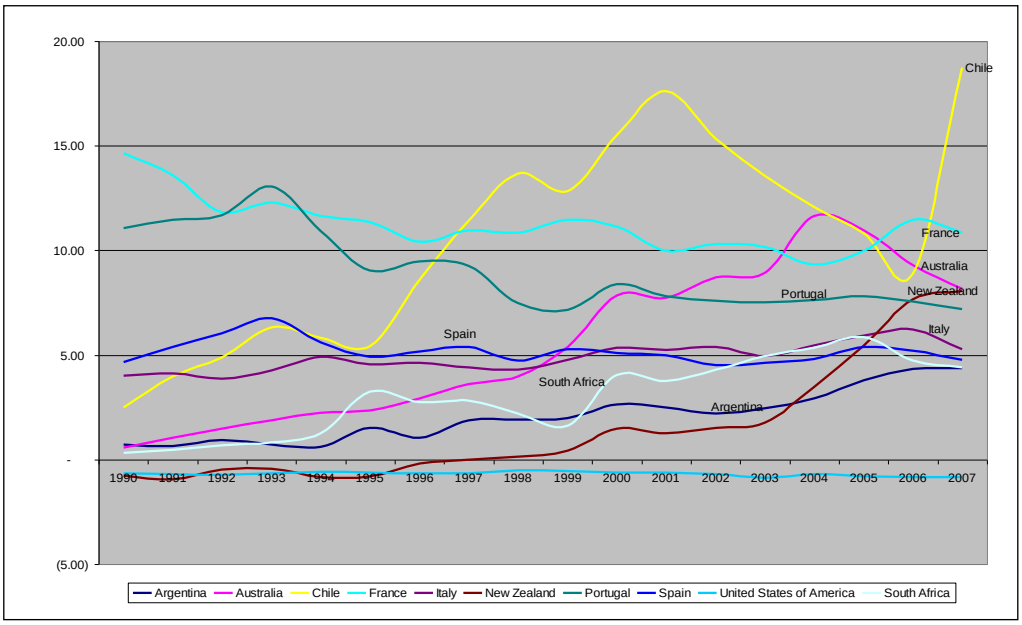

Figure 3. Trends in the competitiveness of selected wine producing countries (1990-2007)
Source: FAOSTATS

International comparisons: Wine trading (both at import and export levels) is one of the most dynamic and competitive activities in the agri-food environment. Since the late 1980s, the share of wine production that is traded internationally has nearly doubled and wine trade has brought major gains to participants in expanding countries, but pain to many traditional producers (Anderson, 2004). A view of South African competitive performance measured by the RTA, in comparison with some other major wine trading economics is instructive.

STEP 2: Factors of Competitiveness in the SA Wine Industry

Step 2 of the comprehensive analysis employs a qualitative methodology, based on opinions and perceptions of persons responsible for strategic direction and executive decisions in the SA wine industry. This qualitative approach, based on personal discussions, focus group sessions and qualitative surveys, explain the measured trends and then identify and analyze the factors influencing these competitive trends in the wine industry.

Commenting on Trends and Phases in Competitiveness Performance

From the graphical illustrations in Figures 2 and 3, and based on interviews with prominent wine analysts, executives and stakeholders, a number of phases in the competitiveness performance of the South African wine industry since 1960 can be constructed and described i.e. a short commentary on the recent history of the competitive performance of the South African wine industry (SAWB 2005; SAWC 2007, 2010; Van Rooyen 2007; Bayley 2008; Le Roux 2008; Joubert 2010; Bruwer 2010).

Phase 1 - Regulated competitiveness (– up to 1970): During this period (effectively starting in the late 1930s), the South African wine industry was heavily regulated through centralized controls on varietal choices and vine material, wine and wine grape production quotas, production cost based regulated pricing, surplus removal schemes and price agreements. The KWV (Koperatiewe Wijnboere Vereniging) established in 1918 and representing wine grape producers, was granted statutory powers to regulate supply in the industry. This period was characterized by a focus on high volume production of relatively lower quality wines, producer income stabilization and an overall orientation towards brandy and fortified wine production as a "surplus removal" type scheme (Vink, Williams and Kirsten 2004).

Phase 2 – Competing in a constrained economic and political environment (1970-1990): Increasing political pressures on South Africa by the international environment during the 1970s and the imposing of "anti-apartheid" trade sanctions brought the highly regulated industry almost to a halt. Economic survival was possible through occasional exports of large volumes of low quality wine to Eastern Europe and domestic consumption (Vink, Williams and Kirsten 2004). One important technical innovation during this period was the introduction of the "Wine of Origin" scheme which brought strictly enforced local wine industry regulations in line with those in European countries. Cultivar based and classic wines also became more popular. Wine tourism and 'wine routes' were introduced, together with the "estate wine label" concept where estates produced their own brands.

Phase 3 – The 'Madiba Magic' period (1990-1995): With the release of Nelson "Madiba" Mandela in 1990 and the following political liberation of the South African society, the wine industry started with a remarkable period of activity and transformation. Economic sanctions were lifted, leading to international business exposure, access to international markets, interaction with trade supply chains and increased investments. The South African wine business scene however also changed dramatically as the impact of international competitiveness hit "local shores". By 1997 the industry was fully deregulated and wine surpluses, quota allocations, and administrative pricing schemes were removed. The Wine of Origin scheme was maintained and the Integrated Production of Wine (IPW) programme, to support environmentally sustainable production and wine making practices, was widely implemented. International sales of South African wines increased from 20 million liters in 1992 to over 72.8 million liters (still only 14.6 % of the wine crop) in 1995.

Phase 4 – Facing competitive realities (1996-2000): Despite increased sales (at relative low price points) certain cracks started to appear in 1996 in the South African wine success story. Internationally renowned wine writers and wine judges called for changes in style and quality and the need for South Africa to produce internationally accepted "new world" wines – fruity, non-grassy, less tannins, great consistency, more quality reds, etc.. Australia also became a much more aggressive player in the UK, South Africa's most important market – especially in the super market environment.

This resulted in a range of technical innovations, including the planting of improved grape varieties and virus-free plant material. The terroir system was extended, together with cultivar specific site solutions and the planting of more red varieties to strengthen the "Wine of Origin" scheme. Supply chain efficiency and reliability became a major success factor for the wine business (SAWB, 2002 and 2005). At the start of the new millennium, the South African wine industry responded positively on competitive realities, producing "good value for money" wines in the new world style, and with a distinctly South African character. Exports rose from 99.9 million liters in 1996 (17.3% of the wine crop), to 141 million liters in 2000 (26% of the wine crop).

Phase 5 – Towards becoming a global player (2000 - 2005): The industry mobilized and jointly decided on a strategic 'course for excellence' through the acceptance of Vision 2020, the establishment of the SA Wine & Brandy Company (SAWB) [trading as the SA Wine Industry Council (SAWC) since 2007] as a coordinating body and the setting of a framework for a partnership with government through the 'Wine Industry Strategy Plan' (WIP) in 2003. This phase also records a sustained increase in exports, in particular to the UK, Netherlands and Germany. Brand development and promotion became noted business strategies, with a particular effort by the wine industry to establish an identity through unique 'Brand SA' properties, emphasizing the great diversity and value for money of South African wines. "Variety is our nature" with an increasing environmental focus (the Wine Bio-Diversity Initiative) and social responsibility and transformation - see the Wine Industry Transformation Charter and Score Card (SAWC, 2007), featured prominently in this "Brand SA" drive. Concepts such as integrity, authenticity and sustainability became key pointers in the industry (see the SA Wine Industry Directory, 2002-2010) as well as the notion of unique and typical South African wines (Pinotage-red; Chenin Blanc-white).

The impact of world market changes, in style and content, fluctuating exchange rates and the presentation of unique lifestyle experiences (wine + food + tourism + value for money) became integrated in South African wine business strategies. Efforts to expand the local market were also implemented, in particular through the expanding of "black diamonds" markets and in the historical black town ships (Ndanga, Louw and Van Rooyen 2010). Since 2000, exports again increased to 281 million liters or 44.7% of wine production in 2005.

Phase 6 - Operating in a constrained competitive environment (since 2006): Since the 2005 high point, the wine industry in South Africa is in a declining phase in terms of competitive performance relative to its competitors. This negative trend in competitiveness started in 2006 after the definite positive trend in competitiveness which started in 1990. The main reasons for this decline in competitiveness can be found in the broader wine industry environment in which South African wine businesses now operate. This constrained environment include factors such as the world economic slowdown, declining levels of wine consumption, sustained international strengthening in the value of the local currency, global warming/drought conditions and climatic fluctuations, increases in interest rates, lack of infrastructure maintenance and export facilities, lack of skilled labor, and government's inability to provide sufficient regulatory, certification and support services to the needs of the dynamic wine industry.

Exports dropped in 2006 to 271 million liters – 38.3 percent of the total wine production. In 2008, 39 percent of wine production was exported, although the export volume increased to 411 million liters.

This downward trend in competitiveness is also in line with the findings of the IMD in their World Competitiveness Yearbook on South Africa (IMD, 2001-2011), which showed a drop in South Africa's ranking, from 38th to 50th out of 55 countries in 2007 to 48th out of 57 countries in 2009. In explaining South Africa's drop in global competitiveness rankings, the five most problematic factors for doing business in South Africa were identified by the IMD to be: crime and theft, inefficient government bureaucracy, inadequately educated workforce, restrictive labor regulations and inadequate supply of infrastructure.

A general comment on performance over time is the relative absence of impacts due to climate variations, especially droughts; no serious droughts or adverse climatic conditions were experiences in the wine industry over the last twenty years (SAWID). The SA industry is also quite diverse across a range of climatological types and this, together with the "Integrated Production of Wine (IPW)" scheme mitigated climate risk for the industry as a whole (Le Roux, 2008; Bayley 2008; Bruwer 2010).

The Wine Executive Survey (WES)

Executive views and expert opinions: The WES aim to determine the key factors enhancing or constraining the competitive performance of wine businesses. The focus of this inquiry is at the firm level i.e. individual firms. Executives surveyed are responsible for the success and failure of strategy and operations. Whereas the hard/quantitative data in Step 1 was used to measure competitiveness performance over a specific period, the qualitative survey data of the WES is used to identify factors determining competitive performance - as it is perceived at certain points in time at strategic levels of decision making. The WES provides many unique measures and captures

the informed judgments of business leaders and decision-makers in the wine industry of South Africa.

Data base and time periods of analysis: Whereas Step 1 of the analysis measured the long term trends in competitive performance (1960-2008), the WES was only implemented in 2005 and repeated in 2008.

The WES's provides information on the prevailing perceptions of wine executives and specialists during two periods, situated within the most recent two phases of the competitive performance of the industry i.e. phases 5 and 6 (see Figure 1). The 2005 survey was at the height of competitive performance and the 2008 survey recorded views during the recent declining phase. Respondents were asked to identify and rate factors impacting competitive performance in terms of most enhancing (3), modestly enhancing (2) and most constraining (1).

The 2005 WES: The 50 respondents identified the following as the five most enhancing factors:

- size of the export market;
- opportunities in "environmentally aware" markets for wine;
- local infrastructure and transportation networks;
- technical information flows;
- competitiveness amongst local suppliers to the industry;

The five most constraining factors in 2005 were:

- the strong currency (Rand);
- cost of crime;
- difficulty of starting a new business;
- trust in the political system;
- the incompetency of government administration and bureaucracy;

The 2008 WES: The factors affecting the competitiveness in the wine industry in South Africa in 2008 were identified and rated through responses from 46 executives in the wine industry. The five most enhancing factors for the industry were:

- the strong competition and rivalry in the local market;
- strong international competition;
- the affordability of high quality South African products;
- the entry of new competitors in to the local market;
- quality production services and processes;

The five most constraining factors for the industry during the 2008 period were:

- the low confidence and trust in the political/governance environment;
- reliability of electricity supply;
- the high cost of crime;
- the incompetence of service personnel in the public sector;
- the quality of low skilled labor.

The full list of factors and their ratings are shown in Table 3.

STEP 3: Determinants of Competitive Performance

The third step in the analysis compliments the first two, where competitive performance was firstly quantitatively measured; and secondly qualitatively explained and the various factors impacting on competitiveness identified by industry experts and executives. The methodology developed by Michael Porter (1990) to analyze competitiveness (Porter's Diamond) is used, in an adapted form, in Step 3 to derive the determinants of competitive performance in the wine industry in South Africa from the data previously generated.

The four key determinants of competitive performance of the Porter Diamond – factor conditions, demand conditions, related and supporting industries and firm strategy, structure and rivalry – are all well suited to determine the forces and factors driving competitiveness performance in the trade orientated South African wine industry. However, due to the high degree of regulation of the South African wine industry, related to aspects of quality, certification and also to social, labor and political transformation, the concept of government policy and interventions must be considered in this enquiry. The notion of "luck or chance" is also relevant, as the South African wine industry is highly exposed to changes in macro-economic trends and international factors such as changes in currency values, as well as a range of external factors impacting on costs, such as crime and health situations.

In Step 3 of the analysis, Porter's Diamond is extended to include the impacts that government and chance forces have on competitiveness (Sledge 2005; Esterhuizen and Van Rooyen 2001 and 2005). Accordingly six broad criteria or attributes that shape the environment in which firms compete are analyzed, namely:

- *Factor conditions*– the industry's endowment in factors of production, such as climate, terroir, skilled labor, infrastructure, etc. necessary to compete.
- *Demand conditions*– the nature, changes and knowledge of the market demand for the industry's products or service.
- *Relating and supporting industries*– the presence or absence of competitive supplier and other related industries.
- *Firm strategy, structure and rivalry*– the way companies are created, organized and managed, as well as the nature of domestic rivalry.
- *Government support and policy*– government plays a vital role. Government can influence each of the above determinants, either positively or negatively, through policies and the environment that is created, funding support and the provision of public goods to support private operational capacity and social stability.
- *The role of chance (or luck)* – chance factors/events/ luck are occurrences largely beyond the power of firms and national governments. Such events can nullify sources of competitive advantage and create new ones. The South African wine industry, operating in an "open" global environment and under free market policies with limited government protection and subsidies, will be highly prone to such influences.

In Table 3 the factors listed and rated in the WES's are grouped in terms of the various Porter Diamond determinants. From these the impact of the determinants is then rated to allow for comparisons between the 2005 and 2008 surveys.

Table 3a. The determinants of competitive performance in the South African wine industry-2005 and 2008.

Determinants	2005	2008	Determinants	2005	2008
(i) Production factor conditions	**1.9**		**(ii) Related & supporting industries**	**1.9**	**1.6**
Quality of low-level skilled labor	2	1	Electricity supply	1.5	0.5
Cost of Transport	NA	1.4	Collaboration with scientific research institutions in R&D	2	1.5
Cost of financing	1		Telecommunication	2	1.5
Availability of Skilled labor	2	1	Suppliers of packaging material	2	1.5
Overall cost of doing business	1.5	1	Financial institutions	1	1.5
labor administration cost	1	1	Transport companies	2	1.5
Cost of quality technology	2	1	Internet service providers	1.5	2
Quality of skilled labor	1.5	1.5	Specialized information services	2	2
Cost of skilled labor	2	1.5	Sustainability of local suppliers	2.5	2
Cost of infrastructure	1.5	1	Status of scientific research institutions	2.5	2
Cost of low level skilled labor	2	1.5	Quality of local suppliers		2
Efficiency of general infrastructure	2	1.5			
Credit availability	1.5	2			
Availability of quality technology	2.5	2			
Quality of technology	2.5	2			
Availability of water for industrial purposes	2	2			
Availability of low level skilled labor	3	2			

Table 3b. The determinants of competitive performance in the South African wine industry-2005 and 2008

Determinants	2005	2008	Determinants	2005	2008
(iii) Firm strategy, structure & rivalry	**2.3**	**2.1**	**(iv) Government support & policies**	**1.3**	**1.5**
Expenditure on R&D	2	1.5	Confidence/ trust in political systems and governance	0.5	0.5
Incentives for management	2	1.5	Competence of personnel in the public sector	1	1
Flow of information from Customers	1.5	2	Labor policy and regulation	1	1
Information flow from primary suppliers to company	1.5	2	Administrative/bureaucratic regulations in South Africa	1	1
Substitutes of your company's product or services	2.5	2	Land reform policy	1	1
Continuous innovation	2.5	2	Black Economic Empowerment policy	1	1
Regulatory standards	2.5	2	The tax system	1	1.5
Efficiency of technology in production processes	2.5	2	Political changes	1	2
Environmental awareness	2	2	Environmental regulations	2	2
Invest in staff	2.5	2	Trade policy	2	2
Unique services & processes	NA	2	Macro-economic policy	2	2
Entry of new competitors	3	2.5	Competition law	NA	2
International entry in local market	NA	2.5	Complying with environmental standards	2.5	2
Affordable high quality products	NA	2.5			
Competition in the local market	3	3			
Industry structure and rivalry	2	NA			

Table 3c. The determinants of competitive performance in the South African wine industry-2005 and 2008

Determinants	2005	2008	Determinants	2005	2008
(v) Demand conditions	**2**	**1.8**	**(vi) Chance factors**	**1.3**	**1.4**
Growth in local market	1.5	1.5	Cost of Crime	0.5	0.5
Local market size	1.5	1.5	Cost of HIV/Aids	NA	1.5
Demand for environmental friendly products	2	1.5	Exchange rate	1.5	1.5
Internationalization of local Buyers	NA	1.5	Global developments	2	2
Growth in international markets	2.5	2			
Knowledge of markets	2.5	2.5			
Sophistication of local buyers	NA	2			

***Ratings:** 1 = most constraining; 2 = modestly enhancing; 3 = most enhancing
Source: Adapted from the "the Agricultural Business Chamber and SAWB/SAWC Wine Executive Surveys 2005, 2008"

The factors with an enhancing effect on the competitiveness of the wine industry in South Africa in both 2005 and 2008 are the availability/cost of low-level skilled labor, the quality and availability of technology in South Africa, water availability and the general efficiency of infrastructure.

From 2005 to 2008 most factors however decline. In 2005 the high cost of financing and labor administration cost were rated as most constraining. These were also included as the most constraining factors in 2008, in addition to the quality of low-skilled labor, cost of transport, infrastructure and technology, availability of skilled labor and the overall cost of doing business.

This all indicates that on average the production factor conditions in South Africa have an increasingly constraining effect on the wine industry's competitive performance.

Related and supporting industries: The related and supporting industries, as a determinant of competitiveness in 2008, were rated 1.6, which records a modestly constraining impact on the South African wine industry (Table 3a). In 2005 this factor were rated to have contributed at 1.9. For this determinant 2008 therefore shows a decline in the competitive space of the industry. Most factors, except financial institutions and internet services, which recorded higher ratings in 2008, showed declining ratings, with electricity supplies recording the biggest decline. The status of supporting research institutions and the sustainability of local suppliers rated as the highest contributors in both periods.

Firm strategy, structure and rivalry: The third determinant of competitive advantage is the context in which firms are created, organized and managed as well as the nature of rivalry in the industry (Table 3b). With an average score of 2.1 for 2008, firm strategy, structure and rivalry as a whole, have an enhancing impact on competitiveness of wine businesses in South Africa. The only constraining factors, even though only slight constraining, are the declining expenditure on R&D and incentives to support management performance. In 2008, the most enhancing factors were the ease of entry of new competitors, international entry into the local market, affordability of high quality products and the fierce competition in the local market.

This determinant was rated as highly enhancing in 2005 with 2.5, with the strong enhancing factors the industry regulatory structures and standards, integrity systems, intense internal competition, entry of new competitors on a regular basis, the production of affordable high quality products, firm level investment in human resources, employment of quality technology, the production of unique products, services and processes, the production of environmental friendly products, and continuous technical innovation.

A positive status is generally experienced in this determinant, although a decline from 2005 to 2008 is observed. This can be related to tighter market conditions and factors constraining innovation and technical progress.

Government support and policies: The wine industry in South Africa is highly regulated and to a large degree dependent on good partnership arrangements and effective lobby strategies with government departments and agencies (Table 3b). Government policy and support on matters related to export and trading, science and innovation, empowerment and transformation, tax and excise duties, access to natural resources such as land and water, labor relations, financial arrangements to name some, directly impact this sensitive and highly market orientated industry.

With an average score of 1.5 in 2008, government services, policies and support systems are viewed to act in a constraining manner to the competitive success of the wine industry. However in 2005, with a rating of 1.3, this determinant was rated as more constraining with the major constraining factors burdensome administrative regulations, the impact of legal change, the competence of personnel in the public sector and the tax system's impact on investment and risk-taking. South Africa's resources policies (labour and land) and the lack of clarity of transformation policy also negatively impacted competitive performance in 2005.

Government support and policies were however viewed to become less constraining in 2008. It shows a positive trend towards, partly due to many policy and government level interactions by the industry; the finalisation of the Transformation Charter and Score Card, the Wine Industry Plan, the restructuring of the wine industry's body to become more representative (the SA Wine Industry Council (SAWC)), and on-going supportive trade and promotion interactions. In 2008, the trust in the honesty of politicians, competence of personnel in the public sector, the current impact of the labour policies, administrative regulation in South Africa, the land reform process and the tax system were considered the most constraining factors resulting in the sustained negative overall rating of this determinant.

It is interesting to note that complying with environmental regulations were rated by the wine industry in South Africa in 2005 to have a positive impact on their competitiveness, while macro-economic and trade policy provided moderate enhancements. In 2008, again the compliance with environment standards is considered to enhance competitiveness, as well as trade-, and macro-economic policies and competition law.

Demand conditions: In 2008, the demand conditions had a rating of 1.8 which indicates that the demand conditions may be somewhat constraining the South African wine industry's competitiveness(Table 3c). The rating in 2005 of 2 reflects a more positive view on the market conditions facing South African wines. This view can be partly related to currency revaluation and fluctuations and tighter competition in the global markets.

The Wine Executive Survey (WES) in both 2005 and 2008 indicated that the size of and growth in the local market are constraining the competitiveness of the wine industry in South Africa. The issue of buyers of South African wine being knowledgeable, demanding and buying environmentally friendly products and being concerned of ethics and the integrity of production methods were viewed to have a modestly positive impact on the South African wine industry's competitiveness.

Chance factors: Chance events are occurrences that have little directly to do with circumstances in an industry and are largely outside the power of the firms or a country to influence. Chance events, however, are important because they create opportunities and discontinuities that could allow shifts in competitive performance. Chance events can nullify the advantage of previously established competitors and create the potential that a new firm can supplant them to achieve competitive advantage in response to new and different conditions (Porter, 1998).

For the wine industry of South Africa, the impact of chance factors is considered the most constraining to competitive performance (Table 3c). In 2008 this factor was rated 1.4 against 1.3 in 2005.

The strengthening of the South African exchange rate and the global political/economic developments were rated to have highly constraining impacts, both in 2005 and 2008.

The cost of crime was viewed to be the most constraining factor amongst the chance factors in 2005 and 2008, at a rate of 0.5. The cost of HIV/Aids was rated as the second most constraining chance factor in 2008; in 2005 this was not considered.

STEP 4:Determining the Changing "Competitive Space" of the SA Wine Industry

The "competitive space" for the South African wine industry changed considerably from 2005 to 2008 due to a pronounced decline in most of the determinants and related factors. This view is confirmed by the RTA measurement of the declining competitive performance of the industry.

- Wine industry executives consistently rated firm strategy and rivalry, together with demand/market conditions to have an enhancing impact on competitiveness. However in 2008, firm strategy and rivalry showed a decline. Supporting industries also showed a enhancing effect in 2005, although declining in 2008 (Figure 4);

- Production factor conditions were modestly constraining in 2005 and became more constraining in 2008;
- In both the 2005 and 2008 WES's, executives indicated that the chance related factors and the government support and policies were the most constraining determinants. However, in 2008, these two factors were rated somewhat less constraining - indicating a modestly positive trend.

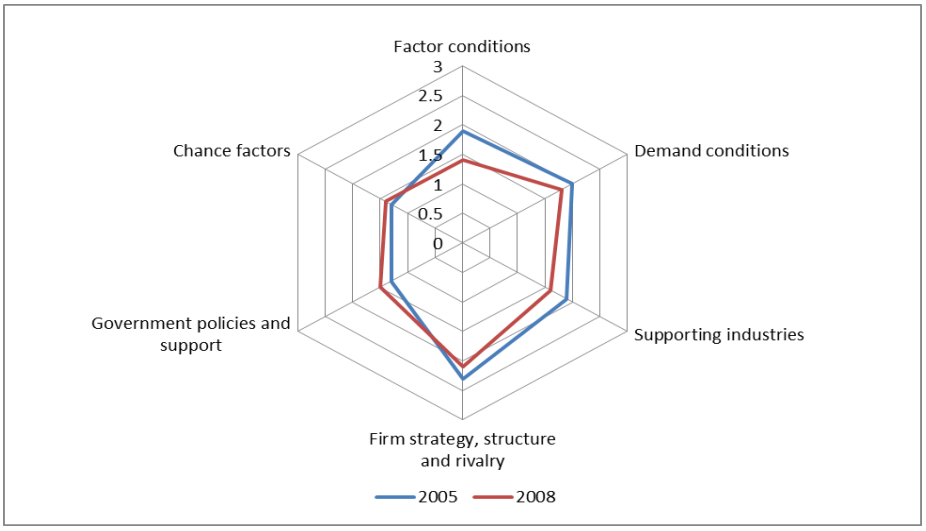

Figure 4. The "Porter" determinants of competitiveness in the South African wine industry, 2005 and 2008.

Ratings: 1 = most constraining; 2 = modestly enhancing; 3 = most enhancing.
Production factor conditions: The average score in 2008 achieved for production factor conditions is 1.4; in 2005 it recorded 1.9, showing a decline from a modestly enhancing state to increasingly constraining in 2008 (Figure 3a).

A strategic agenda for the SA wine industry: In strategic planning work sessions, where these findings and the changing competitive space were discussed with industry representatives (Wine Industry Council, 2005-2008), the decline in the competitive space were noted, in particular the low rating of government support. The importance of a consistent and intelligent "lobby action" with government - an open 'red telephone line' - was viewed as highly relevant for a competitive wine economy in particular as it relates to domestic factors constraining wine trade.

The above analysis identifies a number of aspects to focus such "lobby discussions" and to build the necessary trust between industry and government as important players in this environment. These factors would include: trade agreements and policy development; international market development - regulation and export promotion; infrastructure expansion, in particular exportation facilities and transportation networks; research support and technological innovation; economic empowerment and transformation support; the combating of crime; the simplification of labor regulations; and a reduction in bureaucratic 'red tape' to name the main items on the agenda (Van Rooyen 2007).

Conclusions

This article focused on the measurement and analysis of the competitive performance of the South African wine industry. By applying a four step framework of analysis, the competitive performance of the South African wine industry was traced and analyzed. The analysis established that South Africa's wines are increasingly internationally competitive, with a strong positive trend since 1990. However, recently this trend started to decline.

The determinants of this declining performance were established and analyzed. The openness of the South African wine economy was confirmed as factors such as fluctuating exchange rates and changing market trends play an important role. The role of regulation and a supportive government policy environment were also found to be highly relevant for the competitive performance of the industry.

The continued application of the four step framework will enable the industry to measure and analyze its performance and to determine an agenda for industry level action and the lobbying required to position the industry to operate more competitively.

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The Impact of Ethanol Production on Spatial Grain Market Relationships

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Abstract

Using cointegration theory, grain markets in Michigan, Kansas, Iowa and Indiana were examined to determine if increased ethanol production affected spatial corn price relationships in these states from 1998 through 2008. It was determined that corn prices operated in a stable, long-run equilibrium from 1998 through 2008 and increased ethanol production did not have an effect on this relationship. These findings suggest policy boosting ethanol production has not altered relationships between spatially dispersed corn markets. In addition to policy makers, this information is also useful to farmers and commodity traders who utilize market information when managing their businesses.

Keywords: cointegration, ethanol, grain markets, spatial relationships

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Introduction

The production of corn-based-ethanol in the United States has steadily increased from 1998 to 2008. The creation of laws at the federal, state and local levels of government is a central reason for the growth of the ethanol industry. From September 1998 to June 2008 ethanol production increased from 1.4 billion gallons per year to 9 billion gallons per year and the number of ethanol plants in the United States increased from 50 to 170 (Renewable Fuels Association 2009). While ethanol production increased by nearly 550% from 1998 to 2008, corn production only increased by approximately 24%, from 9.8 billion bushels to 12.1 billion bushels (United States Department of Agriculture 2009). As illustrated by table 1, from 1998 to 2008 the percentage of corn used in the production of ethanol in the United States increased from 5% to 27%. As the percentage of corn used in the production of ethanol in the United States has increased, the proportion of corn used in the production of other components of corn demand has remained steady or declined (Anderson and Coble 2010). The percentage of corn used in the production of ethanol within the particular states of Michigan, Kansas, Indiana and Iowa also increased from 1998 through 2008 and are also found in Table 1.

Table 1. Percent of Corn Used in the Production of Ethanol

Year	Michigan %	Kansas %	Iowa %	Indiana %	United States %
1998	0.00%	1.51%	14.15%	4.84%	5.18%
1999	0.00%	1.50%	14.24%	4.92%	5.62%
2000	0.00%	1.53%	14.39%	4.51%	5.93%
2001	0.00%	6.29%	16.24%	4.16%	6.72%
2002	7.71%	11.52%	17.15%	5.83%	8.54%
2003	6.95%	11.13%	19.63%	4.68%	10.02%
2004	7.02%	11.49%	22.62%	3.96%	10.40%
2005	6.28%	13.37%	28.24%	4.14%	12.68%
2006	19.42%	22.24%	37.80%	4.36%	16.64%
2007	32.46%	30.75%	35.79%	16.63%	18.00%
2008	32.03%	36.92%	50.20%	36.94%	26.85%

The characteristics of ethanol production in Michigan, Kansas, Iowa and Indiana are reflected in the percentage of corn used in the production of ethanol statistic. For example, from 1998 to 2008 the number of ethanol plants in Michigan Kansas, Iowa, and Indiana increased from zero to five, three to thirteen, four to thirty-nine, and one to twelve, respectively (Ethanol Producer Magazine 2009). Corresponding with these new plants, from 1998 to 2008 annual ethanol production in Michigan, Kansas, Iowa, and Indiana increased from zero to 262 million gallons, 17.5 million gallons to 497.5 million gallons, 693 million gallons to 3.04 billion gallons, and 102 million gallons to 894 million gallons, respectively (Ethanol Producer Magazine 2009).

To determine some of the changes that may have occurred as a result of increased ethanol production, this paper will examine how increased ethanol production in the United States affected spatial corn price relationships at different grain markets in the United States.

Specifically, this paper will determine if increases in ethanol production in Michigan, Kansas, Indiana and Iowa affected spatial corn price relationships between different grain markets throughout their respective states. Before determining how increased ethanol production affected corn price relationships, this analysis will first determine if corn prices at different grain markets in Michigan, Kansas, Indiana and Iowa were cointegrated from 1998 through 2008.

Economically speaking, two variables are cointegrated if they have a long-term, or equilibrium, price relationship between them (Gujarati and Porter 2008). Because corn prices at grain markets throughout a state operate within the same geographical procurement market, it is expected that corn prices at different grain markets throughout a particular state will be cointegrated and thus have a long term, equilibrium price relationship. Once this relationship is determined, this study will examine whether existing spatial corn price relationships at grain markets in Michigan, Kansas, Indiana and Iowa were altered because of rapidly increasing ethanol production. Ethanol plant openings created new demand centers for corn which increased the competition for corn and thus increased the flow of information throughout the state concerning corn prices. Increased competition and increased market information in an industry helps to ensure that prices are cointegrated and operate in a stable long-run equilibrium (Goodwin and Schroeder 1991; Brester and Goodwin 1993; Schroeder 1997; Pendell and Schroeder 2006). Therefore, it is possible that increased ethanol production strengthened the relationship of corn prices at different grain markets. If there are years when corn prices at grain markets in Michigan, Kansas, Indiana and Iowa were not operating in a stable long-term equilibrium (not cointegrated), it is possible that increases in the percentage of corn used in ethanol production helped to bring corn price relationships back to a stable long-run equilibrium (cointegrated). Increased competition for a commodity helps to ensure markets are cointegrated and spatial price discrimination in particular regions does not exist (Brester and Goodwin 1993).

Market price relationships regarding increased corn demand in response to ethanol have recently been studied. Harri, Nalley and Hudson (2009) examined changes in the relationships between crude oil and corn prices in risk management strategies for corn producers because of the growing use of corn for ethanol. Using cointegration theory, they found clear evidence that the relationship between corn and oil has strengthened over time as a result of the growing use of corn for ethanol. Anderson and Coble (2010) determined that the strengthening in the relationship between crude oil and corn prices occurred when the corn ethanol production mandates were raised in the Energy Policy Act of 2005.

This paper will be the first research to investigate whether increased ethanol production has strengthened existing relationships among corn prices at different grain markets throughout the Midwestern United States. Government policy is the central reason for increases in ethanol production. If existing corn price relationships have been altered because of government intervention, it is important for policy makers to have this information. Furthermore, corn market participants, such as farmers and merchandisers, need to understand how markets which they trade in have changed since the rapid expansion of the ethanol industry. When grain merchandisers purchase corn from farmers, knowledge regarding relationships among local grain markets is utilized to make a contract. If increased ethanol production has altered corn price relationships at different grain markets, it is useful for both grain merchandisers and farmers to know how corn price relationships at different grain markets have changed.

It is worth noting that grain market's corn price series cointegration has no direct implication on corn price levels. Instead, if corn prices at different grain markets are cointegrated, it is only concluded that there is a long-term, or equilibrium, price relationship found between the corn price series at the different grain markets. At any time period, the cointegrated corn price series at different grain markets may deviate from their equilibrium price relationship, but this deviation will be temporary: there are economic forces that drive the corn price series at different grain markets back toward their long-term equilibrium price relationship (Wooldridge 2006). This distinction is important as this study purposely makes no attempt to understand the net impact of increased ethanol production on corn price *levels*, an issue inherently separate from multi-market price relationships.

The ensuing discussion is aimed at first discovering if corn prices at different grain markets throughout Michigan, Kansas, Indiana and Iowa were cointegrated from 1998 through 2008. Next, it will be determined whether increased ethanol production has altered spatial corn price relationships at different grain markets throughout these states. In addition to a state by state approach to this analysis, a Midwestern United States model will also be created to determine the effect of increased ethanol production on spatial corn price relationships in the Midwestern United States.

Data

Corn price observations from several different grain markets in the Midwestern United States were purchased from Cash Grain Bids Data Service (2008) to determine how increased ethanol production has affected corn price relationships in the Midwestern United States. The purchased data includes daily corn prices collected from every grain market Cash Grain Bids Data Service had data on within 300 miles of Omaha, Nebraska, and within 300 miles of Indianapolis, Indiana.[1] For this study, weekly corn price averages were used and were created from the daily corn price observations recorded by Cash Grain Bids Data Service. Additionally, only weekly corn price averages at grain markets located in Michigan, Kansas, Iowa and Indiana were compiled. McNew and Griffith (2005) also used local corn price data collected from Cash Grain Bids Data Service in their analysis of measuring the impact of ethanol plants on corn basis levels.

Michigan, Kansas, Iowa and Indiana were the states chosen to represent the Midwestern United States in this study. The purchased data set includes price data for fifty-seven grain markets in Michigan, 245 grain markets in Kansas, 511 grain markets in Iowa and 162 grain markets in Indiana. These four states geographically are representative of both the Eastern and Western Corn Belt Region. Additionally, from 1998 through 2008 Iowa annually produced the most corn in the nation (United States Department of Agriculture 2009). Combined Michigan, Kansas, Iowa and Indiana account for approximately fifty-two percent of the national annual production of ethanol (Ethanol Producer Magazine 2009) and about thirty-two percent of the total corn produced in the United States (United States Department of Agriculture 2009).

[1] Budget constraints prohibited purchasing the entire national set of markets tracked by Cash Grain Bids Data Service. Nonetheless, the data purchased collectively captures the majority of grain markets in both the western and eastern cornbelts.

A state by state approach was utilized to determine how increases in ethanol production affected spatial corn price relationships in the Midwestern United States. In each state, the weekly corn price averages recorded at all of the grain markets from September 1998 through June 2008 were complied. Next, two criterions were used to narrow the grain markets to be examined to four grain markets per state. Only four grain markets were examined in each state because of degrees of freedom constraints presented by annual multivariate cointegration testing. The two criterions were (1) completeness of corn price observations in the weekly average corn price series and (2) geographical dispersion between the locations of the different grain markets chosen. Table 2 illustrates which four grain markets were studied in each state along with the characteristics of each weekly average corn price series recorded at each grain market.

Table 2. Weekly Average Corn Price Statistics (cents/bu)

Grain Market	# of Obs.	Mean	Std. Dev.	Minimum	Maximum
Blissfield, MI	512	238	85	145	588
Lake Odessa, MI	512	226	86	137	576
Marlette, MI	512	229	83	136	571
Middleton, MI	512	226	84	136	571
Chapman, KS	512	233	89	144	627
Hillsboro, KS	512	235	87	143	580
Larned, KS	512	241	85	155	576
Osborne, KS	512	230	85	142	555
Algona, IA	512	218	86	129	567
Audubon, IA	512	218	87	127	603
Cedar Rapids, IA	512	242	81	155	583
Chariton, IA	512	225	80	130	557
Columbus, IN	512	235	86	137	586
Delphi, IN	512	242	86	147	592
Greensburg, IN	512	239	83	143	571
Hamlet, IN	512	237	85	143	589

Criterion one noted completeness of corn price observations in the weekly average corn price series as being one way of selecting the proper grain market to study. However, no grain market contained 100% of their weekly corn price observations[2]. Therefore, missing observations were predicted by regressing the Chicago corn price time series with each individual grain market's corn price time series[3]. Weekly average Chicago corn price time series from September 1998 through June 2008 was recorded by the Livestock Market Information Center (2009). All grain markets used in the study were individually missing less than nine percent of their total weekly corn price observations.

[2] Overall, grain markets in these four states were missing 5% of their observations.

[3] Pendell and Schroeder (2006) followed a similar procedure to create missing observations for their cointegration analysis regarding the fed cattle market.

Methods

To determine if increased ethanol production has affected spatial corn price relationships at different grain markets in the Midwestern United States, the first item this analysis investigates is whether corn prices were cointegrated (operating in a stable, long-run equilibrium) from 1998 through 2008. When conducting multivariate cointegration tests one must first determine if the individual corn price series are nonstationary and integrated to the same order (Pendell and Schroeder 2006). To test if the individual corn price series were nonstationary, the Augmented Dickey-Fuller (ADF) unit root test was used. The ADF test utilizes the following OLS regression:

$$1) \qquad \Delta y_t = \alpha + \rho y_{t-1} + \Sigma_{i=1}^{j} \theta \Delta y_{t-i} + \epsilon_t,$$

where y is the particular corn price series, Δ indicates the first difference operator, and j is the lag length that ensures the residual ϵ_t is white noise. The Akaike Information Criteria (AIC) was used to determined proper lag length. The corresponding ADF test statistic is defined as ρ divided by its standard error. Table 3 reports the ADF test results for the corn price series used in our study. The AIC lag lengths that were used in the tests also appear on Table 3.

Table 3. ADF Test Results

Grain Market	Price Series (Levels) Test Statistic	Lag Length	Price Series (First-Differenced) Test Statistic	Lag Length
Blissfield, MI	1.755	2	-7.948*	4
Lake Odessa, MI	1.674	3	-7.851*	4
Marlette, MI	1.199	4	-8.066*	4
Middleton, MI	1.113	4	-7.771*	4
Chapman, KS	2.756	3	-7.747*	4
Hillsboro, KS	1.187	4	-8.462*	4
Larned, KS	1.776	1	-22.561*	0
Osborne, KS	1.578	3	-8.396*	4
Algona, IA	1.023	4	-7.535*	4
Audubon, IA	1.835	4	-7.371*	4
Cedar Rapids, IA	1.242	4	-9.63*	3
Chariton, IA	1.773	1	-8.243*	4
Columbus, IN	1.694	2	-8.816*	4
Delphi, IN	1.663	2	-8.531*	4
Greensburg, IN	0.752	4	-9.422*	3
Hamlet, IN	1.368	4	-7.648*	4

* Indicates rejection of the null hypothesis at 1% significance

As illustrated by Table 3, the null hypothesis that the corn price series contains a unit root was not rejected, implying that the individual corn price series were all nonstationary. Therefore, the next step in this analysis is to determine whether the first differenced corn price series are stationary. After first differencing the corn price series, all of the test statistics were significant at the 1% level. Thus, the null hypothesis that the series contains a unit root was rejected, implying that the

first differencing of the individual price series was stationary. Together these results suggest each corn price series was integrated of order one [I(1)] and a multivariate cointegration analysis could be conducted.

Multivariate cointegration theory following Johansen and Juselius (1990) was used for determining whether the corn prices were cointegrated from 1998-2008. This methodology involves estimating the following vector autoregressive model:

$$\Delta Y_t = \sum_{i=1}^{k-1} \tau_{0i} \Delta Y_{t-i} + v_{0t}$$

2)

$$Y_{t-k} = \sum_{i=1}^{k-1} \tau_{1i} \Delta Y_{t-i} + v_{1t}$$

where Y represents a matrix of each of the corn price series (y) which were studied within Michigan, Kansas, Iowa and Indiana. There are two test statistics used to test the null hypothesis that there are at most r cointegrating vectors in the system Y_t. The following equations represent the maximal eigenvalue test statistic and the trace test statistic:

$$\tau_{MAX} = -T \ln (1 - \lambda_{r+1})$$

3)

$$\tau_{TRACE} = -T \sum_{i=r+1}^{t} \ln (1 - \lambda_i)$$

where T represents the total number of observations in the price series and $\lambda_{r+1}, \ldots, \lambda_p$ represents the p-r smallest possible correlations of residual v_{0t} with respect to residual v_{1t}.

Results

Cointegration from 1998-2008

Table 4 displays the results from the multivariate cointegration procedure. Corn price series from grain markets in Michigan, Kansas, Indiana and Iowa were analyzed. Referring to table 2, four grain markets' corn price series were analyzed in each state. In addition to the states that were analyzed, a Midwestern United States model was also subjected to cointegration testing to determine if corn prices throughout the Midwestern United States were cointegrated from 1998 through 2008. The Midwestern United States model investigates the cointegration of corn prices at four grain markets, one grain market from each of the above investigated states. The grain markets in Marlette, MI; Hillsboro, KS; Chariton, IA; and Greensburg, IN were chosen for the Midwestern United States model. To determine if the corn price series at the grain markets in Michigan, Kansas, Indiana, Iowa and the Midwestern United States were cointegrated, both maximum likelihood cointegration statistics and trace cointegration test statistics were obtained. Because four markets were used in the cointegration analysis, up to three independent cointegrating vectors may exist. Table 4 illustrates the results of Michigan, Kansas, Indiana, Iowa

and Midwestern United States multivariate cointegration testing. Lag lengths were selected at the amount where Akaike's Final Prediction Error (FPE) was minimized.

Table 4. State/Region Specific Grain Markets Multivariate Cointegration Testing Results

Null Hypothesis	Alternative Hypothesis	Michigan Test Stat	Kansas Test Stat	Iowa Test Stat	Indiana Test Stat	Midwest Test Stat	5% Critical Value
Trace Test							
Ho: r=0	H1: r>0	157.36*	121.75*	142.45*	206.22*	106.43*	47.21
Ho: r=1	H1: r>1	82.55*	58.06*	74.75*	121.48*	55.25*	29.38
Ho: r=2	H1: r>2	27.49*	23.50*	32.67*	42.57*	19.87*	15.34
Ho: r=3	H1: r>3	2.21	3.68	1.36	1.60	1.05	3.84
Max Test							
Ho: r=0	H1: r=1	74.81*	63.69*	67.70*	84.74*	51.17*	27.07
Ho: r=1	H1: r=2	55.06*	34.56*	42.08*	78.90*	35.39*	20.97
Ho: r=2	H1: r=3	25.27*	19.82*	31.32*	40.97*	18.82*	14.07
Ho: r=3	H1: r=4	2.21	3.68	1.36	1.60	1.05	3.76

*Indicates rejection of the null hypothesis at 5% significance

Table 4 displays three cointegrating vectors for the five corn price series using both the maximal eigenvalue test statistic and the trace test statistic for the corn price series at grain markets in Michigan, Kansas, Iowa, Indiana and the Midwestern United States. Thus, there was a long-run, or equilibrium, price relationship found between the corn price series at the different grain markets evaluated in Michigan, Kansas, Iowa, Indiana and the Midwestern United States. Therefore, from 1998 to 2008 in Michigan, the corn prices series from grain markets in Blissfield, Lake Odessa, Marlette and Middleton were cointegrated; in Kansas the corn price series at Chapman, Hillsboro, Larned and Osborne were cointegrated; in Iowa the corn price series at Algona, Audubon, Cedar Rapids and Chariton were cointegrated; in Indiana the corn price series at Columbus, Delphi, Greensburg and Hamlet were cointegrated and in the Midwestern United States grain markets at Marlette, MI; Hillsboro, KS; Chariton, IA; and Greensburg, IN were cointegrated.

The Effect of Increased Ethanol Production on Cointegration

This section of analysis examines if increases in ethanol production affected spatial corn price relationships at grain markets in the Midwestern United States. To accomplish this, methodology will follow Brester and Goodwin (1993). Brester and Goodwin determined if the increased consolidation of the wheat industry into only four major firms impacted the competitiveness of the wheat market. The four-firm concentration ratio in the United States wheat milling industry increased from 37% to 66% from 1980 to 1991. To determine if this impacted wheat price relationships, they first estimated annual cointegration statistics from wheat markets that represented different regions of the United States. The annual cointegration test statistics can be thought of as a measure of the degree of cointegration over time. A larger statistic indicates a strong degree of cointegration (Goodwin and Schroeder 1991; Brester and Goodwin 1993; Schroeder 1997). For years 1980 through 1991, they estimated the annual cointegration statistics of the Kansas City, Houston, Omaha and Portland wheat price series in addition to the Kansas

City wheat middlings and flour price series. Next, Brester and Goodwin regressed their annual cointegration test statistics on the four-firm concentration ratio of the United States wheat milling industry to determine if the increased four-firm concentration ratio in the United States wheat milling industry affected the annual cointegration of wheat prices at different wheat markets. Brester and Goodwin found that the four-firm concentration ratio was negatively correlated and weakly related to the degree of annual cointegration between wheat prices and Kansas City wheat middlings and flour price series. Therefore, Brester and Goodwin concluded that the four-firm concentration ratio negatively (although weakly) did affect the cointegration of wheat, flour and wheat milling prices.

Similarly, this analysis will determine if increased ethanol production affected the cointegration of corn prices a different grain markets in the Midwestern United States. Specifically, this study will determine if increased local demand for corn and increased market information regarding the corn market caused an increase in the degree of cointegration between corn prices at different grain markets in the Midwestern United States. To accomplish this, this study first estimates the annual degree of cointegration statistics between corn prices at the previously studied grain markets within the previously studied states. Table 5 displays the annual cointegration maximal eigenvalue test statistics. The proper lag lengths were determined by the minimum value of the FPE but are excluded to save space. The annual test statistics for the null hypothesis r=3 have also been excluded from Table 5 to save space. The annual cointegration trace statistics for the studied grain markets were recorded but also excluded from table 5 to save space.

Following Brester and Goodwin, the maximal eigenvalue test statistics for the years 1998 through 2008 were then regressed on the percentage of each state's corn production which was used in the production of ethanol. To run this regression, an ordinary least squares approach would not be sufficient because our regression contains a non normal distribution. A non normal distribution results because the dependent variable in this model is the maximal eigenvalue test statistics. Therefore, Efron's bootstrapping technique was used to solve the problem of a nonnormal distribution. Brester and Goodwin also utilized Efron's bootstrapping technique in their analysis. Efron's bootstrapping technique regurgitates a given sample over and over again and then obtains the sampling distributions of the parameters of interest to fix the problem of non normal distribution (Gujarati and Porter 2009).

Using Efron's bootstrapping technique with 1,000 replications, the result of regressing the annual cointegration maximal eigenvalue test statistics (MAXE) obtained in Michigan, Kansas, Iowa, Indiana and the Midwestern United States on percent of corn used in the production of ethanol (PCE) in these states and region is found in table 6. Also found in table 6 is whether the increase in the number of ethanol plants (EP) in Michigan, Kansas, Iowa, Indiana and the Midwestern United States altered the annual degree of cointegration of corn prices in these states and region[4]. This was determined by using Efron's bootstrapping technique with 1,000 replications to regress the annual cointegration maximal eigenvalue test statistics (MAXE) for Michigan, Kansas, Iowa, Indiana and the Midwestern United States on the number of ethanol plants (EP) in these states and region.

[4] For the Midwestern United States model, the percentage of corn used in the production of ethanol is equal to this combined percentage for states Michigan, Kansas, Iowa and Indiana. Similarly, the number of ethanol plants in the Midwestern United States model is equal to the number of ethanol plants in Michigan, Kansas, Iowa and Indiana.

Table 5. State/Region Specific Grain Markets Annual Cointegration Tests

		Maximal Eigenvalue Test Statistic					
Time Period	Null Hyp. Ho:	Michigan	Kansas	Iowa	Indiana	Midwest	5% Critical Value
Sept.	r=0	26.78	19.59	25.68	27.73*	49.11*	27.07
1998-1999	r=1	17.77	10.84	16.70	11.79	15.51	20.97
	r=2	6.57	8.14	12.66	6.95	9.37	14.07
1999-2000	r=0	34.29*	34.02*	56.25*	35.96*	23.65	27.07
	r=1	19.32	19.96	25.38*	29.14*	12.58	20.97
	r=2	16.22	12.48	9.90	6.23	5.76	14.07
2000-2001	r=0	75.55*	35.85*	41.41*	32.29*	31.72*	27.07
	r=1	13.47	17.13	25.80*	26.22*	14.79	20.97
	r=2	11.28	15.05	16.19	9.74	11.58	14.07
2001-2002	r=0	30.12*	32.49*	91.75*	42.87*	25.25	27.07
	r=1	21.54*	21.93	33.73*	26.63*	18.36	20.97
	r=2	5.28	18.88	20.73*	5.29	10.51	14.07
2002-2003	r=0	51.14*	42.68*	34.41*	52.87*	26.17	27.07
	r=1	37.35*	20.69	21.59*	16.76	19.26	20.97
	r=2	25.42	1.70	15.87*	5.81	3.16	14.07
2003-2004	r=0	22.02	54.49*	24.58	69.66*	30.9*	27.07
	r=1	11.50	25.05*	12.52	15.10	10.7	20.97
	r=2	4.64	12.77	7.43	9.07	8.53	14.07
2004-2005	r=0	25.20	51.31*	22.47	15.97	31.24*	27.07
	r=1	10.69	28.2*	12.15	14.94	8.17	20.97
	r=2	9.36	19.47*	8.42	5.83	4.76	14.07
2005-2006	r=0	64.51*	31.52*	49.46*	22.38	51.75*	27.07
	r=1	30.35*	18.43	26.32*	11.83	29.92*	20.97
	r=2	12.28	7.94	8.73	6.17	17.19*	14.07
2006-2007	r=0	32.49*	34.30*	36.36*	30.48*	21.98	27.07
	r=1	11.08	18.21	15.12	19.77	16.70	20.97
	r=2	8.13	9.91	9.07	8.88	4.59	14.07
2007-2008	r=0	24.63	29.08*	19.94	72.97*	22.01	27.07
	r=1	19.69	25.94*	10.59	25.77*	11.27	20.97
	r=2	7.82	5.69	7.09	10.03	5.74	14.07
2008-	r=0	22.74	93.42*	45.63*	28.82*	56.40*	27.07
June 2008	r=1	14.46	35.24*	14.15	17.31	14.95	20.97
	r=2	9.29	15.06*	6.25	10.79	11.57	14.07

*Indicates rejection of the null hypothesis at 5% significance

Table 6. Efron's Bootstrapping Results

	Michigan	Kansas	Iowa	Indiana	Midwest
CE intercept	43.10*	28.67*	47.29*	38.37	26.54*
PCE coefficient	-57.81	96.74	-28.35	10.51	61.81
R-squared	0.1515	0.3391	0.0273	0.0032	0.1100
EP intercept	42.93*	20.36	46.87*	38.44	25.53*
EP coefficient	-3.69	3.45	-0.43	0.51	0.93
R-squared	0.1499	0.3399	0.0568	0.0113	0.0800

* Indicates significance at the five percent level

As evidenced by Table 6, the Michigan, Kansas, Indiana, Iowa and Midwestern United States percentage of corn used in the production of ethanol is not significantly different from zero and several models had a poor R^2. Therefore, the percentage of corn production used in the production of ethanol in Michigan, Kansas, Iowa, Indiana and the Midwestern United States is not significantly correlated with the annual cointegration maximal eigenvalue test statistic. This process was also performed by using Efron's bootstrapping technique with 1,000 replications to regress the annual trace test statistics on the percent of corn production used in the production of ethanol in the studied states and region. Similar to the previous regression, the percentage of corn used in the production of ethanol in the studied states and region was not significantly different from zero. Therefore, the increase in the percent of corn used in the production of ethanol has not had any effect on corn price relationships at grain markets in Michigan, Kansas, Iowa, Indiana and the Midwestern United States.

Also evidenced by table 6, the coefficient for the number of ethanol plants in Michigan, Kansas, Iowa, Indiana and the Midwestern United States is not significantly different from zero and several models again had weak in-sample fits. Therefore, the number of ethanol plants in the studied states and region is not significantly correlated with the annual cointegration maximal eigenvalue test statistic[5]. Therefore, the increase in the number of ethanol plants in the studied states and region has not had any impact on corn price relationships at the evaluated markets.

Summary

From 1998 through 2008, corn prices at grain markets in Michigan, Kansas, Indiana, Iowa and the Midwestern United States were cointegrated. Therefore, from 1998 through 2008 corn prices in these states and region operated in a stable, long-run equilibrium. As a result of government policy, ethanol production rapidly increased from 1998 through 2008 which could have impacted corn price relationships. The expansion of the ethanol industry over this time period created increased demand for corn and increased the flow of information regarding corn prices. Several studies have examined how increased competition in an industry and increased information about a market can strengthen market price relationships and thus strengthen cointegration between

[5] When the annual trace test statistics were regressed with the number of ethanol plants in the studied states and region using Efron's bootstrapping technique with 1,000 replications the results indicated that the coefficients for the number of ethanol plants in the studied states and region also were not significantly different from zero.

markets (e.g. Goodwin and Schroeder 1991; Brester and Goodwin 1993; Schroeder 1997; Pendell and Schroeder 2006; Harri et al. 2010). However, following Brester and Goodwin (1993) methodology, this analysis was unable to conclude that increased ethanol production from 1998 through 2008 had an effect on corn price relationships at grain markets in the Midwestern United States.

If grain market's corn price series are cointegrated, this has no implication on corn price levels. Instead, if corn prices at different grain markets are cointegrated, it is only concluded that there is a long-term price relationship found between the corn price series at different grain markets. Additionally, if corn price series at the different grain markets are cointegrated, the corn price series relationships may deviate from their equilibrium price relationship, but this deviation is temporary because there are economic forces that drive the relationship between corn price series at different grain markets back toward their long-term equilibrium price relationship.

Despite the fact this analysis only used a subset of grain markets from each state, the grain markets that were analyzed are a good indication of corn price relationships at all the grain markets located throughout Michigan, Kansas, Indiana and Iowa. Therefore, the findings of this study have many implications. Despite increases in ethanol production, spatial price relationships at grain markets in Michigan, Kansas, Indiana, Iowa and the Midwestern United States have not changed. Therefore, from 1998 through 2008, farmers and commodity traders who utilized knowledge regarding the relationships between corn prices at different grain markets in order to make managerial decisions (e.g. initiating hedging positions or timing of sales) were correct if they assumed the relationships between corn prices at different grain markets remained the same. The result of this study is also important for policy makers. This study provides evidence to policy makers that government policy that increased ethanol production did not alter corn price relationships (again, not to be confused with altering corn price levels). Corn price relationships at grain markets in Michigan, Kansas, Iowa and Indiana are the same as they were before the policy driven expansion of the ethanol industry.

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Financing Chain Associations

Industry Speaks

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Abstract

Fundecitrus, an industry association in Brazil which serves as a consortium of orange juice related industries and producers recently created a new contribution model for its organization. The model was developed based upon four pillars: (1) Benchmarking with other associations, both national and international companies. (2) Interaction with the chain community, through questionnaires, a consulting panel and workshops. (3) Formulating a collection model that was more equitable to the participating stakeholders. (4) A management and control system plan for implementing the project. The model was developed by working closely with the Fundecitrus Management Board. This research will be relevant to managers of other trade associations who are interested in restructuring their own contribution model by utilizing a process which can be replicated.

Keywords: industry associations, contribution systems, citriculture, Fundercitus

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Introduction

The Brazilian citriculture industry has an exemplary past. From the beginning it has generated more than $60 billion for Brazil and has provided worldwide leadership in marketshare, innovations, logistics and positioning. Maintenance of the Brazilian citriculture industry is of the utmost economic importance. Brazil grows 20% of all oranges produced worldwide and accounts for 85% of commercialized orange juice internationally. Most of the oranges grown in Brazil (98%) are exported. Brazilian citrus is primarily exported to: Europe (70%), North America (13%), Asia (13%) and others (4%). This productive chain generates around $1.5 to 2 billion per year for Brazil. Citriculture is one of the major activities in Brazilian agribusiness, impacting nearly 400 cities in the state of São Paulo, creating about 200,000 direct and indirect jobs, including temporary employment during the harvest phase that is characterized by manual picking in Brazil.

Country	Grapefruit	Lemons and limes	Oranges	Tangerines, etc.	Other	Total
Brazil	72,000	1,060,000	18,279,309	1,271,000	-	20,682,309
China	547,000	745,100	2,865,000	14,152,000	1,308,000	19,617,100
United States	1,580,000	722,000	7,357,000	328,000	30,000	10,017,000
Mexico	390,000	1,880,000	4,160,000	355,000	66,000	6,851,000
India	178,000	2,060,000	3,900,000	-	148,000	6,286,000
Spain	35,000	880,000	2,691,400	2,080,700	16,500	5,703,600
Iran	54,000	615,000	2,300,000	702,000	68,000	3,739,000
Italy	7,000	546,584	2,293,466	702,732	30,000	3,579,782
Nigeria	-	-	-	-	3,325,000	3,325,000
Turkey	181,923	706,652	1,472,454	738,786	2,599	3,102,414
World	**5,061,023**	**13,032,388**	**63,906,064**	**26,513,986**	**7,137,084**	**115,650,545**

Figure 1. Top ten total Citrus Fruit Producers for 2007[1]
Source: Food And Agricultural Organization of United Nations: Economic And Social Department
*World's top producer in each category is highlighted in gray.

In recent years, one of the biggest threats to the Brazilian citriculture is the increase in number of plant diseases that attack the groves. Such problems, besides making production onerous and dependent on high technology controls, reduce productivity and cause irreversible damages through tree eradication.

Periodic inspection of groves is essential to early disease detection and prevention.
The São Paulo state government was responsible for providing this service. However, limited financial and structural resources within the Brazilian government jeopardized quality monitoring. In order to support citriculture and adequately address these challenges, orange juice indus-

tries and producers joined forces in 1977 to create Fundecitrus—Fund for Citrus Plant Protection. In the 1990's, the organization developed a research partnership with both Brazilian and international institutions and universities. Since its founding, Fundecitrus has become one of the most respected organizations in the world for vocation and innovation in tracking diseases, as well as for generating and disseminating new technology.

In 2009 this non-governmental organization was re-structured into three areas:

1. Technical—responsible for inspection and producer training. They employ approximately 2,000 assistants and more than 100 coordinators, distributed through 54 regional offices.
2. Scientific—conducts and finances scientific research with about 15 researchers.
3. Communication— provides a communication channel for the producers through an informative bi-monthly magazine and manages the institution's web site.

An operating budget of nearly $20 million annually is funded through assessments from producers' and the orange juice industry. Contributions are calculated on a base collection of $ 0.08 for each orange box (40.8 kg) delivered from producers to the orange juice industries. The revenue from each box of oranges delivered from the producer to the orange juice factories, are divided between producers and factories equally.

Meanwhile, the collection model for contributions was modified in 2008 by a new statute. The new model proposed a different way to calculate the assessment, by switching from a per box charge to the number of citrus trees—per property of each associate. This modification enabled for the inclusion of citrus producers who deliver fresh consumption products to markets.

The new model would generate additional revenue from the factories producing juice, machines utilized in juice production, inputs and others. The new model provides a wider collection range by including citrus producers whose products are destined for the fresh market and adding some additional links into the production chain. However, this new inclusion model created a new set of questions and challenges for the Fundecitrus management board:

- How to assess the inventory of the citrus groves?
- What operational procedures are needed to implement this new collection?
- Is this the right time to modify the contribution model or is it still too early, based on the information that the organization received from the associates?
- How do we get other links within the production chain to contribute to Fundecitrus?
- How do we strengthen our credibility and support for the proposal?
- How can we motivate other agents to contribute to Fundecitrus?

One of the biggest factors effecting the development of group actions in Brazil is resources and leadership. The majority of non-members simply are not interested in becoming members. These factors impede any significant change.

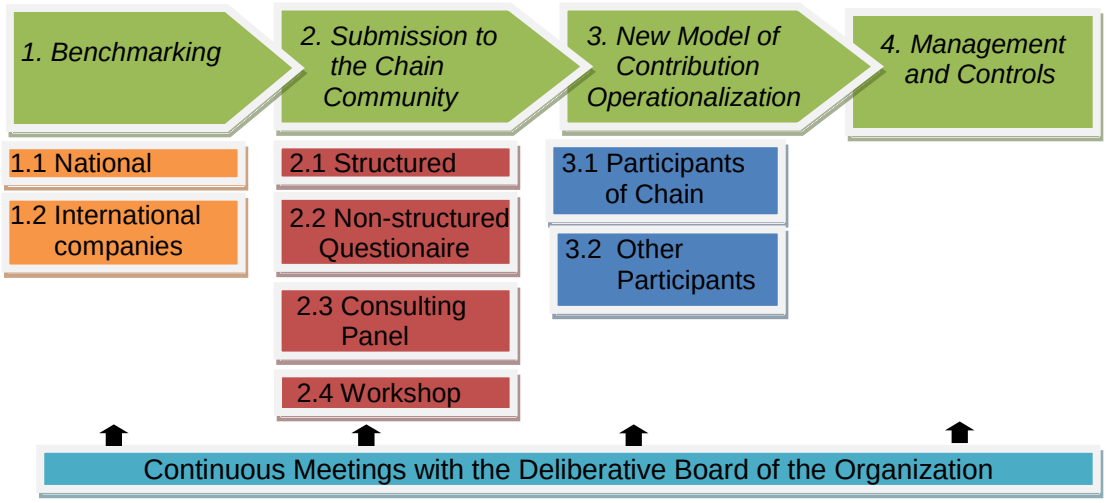
Organizations that want to prosper must respond quickly to the challenges posed by political, economic, technological, social and environmental regulations. Non-mandatory industrial organizations may experience difficulties in financing, mainly in times of economic crisis. Because there is no guarantee of economic stability today, it may be necessary to rethink models of contribution. Whether an organization is linked to the citrus industry in Brazil, the dairy industry in Australia, or coffee industry in Colombia, it is important to know how other contribution systems are organized in order to gain new ideas and solutions on how to best operationalize it within another organization. This type of information extraction can be accomplished through a tool called benchmarking.

This paper discusses the challenge of creating a new revenue stream for industry associations and examines the process that one non-governmental organization went through when it decided to change its contribution system. This research can serve as a resource and model for others chain organizations facing similar issues.

Benchmarking

In order to answer the posed questions, a model was developed based upon four pillars: (1) Benchmarking with other associations—both national and international companies. (2) Interaction with the chain community, through questionnaires, a consulting panel and workshops. (3) The formulation a contribution model that is more equitable to the participating stakeholders. (4) A management and control system for the new method. It is important to emphasize that each of these steps were developed through continuous meetings with the management board of the organization. This method is synthesized in Figure 2.

The benchmarking method was applied to fifteen organizations, seven domestic companies and eight abroad. Each representied different production chains and services. Apart from separating compulsory and non-compulsory contributions, the study attempted to answer three main questions:



Steps	Details
1. Benchmarking	To understand the contribution method of the system that is being studied. To search contribution models of national and international industry organizations to learn their core objectives, value proposition for its their membership, ways of coordinating the contribution system, frequency of collection and how their database renewal works
2. Submission to the Chain Community	This is the central issue of the methodology. It should be conducted interviews with all actors in the productive chaining using structured and unstructured questionnaires, consulting panel and workshops aimed at increasing the degree of stakeholder involvement across the chain.
3. New Model of Contribution Operationalization	Define the contributions to the private sector, based on their participation and reliance on agro-industrial system and what are the resources coming from source public funding. Set to make this charge.
4. Management of Control	The results obtained with the global goals of the productive chain should be measured, preferably with quantitative criteria (increase in consumption, production, employment, bank profit, etc.) and widely disseminated to all members.

Figure 2. The Method for Industry Association's Contribution.
Source: Neves, Gomes and Trombin, 2010.

1. What is the base collection system used by these organizations? What is the collection criterion used (e.g. based on plant, area, processed volume, fiscal discount)?
2. How is the resource collection carried out (for example: Are bills sent via a bank? Are discounts given on payments for raw materials? Are taxes collected)?
3. How is the database of contributing members managed and how is data updated?

Results

Notice that from the 15 organizations polled in the benchmarking sample, seven receive income from compulsory contributions, as shown in Table 1 (Appendix). The international organizations: IDFA, Dairy Australia and the Florida Department of Citrus, all received contributions based on processed volume. Dairy Australia, apart from charges based on processed volume, receives financial AID from the American government to supplement its income.

IDFA is an interesting case. In addition to collecting charges from producers and industry based on the volume of processed milk, IDFA finds additional ways to collect revenue from stakeholders through a charge based on turnover from all agents within the chain; all companies supplying ingredients, equipment, and packaging according to the gross turnover of sales related to the dairy industry.

It was noted that all the compulsory organizations use a database renewal system that uses a self-reporting system supplied from contributing members—a process which is not costly to implement. The collection mechanism for non-compulsory contributions, are completed mostly through billings sent by banks. Another fact that draws attention is that most organizations have

a more onerous database renewal system, including constant visits to property and/or use of GPS and satellite.

Table 2 (Appendix) shows organizations whose contributions are not compulsory. Among the cases worth highlighting is BSCA (Brazil Specialty Coffee Association), who not only collects a charge based on planted area, but also has other methods of collection based on exported volume, nominal collection (different charges for each member category), a charge for production certification and a charge for the stamp.

Industrial organizations that involve all links in the production chain tend to generate a stronger contribution system and organization. This paper provides examples of how an organization could restructure its contribution model to involve more participants in the supply chain. The objective of this case study is to serve as an example for other industry associations to see how this association has proposed the contribution to different links in the supply chain.

Under the current contribution model, Fundecitrus's income is basically composed of contributions coming from citriculturists, orange juice industries, punctual deposits made by the State and Federal Government, and other resources that Fundecitrus obtains in Brazil and abroad.

In the new stature, resources for Fundecitrus will consist of contributions and donations from: (1) citriculturists; (2) nurserists; (3) manufacturers of components used in citriculture; (4) fruit processing companies (packing houses); (5) income generating and contractual services such as the government (MAPA and Agriculture Department of São Paulo State); (6) subventions and donations from individuals, private corporations and other sources.

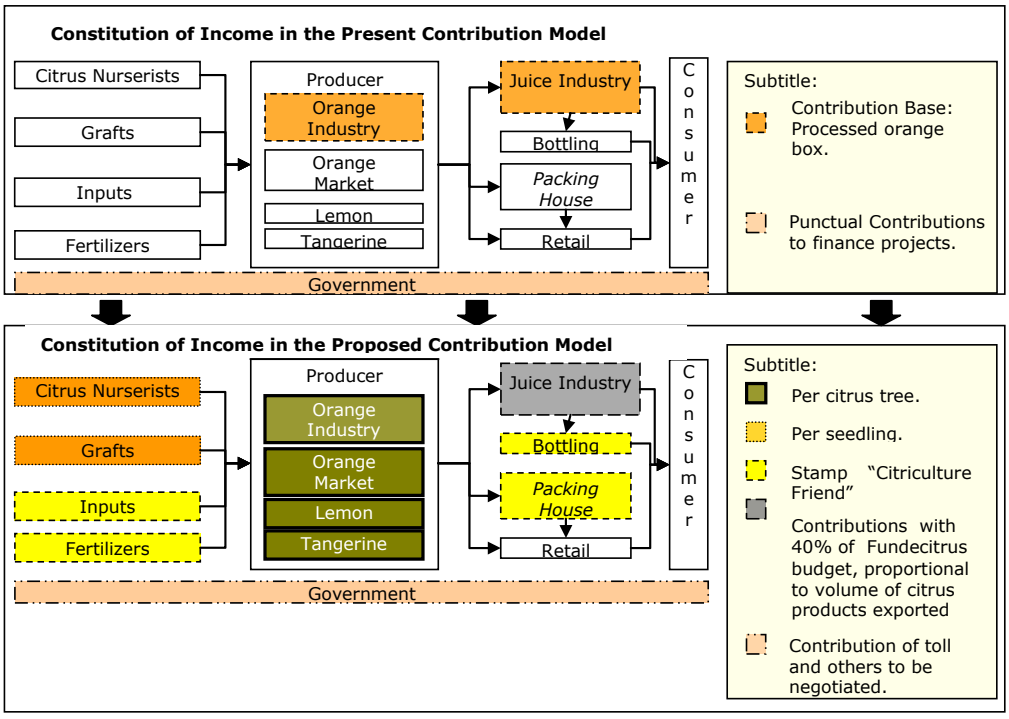


Figure 2. Fundecitrus income constitution by links of the production chain.
Source: Neves, Gomes and Trombin, 2007.

Figure 2 shows the origin of contribution in the present model and the model proposed by the new statute. The new model broadens the contribution base, including growers of fruit for "in natura" consumption, besides including other sectors of the citrus production chain.

Restructuring the contribution model so that revenues are calculated by trees rather than boxes creates new opportunities and challenges. The benefits are:

- Higher coverage, since all citrus groves would now be covered in the new calculation rather than only saleable citrus. This creates a more equitable revenue stream for Fundecitrus. Inspection costs account for the largest part of their budget, which is already based on trees rather than boxes. Therefore, they will now be able to charge for this service using the same cost generating unit.

- The new calculation model will increase productivity. The more productive the citriculturist (box/tree), the lower the amount paid per box. For example, a citriculturist, who produces on average three boxes per tree, pays $ 0.04 per box. If we consider a unit cost based on average of $ 0.076 per tree, this citriculturist will pay approximately $ 0.025 per box.

- Greater citriculturist involvement and participation in the association. Since the trees belong to the citriculturists and the new contribution model is based upon the number of trees, a greater representativeness will occur with Fundecitrus. As a more complex inventory system of citrus groves become cataloged, there are will also be opportunities to collect additional data such as tree varieties and age. These will create valued added services that encourage citiculturist to become more engaged in the strategic decision-making and planning.

- Producers know in advance how much they will have to pay, regardless of their production. The cost will be fixed and it won't be variable.

However, a big concern among associations and trade unions, which also must be considered is that citriculturists face a serious situation in terms of economic sustainability due to older groves that are in more advanced stages of diseases and consequently less productive. These will have an impact on budgets and are a hindrance to expanding groves and operations. Due to this challenge, this report aims to suggest possible solutions divided into 8 sub-items: (1) citrus producers, (2) citrus nurserists, (3) inputs manufacturers, (4) processing companies or packing houses, (5) the Orange Juice industry, (6) bottling companies, (7) government, (8) service supply.

Management and Control

Alternatives were discussed on how to best operationalize the new model in a short-time period. A set of alternatives were named *Short-Term Solutions*. In addition to the proposal, this work also suggests more elaborate measures that could be implemented after the first two years of the implementation, that should occurs in the following two years.

The proposal is explained in detail, following the order of citriculture dependence and importance in relation to the volume of contributions. Table 3 shows all the solutions proposed and summarized, per agent involved in the chain, for short and long-term implementation.

Table 3. Solutions for deployment for short and long-term

Item	**Short-Term Solutions (2 first years)**	**Purpose from the third year ahead, but that must be developed immediately**
Citrus Grower Contribution	Maintenance of the actual model for more two harvests. Conquest groups and producers that do not contribute to re-contribute To star immediately the procedures to operationalize the 3rd year purpose. Research of the number of citric trees owned by the citrus growers, through declaratory act or with the government help to use National System of Rural Register (NSRR) or the Rural Territorial Tax (RTT). Use Geo-referencing System	Contribution of US$ 0.076 per citric tree. This value equates to the current contribution of US$ 0.04 per box, considering the historical average yield of 1.9 boxes / tree. The purpose from the 3 year ahead can be anticipated when Fundecitrus has the correct data for the groves age. Contributions vary according to the tree age. ▪ New Tree = US$ 0.03 ▪ Grown Tree = US$ 0.076 Another option is: ▪ New Tree = US$ 0.00 (zero). ▪ Grown Tree = U$ 0.089
Orange Juice Industry Contribution	50% of the Fundecitrus budget (US$ 19.5 million in 2007/08) will be divided proportionately between industries in accordance with the market share of each one, based on SECEX data joined.	Gradual decrease of the industry participation in the Fundecitrus budget, with the average between 30 to 40%.
Citrus Nurseries Contribution	Contribution of US$ 0.01 per commercialized stem.	Include the contribution of graft-stocks, with proportional value for the stem based on the production cost.
Inputs Suppliers Contribution	Contribution of 0.5% of gross revenue of the company with the citrus industry. However, the company can use in their communications materials for a trademark such as "Friend of Citriculture," which will certify that the company contributes to the citrus tree protection. Agreement of Fundecitrus with industry associations or companies.	Check whether the contribution of 0.5% may increase depending on the trademark recovery and recognition by the citrus growers.
Packing Houses Contribution	Contribution of 0.5% of the company gross with citrus. On the other hand, authorization to use the trademark "Friend of Citriculture”.	Join the MAP to link the CFO emission only for products grown or derived from citrus groves that have a Fundecitrus certificate of inspection.
Packaging Companies Contribution	Individual negotiations with the packaging companies. It is also recommended 0.5% of benefits with citrus to use the Fundecitrus trademark.	See how this contribution can increase according to the time, if there is the trademark possibility and acceptance are big.
Government Contribution	Negotiate 50% of taxes collected in tolls created from the handling of citrus products to be transferred to the tree defense and a supplementary budget for special projects through FAPESP, Department of Agriculture and other state and federal organizations.	ICMS credit recovery and other forms.

Source: Neves, Gomes and Trombin, 2010.

Managerial Implications and Discussion

The purpose of this paper was to show how industrial organizations can expand their current contribution method to include a wider distribution network by including other links in a productive chain. To achieve this goal, a case study approach was developed which identified critical factors important to the success contribution system planning process. The factors identified were: (1) to utilize communication mechanisms in order to educate and enhance awareness showing the importance of the association to all stakeholders, (2) to ensure transparency in the contribution collection, and to (3) hire an external audit to enhance credibility.

Although the method has been applied in the case study described in the paper, the new contribution model has not been effectively implemented yet, preventing a full statement about its effectiveness. This method can be utilized and adapted to any industry association; however it requires adjustments, depending on the specificity of the chain.

Appendix

Table 1. Benchmarking of organizations whose contributions are compulsory.

Organization	International Dairy Foods Association (IDFA)	Dairy Australia	Florida Citrus Departament	SENAI	SENAC	SEBRAE	CAFE DE COLOMBIA
Country	**USA**	**Australia**	**USA**	**Brazil**	**Brazil**	**Brazil**	**Colombia**
Main Objective	Represent the AGS of American milk	Represent the AGS Australian milk	Promote Florida's citrus products	Train workers for industry sector	Train professionals for commerce and services	Support the development of small enterprises	Foment Colombian coffee
Size	533 companies	9300 farms	Florida's Citrus Industrial Sector	28 industry sectors	All commerce and service sector	Brazilian commercial sector	380000 coffee producers
Collection of Contribution (Source of Income)	Producers: charge on processed volume Other Agents: % of the turnover	Charge on processed volume and Financial aid from the government for R&D	Charge on processed volume	1% on the industries pay rolls Companies with more than 500 employees pay 1% more	% on the commercial sector pay roll Own income from courses and training programs	% on the companies' pay roll	Difference between the price of coffee in foreign market and domestic market, collected by the fund FONC Issuing of Public Bonds
Collection System	Bill	Discount on delivery of raw material to the industry	Discount on delivery of raw material to the industry	Bill ▪ Security Note ▪ Federal Revenue Service	Bill	Through INSS	Collection of export price difference
Collection	Annually	Monthly	Weekly	Monthly	Monthly	Monthly	Monthly
Database renewal	Survey with Members	Survey with milk processors	Forms sent by the Industry	Companies Reports	Companies Reports	Companies Reports	Export Reports

Source: Surveys and interviews conducted by Markestrat, 2007.

Table 2. Benchmarking of organizations whose contributions are not compulsory.

Organization	Lactea Brasil	Agopa – Association of Cotton Producers in Goias State	Incentive Fund for Culture of Cotton in Goias State	Highlands Country Citrus Growers	Brazil Specialty Coffee Association	Fedelech - National Federation of Milk Producers	Florida Citrus Mutual	National Cattlesmen's Beef Association
Country	**Brazil**	**Brazil**	**Brazil**	**USA**	**Brazil**	**Chile**	**USA**	**USA**
Main Objective	Represent AGS of Brazilian milk	Represent cotton producers in São Paulo and Goiás State	Research and develop cotton cultivars and control pests and diseases	Represent citrus producers of the 3rd largest producing area in Florida	Promote Brazilian Premium Coffee abroad	Represent Milk producers in Chile	Defend interests of Florida's citriculturists	Promote American Beef
Size	1.000 members	77 producers	6.000 producers	Not informed	50 associates	80% of the country's milk	11.000 members	25.000 members
Collection Mechanism	Charge on turnover, in categories of associates	Charge on planted area	Fiscal Reduction ICMS	Charge on planted area	Charge on planted area and exported volume; nominal value in categories of associates	Charge on processed volume	Charge on processed volume	Charge on head traded Nominal value in categories of associates
Collection System	Bill	Bill	Bill	Bill	Bill	Discount on delivery of raw material	Discount on delivery of raw material	Bill
Collection	Monthly	Annually	Monthly	Annually	Monthly	Monthly	Monthly	Monthly
Database Renewal	None	GPS Mapping (annually)	Mapping, Official Invoice, collection document	Annual survey with producers	Certifier (annual visits)	Associations and industries Consults	Agriculture Department Consults	Not informed

Source: Surveys and interviews conducted by Markestrat, 2007.

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