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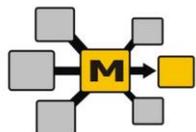


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EDITOR'S NOTE

Dear Readers,

As the leading international journal in agribusiness, this issue features articles representing five continents including seven research manuscripts and a great teaching case study from Australia.

We have three wonderful industry commentaries from McLaughlin et al. and Alltech (Ireland), Gustavo Grobocopatel of Los Grobo (Argentina), and Marcos Fava Neves from Markestat (Brazil). Let me first draw attention to the Alltech commentary. The authors let us peer into the thinking of a remarkable group called The Alltech Presidents Club, who recently met in Shanghai for an open exchange and debate on leadership issues. The commentary reflects the group's thinking about the development of the Chinese branded food market.

In the second Industry Commentary, Gustavo Grobocopatel tackles the sustainability issue from an interesting perspective. His thoughts provide a nice introduction to the IFAMR's next special issue, due out December 2012, focused on "*Managing Wicked Problems in Agribusiness: The Role of Multi-Stakeholder Engagement in Value Creation.*" These are managerial challenges that have to be addressed, and occupy large amounts of time and resources, but are not necessarily solvable. How firms comply with stakeholder expectations about sustainability, animal welfare, transgenic organisms, greenhouse gas emissions, and land use are examples of *wicked problems* facing the modern agribusiness manager. Be on the lookout for the "*Managing Wicked Problems in Agribusiness,*" edited by Domenico Dentoni, Brent Ross, and Otto Hospes.

Happy reading.

Peter Goldsmith, Executive Editor, IFAMR



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Food Store Density, Nutrition Education, Eating Habits and Obesity

Alessandro Bonanno^a and Stephan J. Goetz^b

^a*Assistant Professor of Agricultural Economics, Department of Agricultural Economics, Sociology and Education, The Pennsylvania State University, 207-D Armsby Building, University Park, Pennsylvania, 16802, USA*

^b*Director, The Northeast Regional Center for Rural Development, Professor of Agricultural and Regional Economics, The Pennsylvania State University, 207-C Armsby Building, University Park, Pennsylvania, 16802 USA*

Abstract

Food retailers and restaurants are under scrutiny for their alleged effects on diets and obesity, although no clear evidence of a causal relationship exists. Furthermore, because no prior study controls for nutrition education and the dynamic nature of the underlying phenomena, existing estimates quantifying these relationships could be biased. Using state-level data for the continental U.S. we evaluate how the density of different food stores and per-capita expenditures on SNAP (nutrition) Education impact eating habits and (indirectly) adult obesity, controlling for endogeneity of store locations and con-sumption dynamics. Our results caution against using large-scale policies regulating the food environment and highlight the need to control for nutrition education and process dynamics to obtain unbiased estimates. Implications for the agribusiness sector are discussed.

Keywords: food store density, fruits and vegetables consumption, adult obesity, nutrition education, endogeneity bias, omitted variables bias

[©]Corresponding author: Tel: +1.814.863.8633
Email: abonanno@psu.edu

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Introduction, Background, and Objectives

In 2007-2008, one third of the U.S. adult population was classified as obese (Flegal et al. 2010).¹ Obesity results from consuming excess calories relative to need,² and rising obesity rates are associated with reduced physical labor due to technological change; increased agricultural productivity and food availability; and lower food prices (Philipson and Posner 1999; Lakdawalla and Philipson 2002). Technological progress in food processing has also reduced assembly/preparation time for meals and increased the availability of calorie-dense foods (Cutler, Glaeser, and Shapiro 2003). As a result of these trends, the agribusiness sector as a whole is under scrutiny as it may be contributing to the worsening of consumer diets and the obesity epidemic. Given the large scale of this problem, public policy makers are seeking to mitigate its dimension (Kuchler, Tegene, and Harris 2005). The policy debate assessing what tools may be most effective to curtail the “obesity epidemic” has considered, *inter alia*, taxing high-calorie carbonated soft drinks (Todd and Zhen 2010), nutrition labeling (Arsenault 2010) and regulating food access—i.e., the types of food outlets to which consumers are exposed.³

As higher consumption of particular food categories (such as fruit, as in Lin and Morrison, 2002) is associated with lower body weight, the effect of food outlets on obesity is likely to be indirect, through diets: for example, if certain kinds of food outlets facilitate the consumption of fruits and vegetables, they may mitigate the growing obesity phenomenon. To date, however, research findings in this area are mixed. Rose and Richards (2004) found ease of supermarket access to be associated with increased daily consumption of fruits and vegetables among low-income individuals (SNAP recipients), while Cummins et al. (2005) found no significant changes associated with the entry of a large-scale food retailer. Some studies have looked at the direct impact of food outlets on obesity rates or related consequences. Morland, Diez Roux, and Wing (2006) consider different outlets simultaneously, finding a negative relationship between the presence of supermarkets, overweight and obesity, and the opposite for grocery and convenience stores. Chen, Florax, and Snyder (2009), using geo-referenced micro data from the Indianapolis urban area, found a negative relationship between the density of grocery stores and Body Mass Index (BMI). Courtemanche and Carden (2011) found that the opening of one Wal-Mart Supercenter (henceforth WMSC) per 100,000 residents leads to a 0.24 point increase in BMI and an increase of 2.3% in the likelihood of being obese. This suggests that the real income-increasing effect of lower prices may not translate into consumption of healthier foods.

Researchers have also examined the role of restaurants on diets, as meals consumed in these establishments are usually less healthy than homemade meals (Lin and Frazão 1997; Chou, Grossman, and Saffer 2004). In particular, fast food restaurants are associated with higher consumption of fat, sodium and soft drinks (Bowman and Vinyard 2004) and lower consumption of fruits and vegetables (Powell et al. 2007). Also, using different databases and

¹ The BMI or Body Mass Index is the ratio of an individual’s weight in Kilograms and height squared, in meters. The U.S. Center of Disease Control and Prevention (CDC) classifies the BMI of adults as: Underweight <18.5; Normal weight 18.5-24.9; Overweight: 25–29.9; Obese: >30. In 2007-08, 33.8% of adults were obese.

² For a discussion of the dynamics between energy stored, appetite, metabolism and the factors impacting these relationships, see Egger and Swinburn (1997).

³ See White (2007) for a detailed review of the literature on food access and obesity.

empirical approaches, previous studies have established positive relationships between restaurant density and adult BMI (Chou, Grossman, and Saffer 2004; Chen, Florax, and Snyder 2009) or obesity among children (Currie et al. 2009). In response, policymakers have proposed zoning laws in urban areas to limit fast-food access (the CDC has a “Zoning to encourage healthy eating” program), mandatory caloric labels on restaurant menus and other strategies, all with limited effectiveness.⁴

Given the strong advocacy in the public media (see the examples reported in Collins and Baker, 2009) for regulating food outlet locations (in particular fast food restaurants) one would expect the existing empirical evidence to show a clear causal relationship between food store location, diets and obesity, and to account for sources of potential bias in the estimated impacts. However, several important aspects have been disregarded in prior research.

In the first place, most prior studies (Courtemanche and Carden 2011), being one of the exceptions, have largely disregarded issues of causality, failing to account for confounding factors (*e.g.*, endogeneity of store location) which could bias the estimated effect of particular food outlets on diets (fruits and vegetables consumption) and/or obesity rates/BMI. Such a bias could be particularly marked in the case of fast-food restaurants, as they may locate in neighborhoods where consumers are more likely to engage in unhealthy food choices and eating behaviors.⁵ The existing evidence of causal effects from micro-level studies is mixed. Using number of highway exits at the county level as instruments for fast-food restaurant density, Dunn (2008) found that a 10% increase in fast-food restaurants increases BMI by 0.33 points. Using interstate highways in rural areas as instruments for restaurant density, Anderson and Matsa (2011) found no causal link between food consumption at fast-food and full service restaurants and obesity, indicating that consumers who eat more often at restaurants may offset calories by eating less on other occasions. Similar mixed findings emerge at the aggregate level: although a positive correlation exists between the presence of fast food restaurants and adult obesity at the state-level (Maddock 2004), serious doubt has been cast on whether the relationship is causal (Collins and Baker 2009).

Second, consumers’ nutrition knowledge can influence the relationship between food stores and eating habits or obesity. Evidence exists that nutrition education results in higher intakes of fruit and vegetables (see, *e.g.*, the results of nutrition interventions among older adults reported by Sahyoun, Pratt, and Anderson 2004) and that nutrition knowledge spills over across family members (in particular from mothers to preschool children, as shown by Variyam et al. 1999). Effective nutrition education could discourage consumers from patronizing fast food restaurants or increase patronage of fruit and vegetables stores as they seek healthier food products. The effect of nutrition education on the dietary choices of consumers patronizing larger stores is less clear; as these types of outlets offer access to a multitude of food items, some consumers may

⁴ In New York City, for example, Elbel et al. (2009) found that labels increase awareness of calories but do not alter food choices.

⁵ Areas with less-privileged individuals are characterized by limited access to “high quality” food stores (see for example Moore and Diez Roux, 2006; Powell et al. 2007), leading to poorer diets and higher obesity. Fast food outlets may locate disproportionately in low-income areas; to the extent that such areas contain more obese individuals, higher obesity rates may be a cause of fast food stores locating in a community, rather than a consequence.

still adopt unhealthy diets even in the presence of higher nutrition education expenditures, as they will be exposed to both healthy and unhealthy choices in the same store. Nonetheless, failure to control for the effect of nutrition knowledge or education on eating habits or obesity may result in omitted variables bias.

Finding variables that capture nutrition education is a challenge, as objective measures are needed in place of self-rated health knowledge measures which may be a weak determinant of consumption of fruits and vegetables (see for example Schroeter, House, and Lorence, 2009). Alternatively, one would need to capture a series of repeated controlled experiments or a large-scale nutrition education campaign. The USDA's Supplemental Nutritional Assistance Program-Nutrition Education (SNAP-Ed) is an example of the latter.⁶ SNAP-Ed seeks to improve diets of low-income individuals, it is implemented to varying degrees across states,⁷ and it has grown from \$6.61 mn in FY 1992 to over \$380 mn in FY 2010, providing variation in the implementation across time and space. At least one study (McGeary 2009) finds that increased federal SNAP-Ed outlays may help to mitigate adult obesity.

Last, as most studies linking food stores' presence, eating habits and obesity use cross sectional data, they cannot account for the dynamic aspects of the process generating eating habits and obesity. On average, consumers tend to prefer those foods they consume habitually (Mela 1999). This indicates that there is some persistence in eating habits over time, and that greater availability of certain foods may lead consumers to associate them with "the norm." Also, as energy-dense foods on average tend to be liked more than others (with taste rating higher than health and variety), habits involving the repeated consumption of these products are more likely to develop (Drewnowski and Specter 2004). Furthermore, as obesity can be an outcome of sustained energy imbalance over time (Egger and Swinburn 1997), current obesity levels are a function of present and past eating (and other) habits, as well as other features such as consumers' socio-demographic profiles and the food available to them. In sum, failure to account for the dynamic aspects of these relationships may result in model misspecifications and therefore in biased estimates.

The objective of this paper is to assess the existence of the biases discussed above and, more specifically, to: 1) analyze whether an aggregate, causal effect of the density of different food outlets on eating habits exists; 2) assess the indirect aggregate effect of food outlets on BMI via their impact on eating habits and; 3) determine whether investing in nutrition education could

⁶ The Expanded Food and Nutrition Education Program (EFNEP) by the National Institute of Food and Agriculture is another example of federally funded program aimed at improving diets and nutrition education levels of limited-resource individuals. EFNEP activities target adults or youth audiences and aim to inform and train the recipients in different aspects of nutrition, diets, food preparation, food sourcing and health; program participants are selected through referral programs using several channels including SNAP and WIC offices, churches, local business, etc. Program delivery uses peer educators and volunteers trained by county extension professional and a variety of delivery methods. Given the heterogeneity of implementation we opted for not using it as proxy for nutrition education.

⁷ The SNAP-Ed program is an optional program of nutrition education that State Agencies can deliver to SNAP recipients as part of their program operations. State agencies submit an annual SNAP-Ed plan to the Food and Nutrition System of the USDA (some States have multiyear plans), highlighting the budget and the proposed activities for the following year. Federal funds cover 50% of the program costs. The goal of SNAP-Ed is to increase the consumption of fruits and vegetables, whole grains, and fat-free or low-fat milk products, physical activity and to maintain a balanced caloric intake (USDA 2010).

substitute for regulation of food outlet locations in improving eating habits and obesity rates. We use state-level data for the Contiguous U.S. on the percent of adults eating at least five servings of fruit and vegetables daily as a proxy (albeit incomplete)⁸ for eating habits, and the share of adult population with BMI of 30 or above, as a measure of obesity rates. Food outlet density is measured as per-capita grocery stores, fruit and vegetable stores, full and limited-service restaurants, and WMSCs. Our proxy for public expenditure on nutrition education programs are the inflation-adjusted per-capita SNAP-Ed expenditures.⁹ We use supply-side drivers of store locations as instrumental variables and to account for possible endogeneity of food store density. Also, to further reduce bias in the estimates, we account for the dynamic nature of the process generating eating habits and obesity.

Understanding the role of the food environment vs. nutrition education in expanding the share of adult population engaging in healthy eating habits has clear policy implications and is relevant for the agribusiness sector as a whole. Food retailers and food service companies, as well as many food manufacturers, are under scrutiny for their potential roles in shaping diets and in contributing to the obesity epidemic. This study seeks to provide additional evidence on whether policies aimed at regulating the food environment (i.e., the location of food retailers and restaurants) are likely to achieve the intended goals. Furthermore, analyzing the effect of nutrition education on fruit and vegetables consumption, vis-à-vis that of food outlets, could prove useful to agribusiness firms (especially food retailers) by allowing them to propose alternative “policy recipes” to direct regulation counteracting the obesity epidemic. Last, the quantification of the impact of nutrition education expenditure on the share of adults eating fruits and vegetables five or more times per day could prove useful to fruit and vegetables producers and processors as it may illustrate whether nutrition education can be used to expand their consumer base.

Empirical Methods

The Model

We posit a linear relationship between consumption of fruits and vegetables, food access (i.e., food store density), and other exogenous control variables. Let $FV5_{it}$ be the share of the adult population consuming fruit and vegetables at least five times a day in state i at time t (our proxy for healthy eating), NEd_{it} is a proxy measure of the average exposure to nutrition education of individuals in state i at time t , and FA_{jit} a proxy for the average consumer’s access to the j -th type of food outlet in state i at time t . We consider:

⁸ Fruit and vegetables consumption is, at best, an incomplete proxy for the adoption of healthy diets, as it does not take into account the consumption of other food groups (consumers who consume more servings of fruits and vegetables may also consume more “unhealthy” foods containing, for example, high values of sodium and fat). Furthermore, the concept of a “healthy” diet can differ among different subgroups of the population. Readers should keep in mind these caveats, which also hold for the interpretation of the results.

⁹ All monetary variables are measured in real terms.

$$(1) \quad FV5_{it} = \gamma_0 + \gamma_{NEd}NEd_{it} + \sum_j \gamma_{FAj}FA_{jit} + \sum_h \gamma_{OHh}OH_{hit} + \sum_k \gamma_{SDk}SD_{kit} + \sum_m \gamma_{Enm}En_{mit} + \sum_l \gamma_{Rl}REG_{li} + \sum_t \gamma_{Tt}T_t + \varepsilon_{FVit}$$

where *OH* are variables capturing other habits and behaviors, *SD* are socio-demographic characteristics capturing heterogeneity in consumers' tastes, *En* are variables capturing environmental characteristics impacting eating habits, *REG* are regional fixed-effects capturing the heterogeneity of diets across areas, and *T* are year indicators controlling for changes in diets over time; the γ s are parameters to be estimated, and ε_{FVit} is an idiosyncratic error term. Equation (1) ignores the dynamic aspects of the process generating eating habits, discussed above. Maintaining the assumptions of linearity, by virtue of the mechanics of the geometric distributed lag model¹⁰ we can rewrite equation (1) to include the effect of lagged eating habits ($FV5_{it-1}$) as:

$$(2) \quad FV5_{it} = \gamma_0 + \gamma_{FV5t-1}FV5_{it-1} + \gamma_{NEd}NEd_{it} + \sum_j \gamma_{FAj}FA_{jit} + \sum_h \gamma_{OHh}OH_{hit} + \sum_k \gamma_{SDk}SD_{kit} + \sum_l \gamma_{Rl}REG_{li} + \sum_t \gamma_{Tt}T_t + \sum_m \gamma_{Enm}En_{mit} + \varepsilon_{FVit}$$

so that one can calculate both short-run and long-run effects of explanatory variables on $FV5_{it}$.

Consider a variable Z_j ; while its short-run impact on $FV5_{it}$ is $\frac{\partial FV5_{it}^{SR}}{\partial Z_j} = \gamma_Z$, following the logic of the geometric distributed lag models (Greene, 2003), the long-run parameters (and implicitly the long-run marginal effects) of Z_j on $FV5_{it}$ can be measured as $\frac{\partial FV5_{it}^{LR}}{\partial Z_j} = \frac{\gamma_Z}{1 - \gamma_{FV5t-1}}$. It

should be noted that the long-run marginal effects refer to an indefinite future period in which the market reaches long-run equilibrium.

Let ObI_{it} represent the incidence of adult obesity in area i at time t and the relationship between obesity rates and its determinants be:

$$(3) \quad ObI_{it} = \delta_0 + \delta_{FV5}FV5_{it} + \sum_h \delta_{OHh}OH_{hit}^{Ob} + \sum_k \delta_{SDk}SD_{kit}^{Ob} + \sum_l \delta_{Rl}REG_{li} + \sum_t \delta_{Tt}T_t + \varepsilon_{ObIit}$$

where the groups of explanatory variables are described above, the δ s are parameters to be estimated, and ε_{ObIit} is an idiosyncratic error term. Equation (3) states that obesity is a function of eating and other habits controlling also for socio-demographic characteristics: the subscript *Ob* indicates that the subsets of *OH* and *SD* entering the obesity equation are specific for that equation.

¹⁰ See the Appendix for a brief illustration of this model. The interested reader will find a more detailed discussion of geometric lag models and other distributed lag models in Greene (2003).

One can combine the estimated coefficients of equations (1) and (3) to obtain the indirect marginal effects of food access and nutrition education on adult obesity incidence as:

$$\frac{\partial ObI_{it}}{\partial NEd_{it}} = \frac{\partial ObI_{it}}{\partial FV5_{it}} \frac{\partial FV5_{it}}{\partial NEd_{it}} = \delta_{FV5} \gamma_{NEd} \quad \text{and} \quad \frac{\partial ObI_{it}}{\partial FA_{jit}} = \frac{\partial ObI_{it}}{\partial FV5_{it}} \frac{\partial FV5_{it}}{\partial FA_{jit}} = \delta_{FV5} \gamma_{FAj},$$

respectively. The intuition behind these measures is the following: given the assumptions of our model, a marginal change in nutrition education (access to outlet-type j) will lead to a marginal change in the incidence of adults consuming fruits and vegetables equal to γ_{NEd} (γ_{FAj}); since a marginal change in $FV5_{it}$ leads to a change in the incidence of adult obesity, a marginal change in NEd_{it} (FA_{jit}) will have an indirect impact on adult obesity equal to $\delta_{FV5} \gamma_{NEd}$ ($\delta_{FV5} \gamma_{FAj}$).

Similarly, the marginal effects on ObI of those variables impacting both the incidences of adult obesity and adults consuming fruit and vegetables at least five times a day, are illustrated below. Using a socio-demographic variable common to both equations (such as income and education, represented below as SD_k) one has:

$$\frac{\partial ObI_{it}}{\partial SD_{kit}} = \frac{\partial ObI_{it}}{\partial SD_{kit}} \Big|_{FV5_{it}} + \frac{\partial ObI_{it}}{\partial FV5_{it}} \frac{\partial FV5_{it}}{\partial SD_{kit}} = \delta_{SDk} + \delta_{FV5} \gamma_{SDk}.$$

where the first term in the mid-portion of the equation represents the direct effect of SD_k on adult obesity incidence, while the second captures the indirect effect through $FV5$, similar to the indirect effects of nutrition education and food access illustrated above. That is, these marginal effects will account for the fact that other habits (OH) and socio-demographic (SD) factors impact both eating habits and body weight.

Again, using the assumptions of the geometric distributed lag model and maintaining a linear functional form, an alternative specification of equation (3) that includes the effect of previous obesity values (ObI_{it-1}) on current values is:

$$(4) \quad ObI_{it} = \delta_0 + \delta_{Ob-1} ObI_{it-1} + \delta_{FV5} FV5_{it} + \sum_h \delta_{OHh} OH_{hit} + \sum_k \delta_{SDk} SD_{kit} + \sum_l \delta_{REGl} REG_{li} + \sum_t \delta_{Tt} T_t + \varepsilon_{ObIit}$$

where ObI_{it-1} represents the one-period lagged value of adult obesity in area i . Following the same logic discussed above for the other marginal effects and the calculation of long-run parameters, using the estimated coefficients of equations (2) and (4), the long-run marginal effects of the variation in food access, nutrition education and demographics on adult obesity rates are:

$$\frac{\partial ObI_{it}^{LR}}{\partial FA_{jit}} = \frac{\delta_{FV5}}{1 - \delta_{Ob-1}} \frac{\gamma_{FAj}}{1 - \gamma_{FV5t-1}}; \quad \frac{\partial ObI_{it}^{LR}}{\partial NEd_{it}} = \frac{\delta_{FV5}}{1 - \delta_{Ob-1}} \frac{\gamma_{NEd}}{1 - \gamma_{FV5t-1}};$$

$$\frac{\partial ObI_{it}^{LR}}{\partial SD_{kit}} = \frac{\delta_{SDk}}{1 - \delta_{Ob-1}} + \frac{\delta_{FV5}}{1 - \delta_{Ob-1}} \frac{\gamma_{SDk}}{1 - \gamma_{FV5t-1}}.$$

Data and Variables Description

The main data used are state-level aggregates from the “Prevalence and Trends Data” from the Centers for Disease Control and Prevention’s (CDC) Behavioral Risk Factor Surveillance System (BRFSS) survey,¹¹ available from the CDC website. “Adult obesity” is the state-level percent of adult population whose BMI is 30 and above, while the percent of “Adults who have consumed fruits and vegetables five or more times per day” (FV5 hereafter) is used as a proxy for healthy eating habits. The first variable is obtained from the “Weight Classification by Body Mass Index (BMI)” series, which presents the state-level share of adult population that is neither overweight nor obese ($BMI \leq 24.9$), Overweight ($25.0 \leq BMI < 29.9$) and Obese ($BMI \geq 30.0$). The state-level aggregates are obtained based on individuals’ BMIs calculated from self-reported values of height and weight (BMI>100 are discarded). Similarly FV5 is obtained via state averages of the number of survey respondents who were found to consume more than five servings of fruits and vegetables daily, with values imputed from individuals’ answers to a series of six questions regarding frequency of consumption of fruit and vegetables.¹²

As noted, food store density is measured as the number of food store establishments divided by population. Food store establishment data are from the County Business Pattern, U.S. Bureau of Labor Statistics (BLS). The industries included are: NAICS 4451: Grocery Stores, NAICS 44523: Fruit and Vegetables Stores;¹³ NAICS 7222: Limited Service Restaurants (proxy for fast-food) and NAICS 722: Food Services and Drinking Places. The difference between NAICS 722 and NAICS 7222 establishments represents full-service restaurants. State-level numbers of WMSCs are from the company’s annual shareholder reports. State-level population is from the Population Estimates Program (PEP).

Nutrition education is measured as real state-level per capita annual federal outlays on SNAP-Nutrition Education program (SNAP-Ed). State-level federal outlays, in current dollars were obtained from public use data from the Food and Nutrition Service of the United States Department of Agriculture (FNS – USDA).¹⁴ These amounts represent 50% of the expenditure in programs of nutrition education proposed by State Agencies in each state, i.e., the amount that is federally funded and excluding the expenditure of each state. To account for inflation and evaluate real expenditure, we divided the outlays by general Consumer Price Index (CPI) from

¹¹The BRFSS is an on-going telephone health survey system tracking health conditions and risk behaviors among the U.S. population and collects data on 1) individuals’ habits, such as smoking, physical activity, alcohol consumption; 2) health status and health prevention measures, e.g., whether the respondents had high blood pressure, high cholesterol levels, access to healthcare, etc., and 3) respondents’ socio-demographic characteristics such as children in the household, age and gender. All of these characteristics are self-reported.

¹² Consumption of fruits and vegetables is recorded separately in the BRFSS through six questions, two on the frequency (daily, weekly, monthly or annually) of consumption of fruits (fruit juices and fruit, excluding juices, respectively) and four on the consumption of vegetables (green salad, potatoes - excluding chips and fries, carrots, and servings of other vegetables). The reported values are converted into daily servings consumed by each group, and then used to create summary indexes of fruits and vegetables consumed per day and an indicator variable capturing whether an individual consumed five or more servings of fruits and vegetables per day.

¹³ According to the official Census Definition (<http://www.census.gov/eos/www/naics/>). The establishments included in this industry are specialty food stores primarily engaged in retailing fresh fruits and vegetables, excluding roadside stands and electronic, direct or mail sales. Farmers markets are not included in this classification.

¹⁴ We thank Alice Lockett, at the FNS-USDA for providing data on State-level Federal Outlays for the SNAP-Ed program.

the BLS, and by state-level population, to control for the different sizes of each state and for consistency with the other variables in the models. As such, the coefficients associated with this variable measure how the program could perform if it reached the entire state-population.

Controls used in both equations are the percent of population that is physically active five or more times per week for at least 30 minutes (Phys Act); with a college degree or higher (>College); without children (No Child); and female (% Female) from the BRFSS data. Socio-demographic characteristics such as population belonging to different ethnic groups (% Black; % Other ethnicities) and average age (Age) come from the PEP; real per-capita personal income (Income) is obtained by dividing state-level total income from the American Community Survey by state-level population and by General CPI. The percent of adult population currently smoking (Smoke) and married (% Married), from the BRFSS, are included only in the obesity equation.¹⁵ We use two environmental characteristics that can have an impact on eating habits. The first variable is the general CPI, which accounts for price levels affecting real income and quality of food purchased. The second is the annual average state-level temperature (Temp) from the Earth System Research Laboratory (ESRL) capturing differences in diets due to geography, the likelihood of engaging in outdoor activities, or in activities which may result in different lifestyles and therefore diets (including visiting farm stands). The data cover the years 1998-2006¹⁶ for 47 continental states,¹⁷ for a total of 423 observations. U.S. Census Area fixed-effects and year dummies are used to account for unobservables and the panel nature of the data. A summary of the variables used in the estimation is provided in Table 1, along with descriptive statistics.

Estimation and Identification

An instrumental variable estimation method, the Generalized Method of Moments, or GMM (Hansen, 1982) is used to obtain unbiased estimates and to control for the endogeneity of some of the explanatory variables. This method, as illustrated by Hansen, can be seen as a generalization of other IV methods, including two-stage least squares. Given a vector of exogenous variables Z , in the case of linear models the GMM estimator aims to find the vector of coefficients θ that satisfies the following moment conditions $E[Z'(Y - X'\theta)] = 0$ or $E[Z'e] = 0$, or in other words, the vector of coefficients for which the errors obtained from the model are orthogonal to the vector of exogenous variables Z . Note that Z contains *all* of the exogenous variables in X and at least as many other exogenous variables as the number of endogenous variables. The GMM estimator solves

$$\min_{\theta} [Z'(Y - X'\theta)]'W[Z'(Y - X'\theta)],$$

¹⁵ Smoking habits and marital status are usually controlled for in studies related to obesity; controlling for these variables is not as common in studies of fruit and vegetables consumption. For example Cummins *et al.* (2005) do not control for smoking habits and marital status; Rose and Richards (2004) who did not include smoking as control variable, include instead single parent households, a variable not available in our data.

¹⁶ Although the state-level BRFSS Prevalence and Trends Data are available from 1984, we limit our analysis to the period 1998-2006 to avoid problems arising from changes in the Census' industry classification system, which switched from the SIC 1987 to the NAICS 1997. Observations for FV5 incidence and other regressors, not available for some years, were recovered using linear interpolation.

¹⁷ Utah was excluded from the sample because of missing observations in the BRFSS data.

where W is a weight matrix (usually $Z'Z$), which is solved by

$$\theta^{GMM} = ((X'Z)W(Z'X))^{-1}(X'Z)Y^{18}$$

An illustration of the identification strategy follows. As the food store location decision is in part driven by demand-side factors impacting consumers' eating habits not captured by the other control variables in the model, FA is likely to be correlated with the errors in the $FV5$ equation.¹⁹ Since food retailers and food service establishments locate preferentially where pre-existing infrastructures provide ease of transportation and implementation of logistics structure, our identification strategy uses historical information on infrastructure to capture exogenous (to diets) variation in store-density. We use state-level miles of federal highways in 1950 (U.S. Department of Transportation, Federal Highway Administration, 1950)²⁰, segmented by rural and urban areas, as well as the percent of federal highways in each state in urban and rural locations as instruments. The portion of rural and non-rural land in each state and the square miles of land are from the Gazetteer of counties (U.S. Bureau of Census, 2001). Furthermore, we control for market potential and proxies for land prices, *e.g.*, state-level population density, total land available and the percent of land in natural parks and preserves; also we use the maximum state-level corporate income tax rate (from the U.S. tax foundation) to capture the characteristics of the business environment across states. Our identification strategy for WMSCs²¹ follows the notion that the company's expansion into food retailing capitalizes on converting its mass merchandize Discount Stores (DSs) into supercenters (see Bonanno, 2010); therefore the current number of WMSCs is regressed on the lagged number of DSs (similar to Basker and Noal (2009) who use historical values instead), the average distance from food distribution centers based on Holmes' store location database (Holmes 2010) regional fixed-effects and year dummies. The predicted number of stores is divided by total population (in hundreds of thousands) and used in lieu of the actual ones in the estimation.²²

Endogeneity bias may also affect the obesity equation estimates, since unobservables impacting adult obesity rates could be correlated with fruit and vegetable consumption (*e.g.*, consumption of other food groups). To resolve this issue, the excluded variables from the $FV5$ equations are used as instruments for $FV5_{it}$ in the obesity equation. In equation (2) such variables are CPI, average temperatures, per-capita real SNAP-Ed expenditure and the instrument for WMSC; the same variables are also used in equation (4), along with the appropriately instrumented lagged $FV5$.²³

¹⁸ For a more detailed illustration of the GMM estimator see Wooldridge (2002), Chapter 14.

¹⁹ If, for example, an area is characterized by a higher demand for unhealthy high-calorie food, limited service restaurants will be more likely to find such areas to be profitable and locate there.

²⁰ We use historical highway density measures instead of contemporary ones to mitigate issues of spurious correlation which may arise if the objective of structural interventions to improve the capillarity of highway systems had, as a goal, that of attracting more businesses in a given area.

²¹ Specifically, WMSCs locations may be correlated with particular socio-demographic profile, which may in turn be correlated with poorer diets (*e.g.*, high poverty rates, as in Goetz and Swaminathan, 2006; or share of population receiving food stamps as in Bonanno, 2010).

²² As different instruments were used to control for the endogeneity of WMSCs, we opted to run a separate first-stage OLS regression where both the lagged number of discount stores and the inverse distance from the company's food distribution centers showed positive and statistically significant coefficients, and the R-squared was 0.5996.

²³ The identifying assumptions for the ObI equations is that the exclusion restrictions used (*i.e.* the variables from the $FV5$ equations) explain $FV5$ but not obesity incidence and they are uncorrelated with the errors. The second point can be tested

Table 1. Variables used in the estimation

Variable	Description	Source	Mean	St. dev.
Ob	% of adult population with BMI > 30	BRFSS	21.82	3.50
FV5	% of adult population eating fruits and vegetables 5 or more times daily	BRFSS	23.44	3.75
Grocery	Establishments in NAICS 4451 / 1,000 people	BLS / PEP	0.34	0.09
FV stores	Establishments in NAICS 44523 / 100,000 people	BLS / PEP	0.95	0.66
Lim Serv. Res	(NAICS 722 – NAICS 7222) Establishments / 1,000 people	BLS / PEP	0.80	0.09
Full Serv. Res	Establishments in NAICS 7222 / 1,000 people	BLS / PEP	1.05	0.26
WMSCs	Number of WM Supercenters / 100,000 people	Wal-Mart Inc / PEP	0.49	0.46
SNAP-Ed	Per Capita Expenditure in SNAP-Ed / CPI	ERS / BLS	0.27	0.26
Phys Act	% adults: 30 + minutes of physical activity five or more days / week	BRFSS	74.50	5.13
Smoke	% respondents: currently smoke	BRFSS	22.57	2.93
No Child	% respondents: no children in their household	BRFSS	59.97	3.02
>College	% respondents: highest grade or year of school completed is “College or higher”	BRFSS	29.05	5.50
Income	Real per capita income (Total income / CPI / total population)	ACS / PEP	16.66	2.32
% Female	% of respondents being female	BRFSS	51.72	0.80
% Black	African American population / total population (%)	PEP	7.38	6.62
% Other ethnicities	Population other than White Caucasian or Black / total population (%)	PEP	28.66	2.97
% Married	% of adult population being married	BRFSS	60.34	3.24
Age	Average age	PEP	36.44	1.18
Temp	Average state-level annual temperature	ESRL	52.16	7.63
CPI	General Consumer Price Index	BLS	1.80	0.13

for (see footnote 24). Validating the first point is of particular importance given Courtemanche and Carden’s (2011) result that Wal-Mart’s presence is associated with higher obesity and McGeary’s (2009) findings that SNAP-Ed is negatively related to it. To that end, we included per capita real SNAP-Ed expenditure, CPI, average temperatures and the WMSC instrument as explanatory variables in a specification of the ObI equation where FV5 was excluded from the explanatory variables, and tested for their statistical significance. In the first place the coefficients of SNAP-Ed and temperatures were not statistically significant and, in spite those of those of CPI and WMSC being (individually) significant, jointly they were not. We re-estimated the ObI equation including FV5 in the model both via OLS and GMM (using temperature and SNAP-Ed as instruments for FV5), leaving CPI and WMSC as explanatory variables: the coefficients for both variables were not statistically significant. Repeating the same exercise including the instrumented lag of FV5 led to the same conclusions. This indicates that all these variables, including the WMSC instrument and SNAP-Ed, can be used as instruments in the ObI equation.

Lastly,²⁴ equations (2) and (4) contain lagged dependent variables on the RHS, which are endogenous by construction. In each of the two equations, the lagged dependent variable is regressed on lagged exogenous variables entering the respective equation, and the predicted values used in place of the actual ones. All equations are estimated both via Ordinary Least Squares (OLS) and (GMM).²⁵ An illustration of the moment conditions necessary to hold for the parameters of each equation to be identified is discussed in Appendix 2. Equation (1) was estimated with and without the inclusion of per-capita SNAP-Ed. Once estimates of the parameters are obtained, the impact of FA, SNAP-Ed and other relevant demographic variables on obesity are calculated. Estimation was performed using STATA v. 11.

Empirical Results

Table 2 presents the empirical results of different specifications of equations (1) and (2). The first two columns show OLS estimates without and with SNAP-Ed expenditure; respectively, the third and fourth columns are the GMM estimates. The models show similar goodness of fit (between 0.5274, for the model without SNAP-Ed, estimated via GMM, to 0.5835, for the model with SNAP-Ed, estimated via OLS).²⁶

The magnitude and significance of the FA coefficients' estimates change once SNAP-Ed expenditure is controlled for, supporting the intuition that without controlling for nutrition education, the estimated impact of the built environment on eating habits (or obesity) may be biased. Also, the coefficients change considerably after accounting for FA endogeneity. The estimated grocery store coefficients are positive in all models, but in none of the models are they statistically significant suggesting that a positive correlation exists between access to grocery stores and FV5 incidence; however, this relationship is weak and in all likelihood non-causal, which may explain why previous more limited-scale studies show mixed findings (e.g., Rose and Richards' (2004) and Cummings et al. (2005) report conflicting findings).

²⁴ The use of a linearized geometric distributed lag model requires that the errors of the estimated model not be serially correlated. Tests for first order serial correlation, using Durbin's *h* statistics, show that, in all cases the errors were free from serial correlation.

²⁵ The orthogonality of the over-identifying instruments to the errors of the second stage regressions is evaluated via Hansen's (1982) test. The *J*-statistic of this test is distributed as chi-squared with degrees of freedom equal to the number of over-identifying instruments. A non-significant test statistic indicates that the instruments are valid. To evaluate instead the power of the instruments, we use Staiger and Stock's (1997) rule of thumb: if the *F*-statistic for the joint significance of the instruments' coefficients in the first stage equations exceeds 10 one can rule out weak instruments problems.

²⁶ The instruments used to correct for endogeneity of FA do not violate the orthogonality condition (the *p*-values of Hansen's (1982) *J*-tests are 0.2970 and 0.1649, respectively, in the model with and without SNAP-Ed). The larger *p*-value obtained when accounting for SNAP-Ed, suggests that controlling for this variable leads to more reliable results. Furthermore, the value of the *F*-statistics for the joint significance of the instruments' coefficients in the first stage equations exceed the "rule of thumb" value of 10, suggesting that the instruments used are not weak (Staiger and Stock, 1997). A more in-depth look at the first stage regression results shows the R-squared for the first-stage FA equations ranging from circa 0.6 (limited-service restaurants) to 0.84 (fruits and vegetables stores) and that remarkable similarities appear in the results. For example, maximum corporate tax rate has a negative and significant effect on the density of three out of the four types of stores while a positive relationship exists with population density (the one exception being full service restaurants). The proxy for land availability seems to impact primarily the store density measures with the exception of limited service restaurants, which are, conversely, heavily impacted by highway density (percent of federal highways in urban and rural areas), much more so than other outlets (for example grocery stores and fruits and vegetables stores are only weakly impacted by these variables).

Table 2. Estimated coefficients – Equation 1: incidence of consuming five servings of fruits and vegetables per day.

	OLS		GMM	
	NO SNAP-Ed	With SNAP-Ed	NO SNAP-Ed	With SNAP-Ed
Grocery	3.2273 (2.3454)	2.7901 (2.3224)	4.4157 (6.2735)	3.0192 (6.0118)
FVstores	0.8349** (0.3268)	1.1348*** (0.3364)	0.6645* (0.4058)	0.8953** (0.4077)
LimRes	-1.5921 (2.1214)	-0.8313 (2.1104)	-6.8123 (4.4663)	-4.2693 (4.5650)
FullRes	-2.5394*** (0.9027)	-2.8996*** (0.8994)	3.0450* (1.8373)	1.6750 (1.8789)
WMSCs	-0.9640*** (0.2217)	-1.0324*** (0.2201)	-0.7796*** (0.2439)	-0.8967*** (0.2453)
SNAP-Ed		1.8211*** (0.5685)		1.3709** (0.5830)
Phys Act	0.1124** (0.0499)	0.1039** (0.0494)	0.0899 (0.0752)	0.0885 (0.0730)
No Child	0.0582 (0.0770)	0.0621 (0.0762)	0.0572 (0.1031)	0.0554 (0.0996)
>College	0.2400*** (0.0568)	0.2686*** (0.0569)	0.1721** (0.0878)	0.1972** (0.0858)
PC Income	0.2778** (0.1127)	0.2560** (0.1116)	0.5165*** (0.1892)	0.4553** (0.1872)
%Race	-0.2465*** (0.0746)	-0.2832*** (0.0747)	-0.2793*** (0.0806)	-0.2960*** (0.0799)
% Black	-0.08243** (0.0407)	-0.09438** (0.0404)	-0.1248*** (0.0361)	-0.1212*** (0.0352)
% Fem	-0.0625 (0.3890)	-0.0537 (0.3845)	0.6452 (0.4658)	0.5308 (0.4567)
Age	-0.0160 (0.2459)	-0.1030 (0.2445)	-0.4510 (0.3435)	-0.4221 (0.3342)
Temp	0.0226 (0.0361)	0.0415 (0.0362)	0.0885 (0.0566)	0.0846 (0.0552)
CPI	11.348*** (4.3538)	10.003** (4.3242)	11.899*** (4.4064)	11.333*** (4.1458)
Constant	-10.2790 (22.7260)	-5.8101 (22.5080)	-36.2370 (27.8550)	-30.0000 (26.7270)
R-squared	0.5727	0.5835	0.5274	0.5542
Hansen's J [$\chi^2_{(4)}$]			6.4976	4.9069
p -value J			0.1649	0.2970

Note. *, **, and *** represent 10, 5 and 1% significance levels, respectively. Standard errors in parenthesis. Regional fixed-effects and time dummy coefficients excluded for brevity.

The estimated coefficients of F&V stores are positive and significant, across specifications and estimation methods. After controlling for SNAP-Ed expenditure, the estimated coefficient for F&V stores increases by approximately 30% (0.835 to 1.135 in the OLS results; 0.665 to 0.895 in the GMM). Since the sample average state-level density of FV stores is about one store per 100,000 people, the results indicate that doubling access to F&V stores raises the FV5 incidence by 0.66 % to about 0.9%.

The OLS estimates of the full and limited service restaurants coefficients are negative; the former (-2.539 and -2.899) are statistically significant, while the latter (-1.592 and -0.831) are not, suggesting a negative correlation between restaurants and the incidence of fruits and vegetables consumption among the adult population. The coefficients for limited service restaurants become more negative after endogeneity is controlled for, although it is not statistically significant, suggesting that the density of these establishments is negatively correlated with our crude proxy for healthy eating and that, because fruits and vegetables consumption is likely negatively related to obesity incidence, our results are consistent with previous studies (Chou, Grossman, and Saffer, 2004; Chen, Florax, and Snyder, 2009; Currie et al. 2009); however, this relationship is likely to be non-causal. Instead, once endogeneity is controlled for the sign of the full service restaurant coefficient becomes positive, although significant at the 10% level only in the model without SNAP-Ed.

This result seems to support Anderson and Matsa's (2011) argument that excess calories from meals at restaurants could be offset by reducing consumption on other occasions, or in this case, by increasing the frequency of consumption of fruits and vegetables. However, not all individuals may make such calorie-offsetting decisions: the fact that the coefficient loses statistical significance when our proxy for nutrition education is controlled for, may indicate that only a portion of the population (perhaps consumers who are more educated from a nutritional stand point) would make better dietary choices in the presence of more restaurants, and that once education is controlled for only a correlation persists.

The effect of WMSCs on FV5 incidence is negative and statistically significant across models and estimation methods, with the GMM coefficients showing a lower magnitude than the OLS coefficients, while the coefficients are eight to twelve percent larger when SNAP-Ed expenditure is accounted for. This supports Courtemanche and Carden's (2011) contention that the real income-increasing effect of Wal-Mart's lower prices does not translate into consumption of healthier foods; as the negative relationship between the incidence of adults consuming fruits and vegetables five or more times a day and the company's presence becomes more marked controlling for nutrition education, it may suggest that the less educated consumers are those engaging the most in unhealthy eating practices once they are exposed to more varieties at lower prices. Our results indicate that an increase of one WMSC per 100,000 individuals (a 200% increase in store numbers, the sample average of which is 0.49) would reduce FV5 incidence by 0.78 to 0.9 percentage points.

The coefficients associated with SNAP-Ed expenditures are positive and significant using both OLS and GMM (1.821 and 1.371, respectively), indicating that an increase in per-capita expenditure in SNAP-Ed of \$1/year would raise FV5 incidence by approximately 1.4 to 1.8

percentage points. In other words, investing about \$0.55/year per person in SNAP-Ed could increase FV5 by up to one percent. As the average real per-capita SNAP-Ed in our sample is circa 0.27 \$/year, such a 1% increase would require increasing SNAP-Ed expenditures by 200 to 260%. The reader should keep in mind that since this variable is obtained dividing SNAP-Ed expenditure by the total population, these increases assume that the campaign reaches the entire population of a state. The estimated coefficients of the other variables in the model show similar magnitude and significance across specifications. Physical activity, per capita income and education are positively related to healthy eating (the first being significant only in the OLS estimates), and so is living in areas characterized by warmer climate (significant at the 10% in the model estimated via GMM) and higher price levels. The percent of population that is black or belongs to minority ethnic groups is negatively related to FV5 incidence, while percent of families without children, average age, and the percent of female population have no impact.

Table 3 presents results for equation 2: OLS estimates in the first column and GMM in the second; the third and fourth columns represent the respective long-run parameters. Overall, the direction and magnitude of most of the estimated coefficients are comparable to those presented in Table 2, with improved goodness of fit (0.611 and 0.589 for the models estimated via OLS and GMM, respectively).²⁷ The coefficients associated with $FV5_{it-1}$ are positive and significant, i.e., we find that the values of state-level of FV5 persist over time. The OLS and GMM coefficients are, respectively, 0.3601 and 0.3092, indicating that the impact of previous eating habits could be overestimated by circa 18 % if one does not account for the endogeneity of food store density. The behavior of the estimated FA coefficients is similar to that of equation (1).

Discussing only the statistically significant GMM estimates, the estimated long-run effects show that increasing the number of F&V stores by one unit per 100,000 people could, in the long-run, raise FV5 incidence by 1.23 percentage points while an increase of one WMSC per 100,000 individuals would lower it by 1.53 percentage points. In the long-run, an increase of \$1/year per person in SNAP-Ed expenditure will increase FV5 incidence by 1.79 (GMM estimates) to 2.32 (OLS) percentage points. Thus, in the long-run, FV5 incidence could increase by one percentage point if SNAP-Ed expenditures increased by 0.43 to 0.56 \$/person per year.

²⁷ Also, in this case, the instruments for food store locations satisfy the orthogonality condition (p -value of Hansens's J -test is 0.5099) and show sufficient explanatory power. The performance of the first-stage regressions is very similar to that illustrated for equation (1) in footnote 26, and is not presented for the sake of brevity.

Table 3. Equation 2 – Estimated coefficients: incidence of consuming five servings of fruits and vegetables per day and long-run parameters

	Estimated Coefficients		Long-run Parameters	
	OLS	GMM	OLS	GMM
Lag FV5	0.3601** (0.1629)	0.3092* (0.1837)		
Grocery	4.4194** -1.9860	0.3054 -5.5938	6.9067* (3.6443)	0.4421 (8.0404)
FV stores	0.8619*** (0.3232)	0.8503** (0.4026)	1.3469** (0.5703)	1.2310* (0.7036)
Lim Serv. Res	-1.3502 (2.1693)	-3.4589 (4.0061)	-2.1102 (3.3798)	-5.0073 (5.9355)
Full Serv. Res	-2.5601*** (0.7157)	0.7393 (1.8877)	-4.0010** (1.6657)	1.0702 (2.6267)
WMSCs	-1.0746*** (0.2104)	-1.0590*** (0.2272)	-1.6794*** (0.4911)	-1.5331*** (0.5325)
SNAP-Ed	1.4848*** (0.4710)	1.2347** (0.5726)	2.3205** (0.9399)	1.7875* (0.9653)
Phys Act	0.0031 (0.0794)	0.0124 (0.0800)	0.0049 (0.1243)	0.0180 (0.1167)
No Child	0.0612 (0.0919)	0.0228 (0.0883)	0.0956 (0.1546)	0.0330 (0.1311)
> College	0.1573* (0.0920)	0.1300 (0.0950)	0.2458** (0.1088)	0.1881 (0.1210)
Income	0.1942* (0.1061)	0.2772 (0.2058)	0.3035** (0.1536)	0.4012* (0.2505)
% Oth. Race	-0.2740*** (0.0837)	-0.2586*** (0.0945)	-0.4282*** (0.1292)	-0.3744*** (0.1148)
% Black	-0.0624 (0.0434)	-0.0671 (0.0524)	-0.0975* (0.0555)	-0.0971* (0.0579)
% Fem	(0.1912) (0.3596)	0.1336 (0.5558)	-0.2988 (0.6026)	0.1935 (0.7745)
Age	-0.1759 (0.2450)	-0.2388 (0.3137)	-0.2748 (0.4021)	-0.3457 (0.4433)
Temp	0.0376 (0.0320)	0.0511 (0.0527)	11.5955 (8.4214)	13.0750 (8.4790)
CPI	7.4196 (4.5355)	9.0318* (4.7364)	0.0588 (0.0514)	0.0740 (0.0699)
Constant	12.9670 (19.5750)	-3.7785 (28.9290)		
R-squared	0.6108	0.5893		
Hansen's J [$\chi^2_{(4)}$]		3.2693		
<i>p</i> -value J		0.5099		

Note. *, **, and *** represent 10, 5 and 1% significance levels, respectively. Standard errors in parenthesis. Regional fixed-effects and time dummy coefficients excluded for brevity.

Table 4 presents the results of the obesity equations (3) and (4). The first two columns contain OLS and GMM estimated parameters of equation (3) while the third and fourth columns report the GMM estimates of equation (4) and the calculated long-run parameters. The goodness of fit of the models is comparable (the R-squared are 0.8709 and 0.8423, for equation 3, OLS and GMM respectively, and 0.8567 for equation 4, GMM). While no relationship seems to emerge between FV5 and adult obesity incidence in the OLS estimates (the coefficient being positive, small and not statistically significant), once endogeneity of eating habits is accounted for,²⁸ the results show that a one percentage point increase in FV5 incidence lowers adult obesity incidence by approximately -0.24% (in the short run), while a long-run marginal decrease can reach -0.44% .

Most of the estimated coefficients for the other variables show similar magnitude, sign and significance across specifications and behave as expected. The percent of population holding a college degree or higher shows negative and significant coefficients as do having no children; the signs associated with average age, smoking and belonging to minorities are negative but not statistically significant. Also, the percent of population married and the percent of black population do not show a statistically significant effect. The coefficients of two variables have signs counter to expectation: physical activity and per capita income, both of them positive, although the latter not statistically significant: as these results do not account for the indirect effect on adult obesity incidence though their impact on healthy eating, the full effect should be considered instead, which is discussed below.

Table 5 presents the cumulative impact of SNAP-Ed expenditure, selected FA and demographic variables on adult obesity obtained combining the estimated parameters of equations 1 and 3, with those of equations 2 and 4 (GMM results). As they are obtained from parameters of separate equations, we are unable to provide standard errors associated with them, a caveat that readers should keep in mind. Increasing SNAP-Ed expenditure by \$1/year per individual (that is, under the caveat that the policy would have to reach the entire population) could reduce the incidence of adult obesity by at least 0.3 percentage points. Such an increase translates into a long-run 0.8% decrease in the rate of adult obesity. An increase of one F&V store per 100,000 individuals reduces adult obesity incidence by approximately -0.2 percentage points in the short-run and -0.54% in the long run. The sample average of F&V stores density being about 1, we can conclude that 1) doubling the density of F&V stores reduces adult obesity incidence by half a percentage point, or that 2) increasing the density of F&V by 180% would lower obesity by one percent. The presence of WMSCs results in a short-run obesity-increasing effect ranging from 0.2 to 0.25, and a long-run marginal increase of $2/3$ of a percentage point.

²⁸ The excluded variables from the FV5 equations, used as instruments in the ObI equation, satisfy the orthogonality condition (p -values of Hansen J are 0.6290 and 0.3092, for equation (3) and (4), respectively). The R-squared of the regressions are 0.5556 and 0.5884; the coefficients of WMSC instrument and CPI were statistically significant in the first stage regression (the second at the 10 % level in equation (4)), while the other variables showed less explanatory power, although SNAP-Ed's coefficient approaches the 10% significant levels in both first stage regressions. In spite of the different performances across models, the parameters of the over-identifying instruments are jointly significant at the 1% level in both cases.

Table 4. Equations 3 and 4 – Estimated coefficients: adult obesity incidence and long-run parameters.

	OLS	Eq (3) GMM	Eq (4) GMM	LR parameters Eq. 4 (GMM)
Lag ObI			0.4634*** (0.0856)	
FV5	0.0055 (0.0255)	-0.2338* (0.1394)	-0.2371* (0.1267)	-0.4419* (0.2309)
Phys Act	0.1006*** (0.0241)	0.1228*** (0.0376)	0.0619* (0.0346)	0.1154* (0.0684)
No Child	-0.1615*** (0.0386)	-0.1864*** (0.0510)	-0.1316*** (0.0494)	-0.2452*** (0.0950)
> College	-0.3427*** (0.0309)	-0.3227*** (0.0353)	-0.1901*** (0.0412)	-0.3542*** (0.0649)
% Smokers	-0.0116 (0.0381)	-0.1134 (0.0746)	(0.0881) (0.0755)	-0.1642 (0.1346)
Income	0.0104 (0.0494)	0.0939 (0.0692)	0.0474 (0.0683)	0.0884 (0.1242)
% Oth. Race	-0.0084 (0.0392)	-0.0877 (0.0646)	0.0713 (0.0743)	0.1328 (0.1509)
% Black	0.07654*** (0.0217)	0.05276** (0.0259)	-0.0116 (0.0268)	-0.0217 (0.0513)
% Fem	0.5401*** (0.1637)	0.5185*** (0.1747)	0.6510*** (0.1740)	1.2131*** (0.3945)
Age	-0.0272 (0.1161)	0.0265 (0.1373)	-0.1162 (0.1337)	-0.2165 (0.2541)
% Married	0.0281 (0.0292)	-0.0284 (0.0447)	0.0149 (0.0430)	0.0277 (0.0817)
Constant	8.5778 (9.5569)	19.2020 (12.1710)	-1.6358 (13.7270)	
R-squared	0.8709	0.8423	0.8507	
Hansen's <i>J</i>	$\chi^2_{(3)}=1.7357$;	<i>p</i> -val = 0.6290	$\chi^2_{(4)}=4.7935$;	<i>p</i> -val = 0.3091

Note. *, **, and *** represent 10, 5 and 1% significance levels, respectively. Standard errors in parentheses. Regional fixed-effects and time dummy coefficients excluded for brevity

The cumulative marginal effects of the socio-demographic variables show that increases in income, education and the level of physical activity all have an effect on containing obesity, which supports previous findings. However, the marginal effect of physical activity calculated from the coefficients of equations not including the dependent variable lag, shows perverse (positive) sign; this points to the importance of including dynamics in the model. The results indicate that, as income increases, consumers will consume more overall, but proportionately more fruit and vegetables. Looking at the results of the models accounting for system dynamics, the marginal effect of an increase of \$1,000 per individual results in a 0.15 (short-run) to 0.26

(long-run) points decrease in adult obesity. Comparing this effect to that of SNAP-Ed, an increase of 0.33 \$ per capita in SNAP-Ed among the entire population would (approximately) have the same effect on obesity as that of increasing consumers' income by \$1,000. The cumulative effect of an increase in regular physical activity within the population is to reduce the adult obesity rate, suggesting that the effect of physical activity on obesity may not simply be due to the burning of more calories but also to an improvement in eating habits, because of the adoption of healthier life styles. Last, even if the percent of population holding at least a college degree did not significantly affect healthy eating, its direct effect on adult obesity prevails, leading to a short-run marginal effect of -0.14 and a long-run effect of -0.26 .

Table 5. Calculated marginal impact of SNAP-Ed, selected FA and demographic variables on adult obesity incidence (GMM results only).

	Eq. 1 and 3	Eq. 2 and 4(SR)	Eq. 2 and 4 (LR)
SNAP-Ed	-0.3205	-0.2928	-0.7898
FV stores	-0.2093	-0.2016	-0.5439
WMSCs	0.2096	0.2511	0.6774
Income	-0.0125	-0.1534	-0.2585
Phys Act	0.1021	-0.1893	-0.3516
> College	-0.3888	-0.1442	-0.2559

Discussion, Implications for the Agribusiness Sector, and Limitations

The results illustrated above have a series of policy implications. In the first place, at the aggregate-level, we find no evidence of a negative causal relationship between the density of food-service establishments and the state-level incidence of adult healthy eating (similar to Collins and Baker, 2009, who find no “Granger causality” on obesity incidence using nationwide data), suggesting that policies aiming to restrict access to these outlets may have little impact on improving healthy diets. This result could be seen as an average (aggregate) outcome of consumers' eating habits, which is consistent with Anderson and Matsa's (2011) findings, i.e., that consumers who eat at restaurants more often could offset calories by reducing consumption on other occasions. Another result which may have policy implications is the detrimental effect of WMSCs on eating habits. Consistent with Courtemanche and Carden (2011) we find that the price-decreasing effects of the company may induce consumers to increase consumption overall, but not necessarily that of healthier foods. However, the company has announced (January 2011) a five-year plan to reduce the price of produce and the sodium, trans fat and added sugars content in several food produces under their private brands, as well as pledging to push major suppliers to follow their example (The New York Times, 2011). Policy makers should monitor closely whether this initiative impacts eating habits which, in light of the magnitude of our findings, could have a large impact on obesity rates.

Similarly, our results indicate that expenditures on nutrition education programs can improve eating habits and, indirectly, curb the incidence of adult obesity. However, increases in nutrition education efforts would have to be substantial. Using the combined long-run effects of SNAP-Ed

on obesity, our results indicate that quadrupling average expenditure on nutrition education (see below for some additional caveats on the interpretation of this result) could reduce adult obesity by 0.8%; the feasibility of such a large spending increase as a policy tool is unlikely. However, as the presence of FV stores appears to be a catalyst of healthy eating, the use of local subsidies or zoning laws that enhance the presence of these outlets may be combined with larger nutrition education expenditures and have a synergic effect.

Our findings are relevant for the agribusiness industry on several fronts. In the first place, they advise against large-scale policies to regulate the structure of the food environment; although the results and the data used do not allow for evaluating the effectiveness of such interventions in specific contexts, they indicate that, at the aggregate level, their validity can be questioned. Second, an implication of our results is that agribusiness firms could considerably benefit from investing in nutrition education campaigns (or support already existing ones), on two fronts: 1) in general, they could benefit (indirectly) in terms of their public image as they will contribute to a more widespread adoption of healthy eating habits; 2) more specifically, fruit and vegetables producers and processors could directly benefit from an expanded consumer base which could result from an effective nutrition education campaign.

Our study is, however, not without limitations. First, we use the incidence of adults who consume more than five servings of fruits and vegetables daily as proxy for eating habits among the adult population; that is, as mentioned above, a rough and incomplete proxy for “healthy eating;” future research should consider using more refined measures of the overall quality of individuals’ diets. Second, given the aggregate nature of the data used, we cannot rule out that part of the population could be affected negatively by the presence of outlets such as fast-food restaurants. While some consumers may show marked preference for healthier alternatives, they may still opt for healthy diets regardless of the food environment, others, more susceptible to the surrounding environment, may be affected negatively by the presence of fast foods. These two effects may cancel each other out, resulting in a zero aggregate effect: as such, our results, which depict average aggregate effects, cannot and should not be used to draw inferences on how an individual’s fruit and vegetables consumption habits are affected by the presence of a particular food outlet. Third, although our statistical evidence supports the validity of our identification strategy, our findings are conditional on the choice of instruments for the food density measures. Additional research should explore an alternative identification strategy to shed more light on whether the relationship between the food environment and diet (and its outcomes, such as obesity) is causal or not, and whether different identification strategies produce different results. Fourth, as we estimate the two equations separately, we are unable to provide standard errors for the indirect and combined marginal effects of some of the explanatory variables on adult obesity incidence. Because of the small number of observations and the aggregate nature of the data used in this analysis, the limited variation in the data did not allow us to use successfully simultaneous equation modeling. Future research using more detailed databases and more sophisticated empirical approach could overcome such limitation.

Lastly, two remarks on our use of the per capita real expenditure on SNAP-Ed are warranted. First, it could be argued that because SNAP-Ed reaches only a small portion of the population, i.e., SNAP participants, it may not be worthwhile to investigate the possibility of increasing

SNAP-Ed funding as a policy tool. The reader should however keep in mind that, because of the population it reaches, SNAP-Ed actually targets individuals in greatest need of education from a nutritional standpoint and those who may therefore derive the greatest benefit from it. As a result, the FV5-increasing effect of SNAP-Ed may come largely from the fact that more disadvantaged consumers engage in “healthy eating”; as such, an increase in SNAP-Ed expenditure could be an effective policy tools to improve eating habits among low income households. However, given the size of the increase in SNAP-Ed expenditures needed to achieve a sizeable reduction in obesity, expanding the reach of the policy to target more population may, in practice, be infeasible.²⁹ The infeasibility of such approach is even more evident if one considers that we normalized federal SNAP-Ed expenditure by population, i.e., all of the estimated impacts of this variable refer to a hypothetical scenario where the funds were spent to educate the entire state population and not only SNAP recipients.

Second, our results do depict causal effects if and only if the measure of nutrition education used, per-capita SNAP-Ed, is in fact exogenous. To benefit from SNAP-Ed, states are required to match federal funds; therefore states in which diets are worse are also those where there may be more interest in investing in nutrition education. From an empirical standpoint, this means that one should control for enough factors associated with both diets and policymakers’ decisions to invest in nutrition education, to guarantee that the estimated parameters of equations (1) and (2) are unbiased (McGeary, 2009). The risk of endogeneity bias is, however, limited as we control for consumers’ heterogeneity through aggregate demographic indicators, and exogenous determinants of diets (such as temperature).³⁰

Concluding Remarks

This paper has examined the simultaneous impact of different food outlets’ density and expenditures in nutrition education programs on the incidence of healthy eating among the U.S. adult population and, indirectly, on adult obesity incidence, using a state-level panel data set and controlling for different sources of biases in the estimates. We find that even after controlling for omitted variable, endogeneity bias and the lagged fruit and vegetables consumption incidence, the density of fruits and vegetable stores is associated with higher shares of adults consuming fruits and vegetables regularly, and therefore lower obesity rates. The presence of Wal-Mart Supercenters, in contrast, across specifications, is associated with lower percentages of individuals consuming fruit and vegetables regularly and, as a consequence, with higher levels of obesity. The effect of SNAP-Ed expenditures is consistently that of more healthy eating and, consequently, reduced obesity.

Our results advise against large-scale policies to regulate the structure of the food environment as they indicate instead that investing in nutrition education could be (at the aggregate level), a more suitable tool to improve healthy eating incidence among the adult population. As a result,

²⁹ Also, as an anonymous reviewer pointed out, SNAP-Ed may also capture different attitudes towards SNAP within the states. Addressing this question is beyond the scope of our current study but worth exploring in future research.

³⁰ McGeary (2009) also points out that both funding levels and diets could change in response to local economic conditions. As we control for variables related to economic conditions, e.g., real income and CPI (related to inflationary trends) such a bias should not be an issue here.

while all agribusiness firms could benefit from investing in nutrition education campaigns, as they may gain in terms of image, fruit and vegetables producers and processors would benefit directly from it as they may experience an expanded consumer base.

Future research could use more refined data and econometric analysis to separate the direct and indirect impact of the food outlets on obesity, accounting for the trade-off between having access to more food outlets vs. that of having access to healthier ones. Alternatively, different types of food outlets (for example farmers' markets) or more refined measures of healthy eating (including for example whole grains, low fat dairy, etc.) could be examined.

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Appendix 1: A Brief Illustration of the Geometric Lag Model

The following illustration of the geometric lag model follows the discussion in Greene (2003), chapter 19. Note that Greene discusses two versions of the geometric distributed lag model: the model used here is similar to the “partial adjustment” model.

Let the covariates impacting eating habits be X , and j be their subscript. The process generating eating habits in area i at time t ($t = 1, \dots, T$) is $FV5_{it} = \gamma_0 + \sum_{j=1}^J \sum_{k=0}^{\infty} \lambda^k \gamma_j X_{ji(t-k)} + e_{FV5it}$; $0 < \lambda < 1$

where λ^k is a weight given to the past values of the explanatory variables, and e_{FV5it} contains an autoregressive component or $e_{FV5it} = \lambda e_{FV5it-1} + \varepsilon_{FV5it}$, while ε_{FV5it} is a mean 0 normally distributed disturbance. Subtracting $\lambda FV5_{it-1}$ from both sides of the equation and noting that

$$\lambda FV5_{it-1} = \lambda \gamma_0 + \lambda \sum_{j=1}^J \sum_{k=0}^T \lambda^k \gamma_j X_{ji(t-1-k)} + \lambda e_{FV5it-1} \text{ one has}$$

$$FV5_{it} - \lambda FV5_{it-1} = \gamma_0 - \lambda \gamma_0 + \sum_{j=1}^J \gamma_j X_{jit} + e_{FV5it} - \lambda e_{FV5it-1}. \text{ Defining } \gamma'_0 = \gamma_0 - \lambda \gamma_0 \text{ gives}$$

$$FV5_{it} = \gamma'_0 + \lambda FV5_{it-1} + \sum_{j=1}^J \gamma_j X_{jit} + \varepsilon_{FV5it} \text{ which resembles equation (2).}$$

Appendix 2. Moment Conditions

Following the notation in the “Empirical Methods” section, let’s define vectors containing all the exogenous variables in equation 1 and 3, respectively as

$X_{FV5} = [NEd, OH, SD, WMSC, REG, T, En]$ (where $WMSC$ is the per-capita instrumented number of Wal-Mart Supercenters) and $X_{Obl} = [OH^{Ob}, SD^{Ob}, REG, T]$.

Let the exogenous variables used to capture supply-side variation in the determinant of food stores location in equation 1 and 3 be Z_{FA} . The moment condition to be satisfied in equation 1 and 3, respectively, are $E([X_{FV5}, Z_{FA}]' \varepsilon_{FV5}) = 0$ and $E([LFV5, X_{FV5}, Z_{FA}]' \varepsilon_{FV5}) = 0$, where

$LFV5$ is the instrumented lag of $FV5$, while the moment condition that need to hold in equation 2 and 4, respectively, are

$$E([X_{Obl}, NEd, WMSC, En]' \varepsilon_{Obl}) = 0 \text{ and } E([X_{Obl}, LObl, LFV5, NEd, WMSC, En]' \varepsilon_{Obl}) = 0$$



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Sustained Competitive Advantage in Agribusiness: Applying the Resource-Based Theory to Human Resources

Amin W. Mugera[®]

*Institute of Agriculture & School of Agriculture and Resource Economics, University of Western Australia,
35 Stirling Highway, Crawley, Western Australia 6009*

Abstract

Employees are a strategic resource for agribusiness firms to achieve sustained competitive advantage (SCA). The resource-based theory (RBT) has emerged as a useful framework to analyze the significance of the human resource system in achieving SCA. However, few empirical studies in agribusiness provide evidence of a relationship between human resource system and SCA. This paper builds off our 2005 case study exploring human resource management and sustained competitive advantage. It provides an in depth review of the RBT and develops a framework by which agribusiness scholars might operationalize the RBT for both applied research and guidance for managers.

Keywords: human resource management, resource-based view, agribusiness, sustained competitive advantage

[®]Corresponding author: Tel: +61.8.6488.3427
Email: amin.mugera@uwa.edu.au

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Introduction

The Resource-based theory (RBT) of the firm has been around for over two decades and has emerged to be a dominant management theory in explaining firm performance differentials. The theory holds that the internal resources that a firm controls have the potential to be a source of sustained competitive advantage (SCA) if the resources are valuable, rare, inimitable, and nonsubstitutable (VRIN). The theory serves as a major theoretical foundation in the management scholarly literature and prominently features in most text books in strategic management. Although the core message of the RBT is simple, and easy to grasp and teach, the application of this message in agribusiness has been slow. With the exception of Mugera and Bistch (2005), Gall and Shroeder (2006), Ng and Goldsmith (2010), there is little empirical application of the theory in agribusiness scholarship.

Why has the theory not been widely used in agribusiness scholarship? What is the importance of empirically testing the theory in the agribusiness environment? How can the test be done? What is the implication of the theory for management practice and research? Those important questions need to be addressed if the theory will find wide application in agribusiness.

The purpose of this paper is to review the literature on the RBT and its application to support SCA, with a focus on agribusiness labor management. The paper proposes the RBT as a potential theoretical framework to guide human resource management (HRM) practice and research in agribusiness. Therefore, through the review of a case study, we illustrate how HRM practices fit the RBT basic tenets and propose a conceptual framework to empirically test the RBT in the agribusiness environment. Indeed, empirical studies in non-agricultural oriented industries suggest that there is a close relationship between the employment of HRM instruments shaped according to the RBT and HRM efficiency (Wright et al. 1999). A key question is how to quantify whether the HRM practices shaped according to the RBT can contribute to SCA in agribusiness.

This paper contributes to advancing the discipline of agribusiness management by suggesting a managerial explanation for agribusiness firm behavior. As noted by Ng and Siebert (2009), the problem facing the advancement of agribusiness management is how to develop its research identity by placing greater attention to “strategic management” explanations of the firm rather than economics.

The remainder of this paper is structured as follows: first, the fundamental tenets and recent advances of the RBT are presented; second, a case study is used to illustrate the application of the RBT to analyze HRM issues in agribusiness and, third, the evidence from the case study is used to illustrate how the RBT framework can be extended and operationalized to guide future research and management practice in agribusiness..

Sustained Competitive Advantage in Agribusiness

The agribusiness sector is facing competitive challenges mainly from innovations in technology and information systems, and changes in demography, global economies and climate. Meeting those challenges is the single most important factor for achieving sustained competitive advantage (SCA). Agribusiness firms can respond to those challenges either through changes in managerial capabilities using human resource (HR) programs or through technical capabilities

using technology (Chacko et al. 1997). However, as observed by Pfeffer (1994), there is an economic trade-off between human and capital resources. It is the management of human resources rather than the reliance of advanced technology or patents or strategic position that help firms achieve SCA. Becker (2001) buttressed the strategic importance of human resources to the economic success of agribusiness firms by noting that:

“In most industries, it is now possible to buy on the international marketplace machinery and equipment that is comparable to that in place by the leading global firms. Access to machinery and equipment is not the differentiating factor. Ability to use it effectively is. A company that lost all its equipment but kept the skills and knowhow of its workforce could be back in business relatively quickly. A company that lost its workforce, while keeping its equipment, would never recover.” (Becker et al. 2001, 6)

Given recent trends in the global food and agribusiness sector, agribusiness competitiveness has become a topic of much interest in both the popular press and academic literature. The economic performances of agribusiness firms is projected to continue to increasingly dependent upon management and returns to management rather than ownership of assets and the capital earnings of these assets. This will mainly be through the adoption and use of new and innovative programs and practices in the management of HR and technology.

The focus of this paper is on labor management in large and corporate farms, hereafter-human resource management. Over the last two decades, labor use in the agriculture of North America and Australia has been affected by changes in the composition of agricultural labor and increasing shortage of skilled agricultural labor. The general trend have been a decline of number of farms, an increase of average farm sizes, and a general shortage of sufficient and skilled workforce (Productivity Commission 2005, DEST 2006, NASS 2002). This trend is attributable to a number of factors that include increase in the productivity of rural labour, overall increase in the volume of rural output, and compositional changes in rural output, with a growth in relatively labour intensive industries (Garnett and Lewis 2002). The combination of declining farm numbers, increasing size of operations and less family members returning to farms has meant a demand for employed labor with different skills.

As farms grow beyond the labor capacity of the immediate families, human resources management (HRM) becomes an important management function and practices developed for large non-agricultural corporations often may not fit the agricultural or agribusiness environment (Bitsch 2009). Therefore, HRM as a managerial function plays an important role in agriculture, particularly in the management of agribusiness organizations and large commercial farms. Traditionally, the HRM function has been viewed as the process of attracting, keeping and motivating employees.

The typical characteristic of most successful corporate organizations is a SCA that results from the configuration of their strategic assets to outperform their competitors. Sustaining competitive advantage is very crucial as competing firms will try to imitate, reach, and even outperform their rivals by acquiring similar or better resources that they perceive to be enabling their rivals outperform them.

Human resources are one of the crucial strategic assets in agribusiness and production agriculture. Farm and ranch owners, their family members and cooperating neighbors provide

substantial labor to agricultural operations. However, hired employees provide most agricultural labor especially in the labor-intensive tasks that are not easy to mechanize such as fruit picking and pruning. Attracting, motivating, and retaining qualified employees are some of the key challenges faced by agribusiness organizations. Equally, agribusiness managers face the challenge of managing their employees in an effective and efficient manner to remain competitive in the marketplace. This calls for an understanding of how to model the HRM function to be a prime source of SCA and key driver of value creation. However, agribusiness managers have little research-based information to rely on when developing HRM policies and procedures. As noted by Bitsch (2009), this is partly because research on HRM practices in agribusiness has not received significant attention in the agribusiness literature due to limited research funding, rare peer-reviewed articles, and because many editors do not perceive HRM as a priority.

The resource-based theory (RBT) has received considerable attention in the strategic management literature as a useful framework to analyze the significance of human resources (HR) in achieving SCA. The view posits that firms with a well-managed HR system have the potential to create economic value through their employees, but the potential is only realized when the HRM functions are aligned with the overall competitive strategy of a firm (Barney 2001). However, as noted by Bitsch (2009), there are few labor management studies in agribusiness that have been able to provide evidence of a substantial relationship between any particular HRM practice and productivity or competitive advantage. Yet, it has been observed that technological management programs are less influential in assisting firms to achieve their competitiveness goals than HRM programs (Chacko et al. 1997).

Resource-Based Theory: Literature Review

Literature in strategic management presents two theoretical perspectives in explaining sources of competitive advantage (CA): The Porter's five forces perspective and the resource-based theory (RBT) perspective (Kim and Oh 2003). The first perspective views CA as a position of superior performance that a firm achieves through offering cost advantages or benefit advantages (Porter, 1980, 1981). This model attributes CA to the external environmental factors that a firm must respond to such as erecting barriers of entry to competitors, product differentiation, capital requirements, and buyer switching costs (Lado et al. 1992).

The second model of CA is the resource-based theory (RBT). The model assumes that the desired outcome of managerial effort within the firm is SCA that allows the firm to earn returns that are above industry average (Fahy and Smithee 1999). This model views SCA as emanating from the distinctive resources of a firm that gives it an edge over its rivals. An organization is viewed as a bundle of specialized resources that are deployed to create a privileged market position (Barney 1986a, Ghemawat 1986, Day and Wensley 1988). Therefore, the RBT emphasizes strategic choices where managers of a firm have the important task of identifying, developing, and deploying key resources to maximize returns (Fahy and Smithee 1999). The theory focuses on the link between strategy and the internal resources of a firm in achieving SCA rather than the industry-environmental focus characteristic of the traditional strategic analysis paradigms, for example, the Porter's "five forces model" (Wright et al. 1994).

The RBT of the firm assumes that resources (factors that a firm owns and controls) and capabilities (firm's capacity to deploy resources) are both heterogeneously distributed and

imperfectly immobile. These assumptions allow for the existence of differences in firm resource endowment and those differences persist over time. The theory hypothesizes that if a firm possess and exploits resources and capabilities that are both valuable and rare, it will attain a competitive advantage. The firm will sustain this advantage only if these resources and capabilities are also inimitable and non-substitutable. Barney (1991) defines a firm's resources to include all assets, capabilities, organizational processes, firm attributes, information, and knowledge that it controls and that enable it to conceive and implement strategies that improve its efficiency and effectiveness.

Resource heterogeneity refers to the distribution of different resources across firms. Peteraf (1993) notes that heterogeneity implies that the productive factors used in firms have intrinsically differential levels of efficiency whereby some are superior to others. Therefore, firms endowed with superior resources are economical in production and can effectively compete in the market compared to those without superior resources. Resource immobility refers to the inability of competing firms to obtain resources from other firms (Wright and McMahan 1992). This could be due to several reasons: First, when the resources property rights are not well defined (Dierickx and Cool 1989); second, when the resources have no use outside the firm (Williamson 1975); third, when the resources are co-specialized, that is they are used in conjunction with another or have higher economic value when employed together (Teece 1986); and fourth when the resources have high transaction costs (Williamson 1975). Since the immobile resources are non-tradable or are of less value to other users, they remain bound to the firm and available for use over the long run. Hence, the resources are a source of competitive advantage to the firm (Peteraf 1993).

The assumptions of heterogeneity and immobility of resources are necessary but not sufficient conditions for a firm's resources to hold potential for SCA. A resource must have four other attributes to provide SCA: 1) the resources must add value to the firm; 2) the resources must be rare among current or potential competitors; 3), the resources must be imperfectly imitable; and 4), the resources should not be strategically substitutable with another resource by competing firms (Barney 1991, Wright and McMahan 1992).

A firm's resources are valuable when they enable its management to conceive or implement strategies that improve its efficiency and effectiveness. Valuable resources enable a firm to capitalize on its strengths to exploit the opportunities in the external environment while neutralizing existing threats (Barney 1991, 1999). A resource is rare when a large number of firms do not possess it. Barney (1992) urges that if a large number of firms possess a particular valuable resource, the resource becomes a source of competitive parity and not CA or SCA. Resources that are valuable and rare may lead to the resources being imperfectly imitable, i.e., not easy to obtain or copy (Lippman and Rumelt 1982, Barney 1986a, 1986b). A firm may find it difficult to obtain a valuable and rare resource because of the cost disadvantage it faces compared to firms that possess that resource (Barney 1992). Derricks and Cool (1989) describe three conditions under which resources can be imperfectly imitable. First, when the ability of the firm to obtain resources is dependent on unique historical conditions; second, when the link between the resources and the firm's competitive advantage is causally ambiguous; and third, when the resource generating a firm's competitive advantage is socially complex.

The first condition states that the performance of a firm not only depends on the industry structure within which it operates but also on the historical path it followed to arrive where it is, i.e. path dependent (Barney 1991). For example, a firm that developed significant commitment to a particular way of doing business may find it hard to adapt to minor changes in technology. Causal ambiguity is defined as the situation where the link between the resources controlled by a firm and its SCA is not understood or only understood imperfectly (Lippman and Rumelt 1982, Reed and DeFillippi 1990, Barney 1991). In this case, the relationship between a resource and other firm-specific resources and capabilities creates uncertainty regarding the causes of efficiency differences among firms. This prevents would-be imitators from knowing exactly what to imitate or how to imitate it (Lado et al. 1992, Peteraf 1993). Casual ambiguity arises out of an informational problem where a competitor is unable to identify what are the reasons behind a given firm’s success (Fahy and Smithee 1999).

Social complexity is a complex social situation arising from human interaction and constitutes a competitive advantage. According to Wright et al. (1994), the term refers to the fact that many social phenomena are complex to make it possible to manage and influence them systematically. Examples of social complexity in a firm’s resources include (1) the interpersonal relationship among managers (Hambrick 1987), (2) organizational culture (Barney 1986b), (3) reputation among suppliers (Porter 1980), and (4) a firm’s relationship with customers (Klein and Leffler 1981). The final requirement for a resource to be a source of SCA is non-substitutability. This demands that a firm’s resource must not have other strategically equivalent resources. As such, other competing firms cannot implement the same strategy because of the absence of another strategically equivalent resource to generate the SCA (Barney 1991). Figure 1 presents a conceptual framework for understanding the assumptions and conditions relevant for attaining SCA as postulated by the RBT.

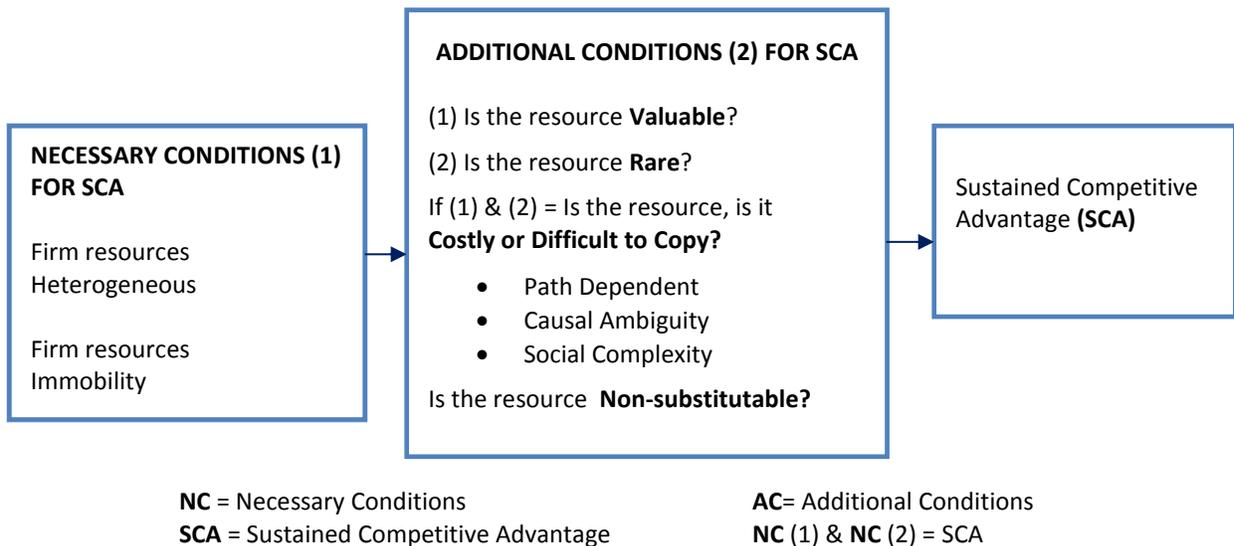


Figure 1. Conceptual framework for sustained competitive advantage as postulated by the Resource-based Theory

The RBT has emerged to be the most prominent and powerful theory of understanding organizations in the last two decades. The theory appears to have reach maturity stage; research using the resource-based framework is now precise and sophisticated, closely resembling a theory than a view¹ (Barney, Ketchen Jr, and Wright 2011). The theory has given rise to prominent spin-offs perspectives that are yet to be tested and operationalized in the agribusiness environment.

Such spin-off perspectives include the knowledge-based view (Grant 1996), the natural-resource-based view (Hart 1995, Hart and Dowell 2011), the dynamic capabilities view (Teece, Pisano, and Shuen 1997), the family capital theory (Hoffman, Hoelscher, and Sorenson 2004), and the corporate diversification view (Wan et al 2011). Insights from the RBT are already integrated with other perspectives such as the institutional theory and strategic HRM (Wright and Snell 1991, Oliver 1997, Wright et al. 2001) and organizational ecology (Ng and Goldsmith 2010).

Hoffman, Hoelscher, and Sorenson (2004) introduced the concept of family capital and proposed that family capital has potential to impact on business performance. Drawing from the RBT, they suggest that family businesses with high levels of family capital possibly do hold SCA over family businesses with low levels of family capital or nonfamily businesses. Eddleston et al. (2008) empirical study of family firms using the RBT confirm that family firms can benefit from emphasizing the positive aspects of kingship and that family relationships can be a source of CA. Hart and Dowell (2011) examine the application of the natural-resource-based view (NRBV) to help firms incorporate environment sustainability in their quest for competitive advantage. They provide a model of SCA that includes the constraints and challenges that the natural environment places on firms.

Kunc and Morecroft (2008) use the RBT to present a framework that connects managerial decision making to resource building and firm performance. The authors identify two decisions making processes: the creative conceptualization of resource configurations intended to deliver CA, and the painstaking development of resources required to implement strategy. They argue that heterogeneity in the resources of rival firms arise from the interplay of those two processes. Sirmon et al. (2011) discusses the potential of an emerging research stream, termed as resource orchestration, to enlighten our understanding of the role of managers' actions in resource management within the RBT. Makadok (2011) notes that although the RBT attributes CA as the main source of interfirm profit differentials, additional sources of profit differentials includes rival restraint, information asymmetry and commitment timing. The author propose for a unified approach of investigating the relative effects of each of those four mechanisms on interfirm profit differentials rather than examining each in isolation.

Wan et al. (2011) outlines ways to enrich the RBT perspectives on corporate diversifications by integration of ideas from organizational economics, new institutional economics, and industrial organization economics. Wenerfelt (2011) examines the process through which a firm can acquire resources and argues that firms should expand their resource portfolios by building on their existing resources. Therefore, as different firms will acquire different new resources, small initial heterogeneities will be amplified over time. Maritan and Peteraf (2011) discuss how to create heterogeneous resource position by resource acquisition in strategic factor markets and internal resource accumulation.

¹ The resource-based theory is also referred to as the resource-based view in the extant literature.

Kraaijenbrink et al. (2010) review some of the main critiques of the RBT. They identify five critiques that do not threaten the RBV's status and three that offer serious challenges that need to be dealt with if the RBV is to realize its potential to explain SCA. They recommend moving the RBV's agenda into the dynamic Austrian framework by incorporating time, space, and uncertainty resolutions into the RBV's axiomatic base.

Kraaijenbrink et al. (2010) highlight the need for analysis within firm boundaries of the internal processes of managing resources and recognition that heterogeneous human capital is a critical underlying mechanism for capabilities. Coff and Kryscynski (2011) agree that human capital provides a promising source of CA but call for stronger micro-foundations for understanding human capital-based CA. They identify individual and firm level components that interact to grant some firms unique capabilities in attracting and retaining, and motivating human capital. Co-specialization of idiosyncratic individuals and organizational systems are identified as among the most powerful isolating mechanisms that sustain human capital-based advantages.

Ng and Goldsmith (2010) use insights from the RBT and Organizational Ecology to explain a firm's entry into the ethanol market. The study demonstrates that a firm's entry timing is dependent on the specialization of their assets to which such specializations introduces a "commitment-flexibility" trade-off that influences a firm's entry into distinct stages of the product market life cycle. The study provides a greater understanding of how specialized assets impact a firm's internal decision process. This study extends RBV explanations of entry timing by attributing entry to both the specialized nature of a firm's assets as well as to the uncertain and population conditions of the market.

On methods and measurement issues within the RBT, Molloy et al. (2011) use content analysis to identify how scholars have examined 186 intangibles in published tests of the RBT. To better link RBT and measurement concerning intangibles, the authors present a theory driven multidisciplinary assessment process that integrates complimentary perspectives of economics and psychology and provides a context-specific theory of intangibles for empirical studies. All those recent development on the RBT suggest that the potential application of the theory to the agribusiness environment is unlimited and remain untapped.

Application of the RBT to HRM

Drawing from the RBT of the firm, literature in strategic HRM is increasingly concerned with whether HR can be a source of CA (Reed and DeFillippi 1990, Wright and McMahan 1992, Wright and Snell 1991, Wright et al. 1994, Kamoche 1998). Ulrich (1991), Wright et al. (1994), Barney, and Wright (1998) used the RBT to describe how HRM practices can be used to develop strategies that leads to CA.

Wright and McMahan (1992) and Wright et al. (1994) describe two conditions in the labor market that make human resources a source of CA: 1) the heterogeneous demand for labor, and 2) the heterogeneous supply of labor. The authors argue that human resources add value to the firm because of the existence of heterogeneous demand for and supply of labor. Heterogeneous demand for labor exists because firms have jobs that require different skills. For example, the skills needed to work on a dairy farm are different from those required to work in a greenhouse

operation. Heterogeneous supply of labor exists because individuals differ in their skills and level of skills. Those two conditions ensure that human resources with high competencies provide value to the firm. Wright et al. (1994) argues that there would be no variance in an individual's contribution to the firm if both the demand for and supply of labor was homogeneous, i.e., all employees and potential employees have equal productive capacity. In this case, there would be no need to create value through investment in employee training and development. However, Barney and Wright (1998) note that the main goal of HR executives is to create value through the HR function. The authors argue that a firm can create value by either decreasing product and services costs or differentiating the product and services in a way that allows it to charge a premium price. Richard (2000) observes that cultural diversity in human capital can serve as a source of CA because it creates value that is both difficult to imitate and rare.

Wright et al. (1994) used the difference in cognitive abilities of individuals to demonstrate that human resources are rare. The authors argued that jobs require individuals to have different skills that allow for variance in individuals contributions in organizations. Hence, since these skills are normally distributed, human resources with high ability levels are rare. Therefore, firms with employees of high average cognitive ability relative to their competitors will also possess more valuable human capital resources. The ultimate goal of all selection programs is to ensure that the organization is hiring only individuals with highest ability. Barney and Wright (1998) use an example from a firm in a highly competitive retailing industry to demonstrate how a firm can develop and exploit rare characteristics of its human resources to gain CA. The retailing industry is characterized as having low skill requirements and high turnover for sales clerks. Assuming the labor pool for sales clerk is homogenous, a firm can invest in attracting and retaining young college-educated sales clerks who desire a career in retailing. The firm can provide high incentive based compensation system that allows the sales persons to earn twice the industry average in pay. In this example, the firm takes labor that is considered homogenous and exploits its rare characteristic - those individuals who desire a career in retailing - to gain CA.

Wright et al. (1994) demonstrate how human resources meet the third criteria of a resource being inimitable by using the concepts of unique historical conditions, causal ambiguity, and social complexity. Human resources are inimitable when the firm has a unique history over the course of which particular cultures and norms develop. The culture and norms may meld human resources together to create a synergistic work culture where individuals cooperate in line with organizational goals. Such an organizational culture rooted in its history may not be imitable. Casual ambiguity leading to efficient production in one firm may be due to teamwork whereby it is impossible for a rival firm to create a team with similar attributes. Social complexity may arise out of transaction specific relationships whereby there is knowledge and trust between employees and other business stakeholders that are hard to analyze and imitate. Barney and Wright (1998) also point that social complex phenomenon such as an organization's unique history or culture that competitors cannot easily imitate. Richard (2000) agrees that human resources cannot be easily imitated because they are protected by knowledge barriers and are socially complex because they involve a mix of talents that are elusive and hard to understand.

The fourth condition for a resource to be a source of SCA is not to have substitutes. Wright et al. (1994) argues that human resources are one of the few firm's resources that have the potential of

not becoming obsolete. Therefore, if one firm develops a technology that provides greater productivity than what is generated by a rival firm that relies on human ability, once the latter firm is able to purchase the new technology its human resources would again become a source of CA. This is because technology can be purchased in the market place or become obsolete while human resources with high cognitive ability and highly committed to the firm are valuable, rare and cannot be imitated. Hence, human resources are non-substitutable.

Application of RBT Model to HRM in Agribusiness

Several scholars have used the RBT to conduct empirical research in strategic HRM in the non-agricultural environment (King and Zeithaml 2001, Richard 2000, Wright et al. 1999, and Koch and McGrath 1996, Wright et al. 1995). However, Mugera and Bitsch (2005) is the only empirical application of the RBT to analyze HRM practices in agribusiness.

This study builds on and extends the work of Mugera and Bitsch (2005) who applied the RBT to analyze HRM practices on six dairy farms in Michigan. Their case study employed in-depth interviews with farm managers, supervisory, and non-supervisory employees in order to illustrate an application of RBT in agribusiness.

The purpose of their 2005 study was to illuminate how the HRM practices of dairy farmers contribute to making human resources and resulting HRM systems valuable, rare, imperfectly imitable, and non-substitutable (Table 1 see Appendix). These are the attributes that contribute to farm competitiveness as postulated by the RBT.

The fundamental purpose of the RBT is to explain how a firm can deploy its internal resources to implement its **business strategy**. The mission statement defines the strategic intent of the firm and the operational goals stipulate how the firm expects to achieve its mission. To achieve CA, the mission statement and operational goals provide a road map to dairy farm managers on how to deploy, develop, and manage their human resources. Two cases had written mission statements. Three other cases did not have written mission statements but the respondents could verbally define the future direction of their farm enterprises. The statements focused on three main issues: increasing profitability, milk quality, employee job satisfaction. The long-term goals revealed that the two main strategies for the dairy farm enterprises is either expansion by increasing herd size and milk production or maintaining the farm at current size. Maintaining a sound financial position by reducing operational costs was a common theme across the six cases. The short-term goals of the farms focused on achieving efficiency in dairy management by keeping the cows healthy, producing premium milk and improving reproduction. Employees identified explicit goals that are measurable and specific as important yardsticks for value creation.

Managers of dairy farms can **create value** by either decreasing operational costs or increasing revenue and employees play a major role in achieving these goals. Employees contributed to this goal by taking measures to ensure a low somatic cell count. Employees also contributed to creating value by striving to achieve other goals such as heat detection, successful insemination, and a low calf mortality rate. Managers recognized the importance of employees in creating value by providing incentives to motivate them to achieve those goals. Rather than hire new employees formally, managers mostly relied on their current employees to recommend job seekers and provide the scarce information about the individuals' work ethics. Employees, therefore,

create value to the farms by providing important information that enables managers to overcome the problem of adverse selection and hiring of low quality employees. This reduces the cost of recruiting through advertisement or through farm labor contactors, hence reduction in operational costs. In all six cases, newly hired employees were trained on how to perform different tasks related to their jobs by working alongside incumbent experienced employees. Incumbent employees, therefore, create value to their farms by training newly hired employees and passing on their knowledge about the farm's routines and culture.

The RBT posits that a resource must be **rare** to be a source of CA. Despite the large pool of job seekers in the labor market, dairy farmers reported difficulties in recruiting employees with the requisite skills and dairy husbandly knowledge. Farmers who had made the transition from hiring local employees to immigrant employees skilled in dairy husbandly did not want to revert to the local workforce. Managers in five cases practiced selective hiring to ensure that only individuals who are can work in teams and have the aptitude to learn and work on a dairy farm were hired. Managers also reported variance in individual performance with some individuals consistently outperforming others. Managers strive to retain such employees even when there were good grounds for termination. This evidence supported the notion that skilled and knowledgeable employees who like working on a dairy farm environment are a rare resource.

Resources are immobile when they cannot be transferred easily from one farm to another. Imobility may arise out of social complexity, causal ambiguity, path dependency, or a combination of all those factors. Internal hiring deterred the transfer of specific skills and knowledge developed on one farm to another. For example, three farms trained their employees on specific milking routines that are not practiced by other dairies. Routines practiced on a particular farm are also path dependent. A farm that has been committed to particular standard operating procedures may find it difficult to adapt to new ways of performing the same tasks. Routines result in immobility of knowledge and skills because they are a result of cumulative experience and practice. Execution of a routine also depends on the given context, i.e., the physical equipment and work environment that facilitates and nurtures collective action.

Well-trained and experienced employees had higher replacement costs because they supply services that cannot be immediately provided by newly hired employees. Managers strived to retain those employees by offering job security, higher compensation, and good interpersonal relationships that minimized their mobility. Two herdsmen, for example, reported that they would not take alternative employment offers because of close interpersonal working relationships with their managers. The herdsmen were not sure whether they would have such working relationships in alternative employment offers.

Path dependency, social complexity, and causal ambiguity contributed to farms developing distinct human resource systems that were **not imitable**. Managers selected and hired non-supervisory employees based on their kinship and friendship ties with current employees because they wanted to have employees who can effectively work together in teams. Employee turnover and termination were reported to be low in five cases where selection was based on kinship and friendship ties; turnover and termination was high in the case where the manager hired walk-ins who had no ties with incumbent employees. In two cases, employees used peer pressure to compel their coworkers who are not able to meet performance expectations or who did not fit into their working culture to quit.

Causal ambiguity describes the inability of competitors to identify and imitate the sources of a firm's CA. For example, a large farm provided higher wages, more benefits and training opportunities to employees compared to a smaller farm. Yet, employees on both farms reported to be satisfied with their current employment. Therefore, employee satisfaction was a source of causal ambiguity. The history of a farm influenced its ability to achieve CA through its human resource system. For example, one manager mentioned that family values and beliefs determined the farm's organizational culture. Family employees trusted each other and subsequently trusted their hired employees. This evidence suggests that family capital can be a source of CA.

Milking is done in shifts and employees work in teams. When employees are able to achieve the set operational goals like low somatic cell count or increased milk production, it is not possible to determine or separate the contribution of each individual in the team. Therefore, high productivity arising from teamwork production is a potential source of causal ambiguity because it is not easy to relate superior performance to an individual's effort. The manager cannot isolate and reward the individual nor can the competitors hire out the individual responsible for the high performance.

Employees on dairy farms are **non-substitutable resources**. All cases hired year-round fulltime employees because dairy farming could not be fully automated. Even on highly mechanized farms, human resources were needed, for example, to monitor the herd health, administer treatment, and assist calving cows. Current technology and machinery will become obsolete over time but human resources that are constantly educated and retrained retain their value. Dairy farm automation may result in increasing the number of cows per employee but does not entirely replace the need for human resources. For example, the organizational culture and interpersonal work relationships that are based on kinship and friendship ties on each farm cannot be easily substituted.

Across case comparisons of the labor management practices indicated that each case had a distinct human resource system emanating from its organizational culture, kinship and friendship ties, resource endowment, and HRM practices. Organizational outcomes, such as voluntary turnover and termination rates, employee satisfaction, and manager satisfaction did not stem from single or isolated HRM practices. Therefore, in each case, the manager had the potential to develop his or her own unique human resource system as a source of SCA. Such a human resource system is not something that can be purchased from the labor market. Overall, the managers recognized the importance of hired labor to the success of their farm enterprises and three managers considered losing their employees due to voluntary turnover as their worst-case scenario in HRM.

The empirical results from the six case studies lend support to the claim that dairy farm managers can manage their human resources effectively and efficiently to achieve CA. Human resources and the emanating human resource systems on dairy farms have the potential of being valuable, rare, inimitable, and non-substitutable if effectively managed².

² The leadership style of the farm manager is equally important in managing resources to achieve CA. The manager who applies good leadership styles can enhance the potential of his HR system to be a source of competitive advantage. The philosophy and personality ("emotional intelligence") of a manager can indirectly lead to CA by influencing the leadership capability necessary for implementing effective strategic change.

Empirical Test of the RBT in the Agribusiness Environment

The RBT was a useful theoretical framework for understanding how human resources in the six dairy cases can be a SCA, and the role of the HRM function in this process. To gain better understating on how to achieve SCA through HR, there is need for future empirical research to narrow the gap between the theoretical utility and the practical utility of the RBT by operationalizing the theory in the agribusiness environment. Levitas and Chi (2002) and Rouse and Daellenbach (2002) both state that RBT can be validated empirically without having to operationalize all its key constructs.

The model depicted in Figure 2 provides a conceptual framework of how different HRM practices from the case study relate to the four key assumptions of the RBT. The model also draws from the work of several authors on the RBT (Barney 1991, Wright et al. 1994 and Wright et al. 2001) to demonstrate that SCA does not emanate from isolated HRM practices, like compensation and training. It emanates from the integration of HR practices, managerial function, and employee behaviors into an HR system that is a strategic partner to the overall competitive strategy of an organization.

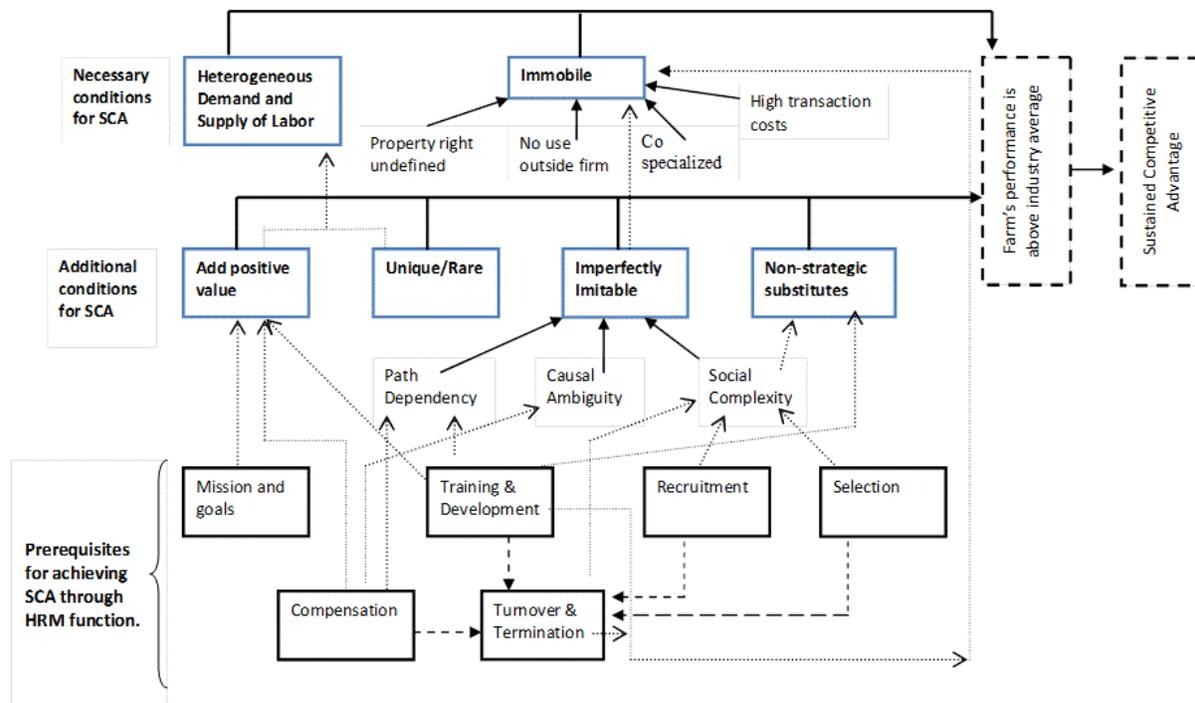


Figure 2. A proposed conceptual framework for investigating the relationship between HR systems and firm performance grounded on the RBT.

Note. Black boxes represent HRM practices, blue boxes represent the necessary and sufficient conditions for the RBT to hold, and dashed boxes represent firm outcomes. Dotted arrows represent the relationship between HRM practices and RBT constructs, dashed arrows represent the relationships between HRM practices and outcomes, and solid arrows indicate the linkage of the RBT constructs and firm outcomes.

The dotted arrows from the boxes with HRM practices indicate how the practice relates to the four key assumptions of the RBT. For example, the arrow extending from compensation to add positive value indicates that managers can use compensation to add value to the farm, say by providing performance based incentives. The arrow extending from compensation to path dependency indicates that the compensation system of a firm is path dependent. Solid arrows that link path dependency, causal ambiguity, and social complexity indicate that those three factors lead to a resource being imperfectly inimitable. Likewise, solid arrows linking to immobility indicate the factors that contribute to a resource being immobile.

The dotted arrows linking add value and rare to heterogeneity indicate that the assumptions of a resource being valuable and rare contribute to the resource being heterogeneous (Barney 1991, Lado and Wilson 1994). The dotted arrow linking imperfect inimitability to immobile indicates that meeting the conditions of not being easy to imitate also contributes to a resource not being easy to transfer from one case to another. Therefore, to empirically test the relationship between the HRM function and the performance of a farm based on the RBT, one needs only to test whether human resources meets the four key assumptions of being valuable, rare, imperfectly inimitable and having no strategic substitute.

The dashed arrows from compensation, training and development, recruitment, and selection indicate that those four practices have an effect on termination and voluntary turnover. Termination and turnover together with the direct effect of training and development eventually affect the mobility or immobility of human resources. The solid lines indicate the conditions postulated by the RBT for a resource to generate competitive advantage.

Before testing the theory one needs to operationalize the key criteria that human resources and the HR system have to meet to fulfill the RBT assumptions of a resource being valuable, rare, inimitable and non-substitutable. This can be achieved by designing a structured questionnaire that focuses on the HRM practices and organizational culture. Those practices would include recruitment and selection criteria, training and development, compensation, and termination. The questionnaire would also include aspects of strategic planning like mission and goal setting.

Collected data could be analyzed using the principal component analysis (PCA) method to extract the main factors that relate to the RBT. Principal component analysis explains the variance structure of a matrix of data through linear combinations of variables. Hence, the data can be reduced to a few principal components that generally describe 80 to 90% of the variance for each construct. The extracted factors can be used as proxies for the four RBT constructs.

To explore the relationship between the four factors and firm performance, truncated and ordinary least square regression models can be used. Sustained competitive advantage can be measured by benchmarking the performance of a farm relative to other farms in the same industry. Return on assets, technical efficiency, and allocative efficiency can be used to measure the performance of firms. Technical efficiency refers to the ability of a firm to obtain maximum output from a given set of inputs with reference to a production function. Allocative efficiency measures the ability of a firm to use inputs and outputs in optimal proportions, given prevailing market prices. Those two measures can be combined to provide the measurement of total economic efficiency. The efficiency scores can be computed from output and inputs data using the

econometric approach (i.e., stochastic frontiers) or mathematical programming approach (i.e., data envelopment analysis).

The dependent variables in the analysis would be measures of technical efficiency, allocative efficiency and return on assets. The extracted factors from PCA would be the explanatory variables in the following regression equations:

$$(1) \text{ Technical efficiency} = \alpha + \beta_1 \text{Value} + \beta_2 \text{Rareness} + \beta_3 \text{Inimitability} + \beta_4 \text{Non-substutable} + \varepsilon$$

$$(2) \text{ Allocative efficiency} = \alpha + \beta_1 \text{Value} + \beta_2 \text{Rareness} + \beta_3 \text{Inimitability} + \beta_4 \text{Non-substutable} + \varepsilon$$

$$(3) \text{ Return on Assets} = \alpha + \beta_1 \text{Value} + \beta_2 \text{Rareness} + \beta_3 \text{Inimitability} + \beta_4 \text{Non-substutable} + \varepsilon$$

The suggested framework would answer the question of why the performance of agribusiness firms differ by extending production economics to explain how HRM practices impacts on a firm's SCA. For instance, the computation of allocative efficiency is important in determining the optimal mix of inputs and outputs given prevailing market prices. Although the proposed framework can be implemented in a cross-sectional setting, use of a longitudinal setting would be more appropriate as the dynamic relationship between the RBT key constructs and firms' performance can be observed over time. Dummy variables can be included in the three equations to control for unobserved heterogeneity across firms, for example, farm size and recent history of major change such as expansion. Equations 1 and 2 can be estimated using truncated regression while equation 3 can be estimated using ordinary least square.

Conclusion

This paper has provided a comprehensive review of the Resource-based theory as a framework to formulate HRM strategies to achieve SCA. Drawing from the fundamental tenets of the theory, a review of empirical studies in strategic HRM served to illustrate how the concept can be applied in agribusiness. A case study in agribusiness was used to illustrate how the different HRM functions fit to the theory. Given that this type of study is still in the explorative stage, a conceptual framework on how to empirically test the theory in agribusiness environment is proposed. This is a good starting point for engaging both practitioners and academicians in developing HR systems that are shaped according to the RBT tenets.

The paper demonstrated that the HRM system is a potential source of SCA for agribusiness firms. Employees in agribusiness firms are enablers of change and can help the agribusiness organizations to dynamically develop and achieve longer-term superior performance relative to other firms in the same industry. However, the gap between the theoretical utility and the practical utility of the RBT need first to be narrowed by operationalizing the theory in the agribusiness environment.

The RBT has not been widely used in agribusiness scholarship, perhaps due to a lack of a comprehensive review of the theory in agribusiness and challenges in operationalizing the theory. Therefore, there is need to empirically test the theory in the agribusiness environment in order to explain differences in the performance of agribusiness firms with the aim of identifying factors that lead to superior performance over time such as management practices or resource

endowment. The necessary next step is to apply the proposed framework to a variety of agricultural settings to evaluate its usefulness and make modifications as necessary.

The management implication of this study is that agribusiness managers can use the RBT framework to configure how their HR system operates and identify ways in which it can be customized to be a source of SCA. The focus should be making the HR system valuable, rare, inimitable, and nonsubstitutable. Managers need to understand how to nurture firm idiosyncrasies such as trust-based relationships and routines that can lead to SCA. This would involve a shift of perspective from one that sees the HRM function as primarily administrative to recognizing the HRM function as a key player in the overall competitive strategy of a firm.

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Appendix

Table 1. Potential Sources of Competitive Advantage in the Six Cases

Valuable	Rare	Inimitable	Non Substitutable
<ul style="list-style-type: none"> ▪ Employees achieve goals that bring revenue to the farms. ▪ Employers provide incentives and bonuses for achieving goals. ▪ Employees avoid mistakes that affect the farm's bottom line. ▪ Employers reduce operational costs by cutting down expenditure on labor. ▪ Employers recruit through their employees provide valuable information about job candidates. ▪ Employers invest in training employees to acquire specialized knowledge and skills. ▪ Current employees train new employees at no cost to the farm. 	<ul style="list-style-type: none"> ▪ Not all job seekers have requisite skills to work on dairy farm. ▪ Employers hire selectively. ▪ Some employees have specialized knowledge such as the veterinarians and nutritionists. ▪ Variance in individual performance at work. ▪ Most employers prefer hiring Hispanic to American employees. ▪ Employers retain their productive employees even then there are reasons to terminate them. 	<p>Social Complexity</p> <ul style="list-style-type: none"> ▪ External social networks used by employees to recruit. ▪ Interpersonal relationships among coworkers based on kinship and friendship ties. E.g., peer pressure. ▪ High performance due to team work production. ▪ Trust based relationships between managers and employees developed over time. <p>Causal Ambiguity</p> <ul style="list-style-type: none"> ▪ Causes for employee satisfaction. ▪ Superior performance emanating from teamwork. <p>Path Dependency</p> <ul style="list-style-type: none"> ▪ Organizational culture-values, norms and beliefs. ▪ Work routines that are farm specific, e.g. milking. ▪ Resource accumulation. E.g., tacit knowledge and skills in employees that results from cumulative learning. 	<ul style="list-style-type: none"> ▪ Unique workplace relationships based on kinship and friendship ties that lead to increased performance. ▪ Organizational culture on the farms that is path dependent. ▪ Human capabilities that cannot be replaced by capital goods.



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Competitiveness, Efficiency and Environmental Impact of Protected Agriculture in Zacatecas, Mexico

Luz E. Padilla Bernal[ⓐ], Alfredo Lara-Herrera^ᵇ, Elivier Reyes-Rivas^ᶜ, and Oscar Perez-Veyna^ᵈ

^ᵃ *Researcher Professor, Unidad Académica de Contaduría y Administración, Universidad Autónoma de Zacatecas, Comercio y Administración s/n, Col. Progreso, Zacatecas, Zac. C.P. 98066, Mexico*

^ᵇ *Researcher Professor, Unidad Académica de Agronomía, Universidad Autónoma de Zacatecas, Carr. Zacatecas - Guadalajara Km 15.5 Cieneguitas, Zac., México*

^ᶜ *Researcher Professor, Unidad Académica de Contaduría y Administración, Universidad Autónoma de Zacatecas, Comercio y Administración s/n, Col. Progreso, Zacatecas, Zac. C.P. 98066, Mexico*

^ᵈ *Researcher Professor, Unidad Académica en Estudios del Desarrollo, Universidad Autónoma de Zacatecas, Av. Preparatoria s/n, Col. Hidráulica, Zacatecas, Zac. C.P. 98064, Mexico*

Abstract

In Zacatecas, agriculture consumes 77% of the underground water; 44% of the aquifers are over extracted. All protected agriculture production systems pump water from the aquifers for irrigation, and 96% of the production units were constructed with government support. They also receive support for inputs and domestic production factors. This paper analyzes the impact of agricultural policy on protected tomato production in the state of Zacatecas, Mexico, by examining competitive and efficient technologies and considering alternative sustainable production practices. The Extended Policy Analysis Matrix was applied. The analysis included four technologies under current conditions and two scenarios: a) adoption of sustainable production practices and b) unsustainable practices, at economic and private prices. The sustainable project paid for itself under both private and economic prices.

Keywords: greenhouses, agricultural production systems, comparative advantage

[ⓐ]Corresponding author: Tel: + 492.9223309

Email: luze@uaz.edu.mx

A. Lara-Herrera: alara204@hotmail.com

E. Reyes-Rivas: ereyes21@yahoo.com.mx O. Perez-Veyna: pveyna@uaz.edu.mx

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Introduction

In the state of Zacatecas, located in the north-central region of Mexico, the number of protected agriculture production units (PU) has had accelerated growth in recent years. The mean rate of annual growth of the cultivated area during the period 2000 to 2010 was 25% (Padilla-Bernal, Lara-Herrera, Reyes-Rivas, and Pérez-Veyna 2011). In 2010, this area was estimated to be 277 ha, of which 90% was cultivated under tomato (SEDAGRO 2010). The area under protected agriculture in Zacatecas accounts for nearly 10% of the total in Mexico (Cook 2007). Given the growth rate of these PU, the area is now estimated to be larger.

The protected agriculture production systems, in the modality of intensive agriculture, aim to obtain the highest yield possible, isolating the crop from natural conditions and applying artificial climate and cultural techniques to obtain maximum profitability (Castellanos and Borbón 2009, 1), implicating better use of the natural resources water and soil (Antón 2004). Technologically advanced production units require higher investment, but yields are higher and risk is lower (Padilla-Bernal, Rumayor, Pérez-Veyna and Reyes-Rivas 2007).

One of the main factors to which rapid expansion of protected agriculture is attributed is government aid for construction. The authorities have considered this modality as an alternative to contribute to regional development (GODEZAC 1999; 2005; 2011). Recently, around 96% of the PU were granted support by the program Alianza para el Campo (SAGARPA 2006; Padilla-Bernal et al. 2010). Furthermore, protected agriculture producers, like other farmers, have access to other types of government aid: subsidy to diesel for agricultural use (SAGARPA 2009), subsidy to electricity for pumping irrigation water, zero aggregated value tax (IVA) on fertilizers, pesticides and other agrochemicals, among others. Some of this support forms part of the government Alianza para el Campo (Contigo) and Apoyos a la Comercialization (SAGARPA 2009). These programs appeared in the 1990s to help incorporate producers into the process of trade aperture and to increase their competitiveness in the face of the State's withdrawal from agricultural production and commercialization. The support that reduces relative prices of agrochemicals and diesel induces higher consumption than would be determined by an undistorted market, resulting in false profitability. A lower relative price of agrochemicals, diesel or irrigation water also discourages the adoption of new technologies (Ávila et al. 2005).

For irrigation, 100% of the protected agriculture production systems in Zacatecas extract underground water; that is, they pump water from the aquifers. The main source of water for the diverse activities of the region is 34 aquifers, of which 44% are over-extracted (CNA 2011). Agriculture consumes 77% of the available underground water (CNA 2008; 2011), irrigating more than 130 thousand hectares (INEGI 2010) with high water consumption caused by over-irrigating and obsolete irrigation systems (OECD 2008, 7; Mojarro et al. 2010, 2-3). In Mexico, whoever receives an underground water concession can use a given amount of water from the aquifer free of charge, an implicit subsidy.

Over-extraction of the aquifers causes damage to the environment. Over-extraction means less water in the future leading to greater salinization of the soil and reduction of crop yields, and thus less sustainable production systems (OECD 2008, 7). A production system is not sustainable if agricultural practices impose negative externalities or degrade the environment, creating a

market failure. Agricultural production costs in unsustainable systems ignore negative immediate impacts on other people or long-term degradation of this natural resource base. On the other hand, eliminating environmental market failures contributes to the creation of sustainable agricultural production systems. It would also contribute to sustainability if government policy corrects negative externalities and degradation of resources (Pearson, Gotsch, and Bahri 2003, 67). Agricultural production costs in the sustainable production systems are fully accounted because they include immediate negative external impacts on other people and expenses to offset long-term degradation of the natural resource base.

In protected agriculture, besides the environmental problems that all agricultural practices generate such as affecting soil quality, soil degradation and salinization, especially where water is limited, there is the additional problem of generating residues (Stanghellini 2003; Ren 2003). For this reason and given the accelerated increase in these production units, the government authorities in Zacatecas are interested in having information that would lead to the creation of a development strategy and the definition of policies oriented toward planning growth of protected agriculture production units and creating norms that help to protect the environment.

The objective of this study was to examine the impact of agricultural policy on protected agriculture tomato production systems in the state of Zacatecas, Mexico, by identifying competitive and efficient technologies, considering alternative sustainable production practices (alternative projects). The analysis is performed under two accounting perspectives. The first perspective uses existing distorted private prices and the second perspective uses efficient economic prices that recognize the true social benefit opportunity cost of using resources in protected agriculture. Elements are provided to contribute to the formulation of policies for sustainable rural development and strategies for increasing the value chain's competitiveness. The following research question is answered: What is the behavior of competitiveness and efficiency in the production systems when they adopt sustainable production practices?

Agricultural Policy and Environmental Market Failures

Agricultural policies are government decisions that have the intention of influencing the level of input and product price stability, public investment that affects agricultural production, costs and incomes, and revenue allotment. Policies that impact the agricultural sector can fall into one of the following three categories: agricultural price policies, macro-economic policies, or public investment policies. One distorting policy is government intervention that forces market prices to diverge from their efficient valuation. Taxes and subsidies, international trade restrictions, or price regulations can lead to divergence from efficient valuation. Distorting policies are usually established to promote non-efficiency objectives, such as equity or safety (Pearson, Gotsch, and Bahri 2003). Another way to make efficient price valuations diverge is market failures. A market failure is created when price mechanisms do not achieve competitive results or efficient prices. The common types of market failures are monopolies, externalities, environmental degradation and imperfections in the market of factors. Environment degradation refers to changes in physical resources such as soil, water or air. In the case of environmental market failures in the agricultural sector, most occur when farmers misuse use a physical resource since they do not have to pay full costs, as is the case of irrigation water in Mexico. There are two types of environmental market failures: environmental externalities and environmental degradation

(Monke and Pearson 1989, 5; Kydd, Pearce, and Stockbridge 1997; Pearson, Gotsch, and Bahri 2003, 67). The existence of an environmental market failure provides a rationale for government intervention to attempt to correct the divergence.

Negative environmental externalities in the agricultural sector are distinguished by involving the use of soil and water; this is the case of water pollution from use of chemical pesticides. They appear when the producer or consumer imposes immediate costs on other people for which they cannot be charged. In contrast, positive externalities occur when producers or consumers generate immediate benefits for others for which they cannot receive compensation. When negative externalities occur, the market fails since they cannot include negative external costs for producers that damage the environment (Baumol and Oates 1995).

Environmental degradation refers to overuse of physical resources (soil, water, air and forests) by producers or consumers. This imposes future costs on all of the users of natural resources including those individuals responsible for degradation of the resource base (Pearson, Gotsch and Bahri 2003, 68). If the negative effects do not occur for many years, producers will have few incentives to invest in resource conservation actions for the future. When users understand the probable impact on the future use of current resources, they may be motivated through policies aimed to conserve resources.

Kydd, Pearce, and Stockbridge (1997, 337-338) assert that, to a certain degree, environmental degradation associated with agricultural production can be reduced through application of conservation measures (Anaya 2010, 65) and improved agricultural practices. Costs associated with these measures are borne directly by expenses incurred in the development of these practices or indirectly through loss of productivity associated with different farming practices. In either case, environmental costs are borne by the producer in absence of government subsidies. Kydd, Pearce, and Stockbridge (1997) add that in most countries the cost of these market failures are not internalized in the indicated way, but are borne by the society as a whole.

Materials and Methods

Extended Policy Analysis Matrix

The Extended Policy Analysis Matrix (EPAM) was used to examine the impact of agricultural policy on protected agriculture production systems in Zacatecas under alternative sustainable production practices (alternative projects). This is used to determine the impact of the policies on competitiveness and efficiency, or comparative advantage, of the production systems in the present and two hypothetical scenarios: a) with the adoption of resource conservation practices, denominated sustainable, and b) with agricultural practices that generate negative externalities, denominated unsustainable. It is also used to guide agricultural research policies and technological change (Monke and Pearson 1989; Pagiola 1991; Kydd, Pearce, and Stockbridge 1997; Pearson, Gotsch, and Bahri 2003).

It should be pointed out that internalizing costs of environmental degradation and taking into account some benefit of alternative sustainable production practices is not an easy task. Although the area to be studied has quite uniform climatic, topographical and physical production

conditions, the quantity of required data is enormous. Where these conditions are diverse, as in most cases, obtaining sufficient information with some degree of detail is practically and financially impossible. Despite all this, a rough estimation that can serve to formulate policy for some commodity can be arrived at (Kydd, Pearce, and Stockbridge 1997, 337; Pearson, Gotsch, and Bahri 2003, 69). Thus, in the case of protected tomato production in the state of Zacatecas, environmental impact of the production systems is incorporated through lower productivity caused by environmental degradation attributed to overuse of underground water.

The main empirical task in the application of EPAM is determining the budgets of agricultural production systems at private or market prices as well as economic efficiency prices. Economic efficiency prices are those that reflect values of scarcity or that recognize the true social opportunity cost. Moreover, prices denominated “sustainable” that are aimed to correct environmentally related market failures were used.

The first row of EPAM is a budget that shows current revenues, costs, and profits at market prices. The second row shows the budget of a scenario denominated “unsustainable”, also at market prices. This registers the drop in productivity associated with environmental degradation. The third row presents a scenario denominated “sustainable” at private prices, which considers the costs and investment required for adoption of alternative sustainable production practices (alternative project).

The fourth row of the matrix (Table 1) is a budget of the current situation valued at economic efficiency prices. The fifth and sixth rows show the “unsustainable” and “sustainable” scenarios also valued at economic efficiency prices, considering environmental costs and their internalization, respectively. The last three rows of the matrix, called divergences, are determined by the difference between the first and fourth rows, between the second and fifth, and between the third and sixth rows. These show the net impact of distorting policies and market failures. The signs of divergences in revenues, costs and profits indicate whether the net effect of the policy and market failures point to a subsidy or a tax, or alternatively, market failures. The costs in EPAM are divided into two columns, one for tradable inputs and another for domestic factors. Tradable inputs are traded or could be traded internationally. Domestic factors are the primary factors of production: labor, capital, land, natural resources.

Applying EPAM, there is competitiveness when, under present market conditions, an individual producer obtains profits in a production system. There is comparative advantage, or it is efficient if, prevalent market distortions are eliminated, a production system is able to generate the highest levels of output and income (Monke and Pearson 1989, 20).

Therefore, if π_p is positive, the system generates profit under current market policies and conditions, and it is said to be competitive. Likewise, if π_e is positive, the system is capable of generating profit valued in prices that reflect scarcity values or social opportunity costs, that is, without subsidies or restrictions imposed by taxes, and therefore, the system is efficient. For

example, if a system receives a subsidy to inputs or pays labor at prices lower than those determined by an efficient labor market, the system can be competitive but is not efficient, or does not have a comparative advantage. Also, $\lambda\pi_{pn}$ and $\lambda\pi_{en}$ registers profits or losses of the systems

denominated unsustainable, while $\lambda\pi_{ps}$ and $\lambda\pi_{es}$ does so for those with alternative projects, valued at both market and economic efficiency prices.

Table 1. Extended Policy Analysis Matrix

	Revenues (<i>R</i>)	Costs		Net profit (π)
		Tradable inputs (<i>TI</i>)	Domestic factors (<i>DF</i>)	
Private prices (current)	R_p	TI_p	DF_p	π_p
Private prices (unsustainable)	λR_{pu}	λTI_{pu}	λDF_{pu}	$\lambda \pi_{pu}$
Private prices (sustainable)	λR_{ps}	λTI_{ps}	λDF_{ps}	$\lambda \pi_{ps}$
Economic prices (current)	R_e	TI_e	DF_e	π_e
Economic prices (unsustainable)	λR_{eu}	λTI_{eu}	λDF_{eu}	$\lambda \pi_{eu}$
Economic prices (sustainable)	λR_{es}	λTI_{es}	λDF_{es}	$\lambda \pi_{es}$
Divergences (current)	Rd_t	$TI d_t$	$DF d_t$	πd_t
Divergences (unsustainable)	λRd_{tu}	$\lambda TI d_{tu}$	$\lambda DF d_{tu}$	$\lambda \pi d_{tu}$
Divergences (sustainable)	λRd_{ts}	$\lambda TI d_{ts}$	$\lambda DF d_{ts}$	$\lambda \pi d_{ts}$

Source. Monke and Pearson 1989; Kydd, Pearce, and Stockbridge 1997; Pearson, Gotsch, and Bahri 2003.

To compare the production systems, which can be different in terms of the relative proportions of inputs they use, with the data registered in EPAM, indicators of competitiveness or profitability and efficiency or comparative advantage are obtained. The indicator of private profitability is the private cost ratio (PCR), also called the competitiveness ratio. PCR measures the proportion of the domestic factor cost relative to value added. Value added is the difference between the value of output and the cost of tradable inputs.

$$1) PCR = \frac{DF_p}{R_p - TI_p}$$

Where DF_p are domestic factors; R_p and TI_p are output value and tradable inputs at private prices. If the ratio is greater than one ($PCR > 1$), the domestic factor cost is greater than the value added or created wealth, and therefore, the system is not profitable: the crop is not profitable for the producer in terms of the prices paid and prices received. If $PCR < 1$, the system is profitable, and earns extraordinary profits. Thus, the most profitable production systems are those with a PCR closest to zero.

The domestic resource cost (DRC) ratio provides a measure of efficiency or level of comparative advantage. This is a ratio similar to that of competitiveness but calculated at economic efficiency prices, obtained with the following equation:

$$2) DRC = \frac{DF_e}{R_e - TI_e}$$

Where R_e , TI_e and DF_e are output value, tradable inputs and domestic factor costs at economic efficiency prices. If $DRC > 1$, the system does not have comparative advantage; if $DRC < 1$, the system has comparative advantage and is said to be economically efficient. Under the assumption that subsidies or taxes and market distortions are eliminated, the empirical analysis of comparative advantage determines whether, in a medium term, certain commodities produced in different regions of the country will be competitive with equivalent products on the international markets. The main limitation of EPAM is its inability to calculate how the production systems expand or contract when prices change, although its structure allows simulation of changes and evaluation of other scenarios.

Unsustainable and Sustainable (Alternative Project) Scenarios

The scenario denominated “unsustainable” considered environmental degradation from the overuse of irrigation water, thereby impacting the productivity of production systems. This is evaluated at both market prices and economic efficiency prices (Pearson, Gotsch, and Bahri 2003, 67-5). Multi-annual budgets were constructed assuming a 2% decrease in yields (Castellanos and Ojodeagua 2009, 187-04; Macías-Duarte et al. 2010, 11-9) with a 15-year time horizon. Adjustments were made for use of day labor during harvest and packing, and an additional investment of digging a well 14 meters deeper was considered (CNA- GODEZAC-UAZ, 2008). In contrast, the scenario denominated “sustainable” adopts sustainable production practices (alternative project). In this scenario, constant production yields over time (15 years) are assumed as well as less use of water by the plant, rainwater harvesting and storage in cisterns, and use of moisture sensors are considered.

Within the EPAM structure, values in the unsustainable and sustainable scenarios are determined by deducting revenues, costs (tradable costs and domestic factor costs) and profits represented by λR , λTI , λDF and $\lambda \pi$ at present value (PV), with both private and economic prices, where the subindexes pn , ps , en and es , refer to valuation at private and economic prices in unsustainable and sustainable production systems, respectively. The prefix λ means that the variable represents discounted revenues, costs or profits at a given time period—for this case, 15 years. For example, λR_{pu} represents the present value (PV) of returns from tomato production in the unsustainable system over 15 years. Therefore,

$$3) \sum_1^n R_{pu} \frac{1}{(1+r)^n}$$

Where r is the interest rate and n the number of years.

The divergences attributed to the adoption of alternative sustainable production practices are calculated by the difference in profits: unsustainable system (with no project) minus sustainable system (alternative project) (Pearson, Gotsch, and Bahri 2003, 58-4).

$$4) \lambda \pi_p = \lambda \pi_{ps} - \lambda \pi_{pn} ;$$

$$5) \lambda \pi_e = \lambda \pi_{es} - \lambda \pi_{en} ;$$

where $\lambda\pi_p$ and $\lambda\pi_e$ are the PV at market (p) and economic efficiency (e) prices of the divergences from adoption of sustainable agricultural practices; $\lambda\pi_{ps}$, $\lambda\pi_{pn}$ and $\lambda\pi_{es}$, $\lambda\pi_{en}$ are the PV of the net benefits from applying sustainable (s) agricultural practices or unsustainable (ns) practices, also valued at market (p) and economic efficiency (e) prices.

Selection of Production Systems and Sources of Information

To determine which production systems to study, tomato production units were grouped by technological level using cluster analysis. The variables used in the analysis were structure, culture method, climate control and size (Padilla-Bernal et al. 2010). Four groups were obtained: high, intermediate (transition), intermediate, and low. One production unit was selected to represent each technological level. The main characteristics of the production systems analyzed are presented in Table 2.

Table 2. Principal characteristics of the protected agriculture production systems.

	Technological Level			
	<i>Low</i>	<i>Intermediate</i>	<i>Intermediate (transition)</i>	<i>High</i>
Tomato type	Saladette	Saladette	Saladette	Raceme globe
Structure	<i>Raspa y amagado</i>	Multitunnel	Multitunnel	Multitunnel
Culture method	Soil	Soil	Hydroponics+soil	Hydroponics
Climate control	Passive	Passive	Active	Active
Size	Large	Medium	Medium	Large
Production period	June-September	May-October	July-November	August-April
Destination market	Domestic and USA	Domestic	Domestic	Domestic and USA
Domestic market	Central wholesale market, Iztapalapa, D.F.	Central wholesale market, Guadalajara	City of Zacatecas and Jerez, Zac.	Central wholesale market, Aguascalientes
Growing cycle (days)	180	240	210	334

Source. Constructed by authors with data obtained in fieldwork.

The information on the technical coefficients of the production systems studied was obtained through a survey carried out in May to June, 2010, of technicians from the selected production units. The unit of analysis was one hectare cultivated in the 2009 cropping season. The technical coefficients per production system were validated by specialists in the area. Private prices of tradable inputs were obtained from suppliers. Information on investment in the structure, wells and irrigation equipment was determined with estimates from construction companies and equipment suppliers. Investment in cisterns for harvesting rainwater was that indicated by Anaya (2010) and Brown, Gerston, and Colley (2005), considering the mean annual rainfall recorded during the period 2002-2010 in the areas where the production systems are located. Additional

information was collected during visits to the production units, for which an observation data card was designed.

The private tomato price considered the market destination, domestic and/or international, and was determined at the farm level taking into account the months the produce was traded. Reference prices were obtained from the Sistema Nacional de Información e Integración de Mercados (SNIIM - National System of Market Information and Integration) and the US International Trade Commission (USITC), for domestic and international markets, respectively.

The economic efficiency price of tomato was determined as an export parity price and tradable inputs as import parity price at the farm level. To calculate parity prices, an adjustment was made for the overvaluation in the exchange rate of the Mexican peso relative to the US dollar. The average annual rate of overvaluation in 2009 was 11.4% (CEFP 2010). The international reference for these inputs was the average price paid by US farmers in April of 2006, 2007 and 2008 (NASS-USDA 2009). In the case of labor, mechanized work, administrative salaries, farm insurance, social security and land, it was assumed that the economic efficiency prices are the same as market prices.

For short and long term credit, the economic opportunity cost of capital was considered with a real interest rate of 10% and 12 %, respectively (Monke and Pearson, 1989), and a rate of accumulated inflation of 3.5% (BANXICO 2010) for the year 2009. In this way, the interest rate on nominal short term credit used in the analysis at market prices (13.91%) was adjusted to an annual 13.92% in the economic analysis, while long term credit ascends from an annual 14.61% to 15.99%. The nominal interest rates are those reported by the Fideicomisos Instituidos en Relación con la Agricultura (FIRA 2009) in 2009, for short term (one year) and long term (10 years) credits to producers with yearly incomes above 1,000 times the minimum wage. The subsidized 9 CU rate of Mex \$0.42 kwh in 2009 (CFE 2007) was adjusted to its real cost, Mex \$1.50 kwh (Fernández 2009).

Results

Tables 3a, 3b and 3c summarize the revenues, costs and profits at both private and economic efficiency prices, as well as the total divergences obtained in the current situation and the two scenarios of the production systems studied. In all cases, profits are reported, although these are higher at economic efficiency prices. This is attributed to the fact that the divergence obtained between the economic price of tomato and the price on the domestic market is higher than the divergence generated by the effect of the policy of overvaluation of the exchange rate in tradable inputs plus the subsidies to the cost of electricity for pumping irrigation water and to the interest rate. As expected, the highest profits occurred in the production system with advanced technology, while the lowest occurred in those with low technology. It should be pointed out that the latter has lower investment than the other systems and produces only during the spring-summer growing season, and consequently, has lower annual yield.

Table 3a. Extended Policy Analysis Matrix for protected tomato production systems. Current situation (thousands of Mexican pesos/ ha).

	Revenues	Costs		Net profits
		Tradable inputs	Domestic factors	
Low technology				
Private prices	1,604	483	688	433
Economic prices	2,157	550	695	912
Divergences	-554	-67	-7	-480
Intermediate technology				
Private prices	2,235	648	893	694
Economic prices	3,038	737	902	1,399
Divergences	-803	-89	-9	-705
Intermediate technology (in transition)				
Private prices	2,437	934	960	542
Economic prices	3,999	1,113	981	1,905
Divergences	-1,563	-178	-21	-1,363
Advanced technology				
Private prices	7,774	2,948	2,065	2,762
Economic prices	9,203	3,507	2,104	3,592
Divergences	-1,429	-560	-39	-830

Notes. Calculated at present value in a period of 15 years, with an interest rate of 14.61% at private prices and 15.99% at economic efficiency prices.

Table 3b. Extended Policy Analysis Matrix for protected tomato production systems. Scenario with unsustainable practices (thousands of Mexican pesos/ha).

	Revenues	Costs		Net profits
		Tradable inputs	Domestic factors	
Low technology				
Private prices	8,646	2,878	4,087	1,682
Economic prices	10,966	3,069	3,864	4,033
Divergences	-2,319	-191	222	-2,351
Intermediate technology				
Private prices	12,058	3,866	5,305	2,887
Economic prices	15,442	4,114	5,018	6,310
Divergences	-3,384	-248	287	-3,423
Intermediate technology (in transition)				
Private prices	13,154	5,571	5,702	1,881
Economic prices	20,328	6,209	5,457	8,662
Divergences	-7,174	-639	245	-6,781
Advanced technology				
Private prices	42,063	17,573	12,280	12,210
Economic prices	46,919	19,570	11,717	15,632
Divergences	-4,856	-1,997	563	-3,422

Notes. Calculated at present value in a period of 15 years, with an interest rate of 14.61% at private prices and 15.99% at economic efficiency prices.

Table 3c. Extended Policy Analysis Matrix for protected tomato production systems. Scenario with sustainable production practices (thousands of Mexican pesos/ha).

	Revenues	Costs		Net profits
		Tradable inputs	Domestic factors	
Low technology				
Private prices	9,557	2,832	4,100	2,624
Economic prices	12,033	3,021	3,864	5,148
Divergences	-2,477	-188	236	-2,525
Intermediate technology				
Private prices	13,320	3,806	5,320	4,195
Economic prices	16,946	4,050	5,015	7,880
Divergences	-3,626	-245	305	-3,686
Intermediate technology (in transition)				
Private prices	14,521	5,514	5,720	3,287
Economic prices	22,308	6,148	5,458	10,702
Divergences	-7,786	-634	262	-7,415
Advanced technology				
Private prices	46,331	17,480	12,299	16,552
Economic prices	51,337	19,470	11,707	20,160
Divergences	-5,006	-1,990	592	-3,608

Notes. Calculated at present value in a period of 15 years, with an interest rate of 14.61% at private prices and 15.99% at economic efficiency prices.

In the current situation, all the indicators of competitiveness (PCR) and efficiency or comparative advantage (DRC) are below one (Table 4). These results show that with no government aid, the production systems obtain extraordinary profits and could survive under a policy of eliminating subsidies to internal factors and distortions to the exchange rate. The lowest private cost ratio (PCR) was found in the production system with advanced technology, which generates the highest return on domestic factors at private prices. In contrast, the lowest domestic resource cost (DRC) ratio in the current situation is found in the system with intermediate technology in transition, followed by that with advanced technology.

Table 4. Indicators of competitiveness and efficiency of the protected tomato production systems (current situation).

Technological level	Competitiveness (PCR)	Economic efficiency (DRC)
Low	0.61	0.43
Intermediate	0.56	0.39
Intermediate (transition)	0.64	0.34
High	0.43	0.37

Source. Constructed by author with information collected during fieldwork.

The net benefit for investing in adoption of sustainable production practices determined as the difference between the profits gained in the sustainable system (with project) and those gained in the unsustainable system (without project) at both private and economic prices is shown in Table 5. Despite the high investment required, in all cases NPV is positive and tends to increase with advances in technology level.

Table 5. Net present value for investing in sustainable production systems.

	Technological level			
	Low ^{1/}	Intermediate ^{1/}	Intermediate ^{1/} (transition)	Advanced ^{2/}
Private prices				
Investment in cistern (000/ Mex\$)	170.10	210.64	210.64	3,113.19
Benefit NPV ^{3/} (000/Mex\$)	942.03	1,307.56	1,406.00	4,342.44
Economic efficiency prices				
Investment in cistern (000/Mex\$)	189.0	234.1	234.1	3,459.7
Benefit NPV ^{3/} (000/Mex\$)	1,115.6	1,570.1	2,039.9	4,528.8

Notes. 1. Geomembrane cistern. 2. Welded steel cistern. 3. Discounted rates used were 14.61% at private prices and 15.99% at economic efficiency prices.

Source. Constructed by author with information collected in fieldwork and from Anaya (2010); Brown, Gerston, and Colley (2005).

Table 6 presents the indicators of competitiveness (PCR) and economic efficiency (DRC) of the unsustainable and sustainable scenarios. Both the private cost ratio (PCR) and the domestic resource cost (DRC) ratio are lower in the scenario where conservation practices are used. In the sustainable scenario, the indicators obtained are similar to those of the current situation, suggesting that adopting conservation practices, besides reducing environmental degradation, helps to maintain current competitiveness and efficiency. Given the results obtained in this study, it is proposed that government support granted for construction of protected agriculture production units be conditioned to adoption of sustainable production practices. Also, we suggest evaluating other alternatives that help producers become aware of the probable impact of excessive use of irrigation water on the future, and encouraging research in the development of agricultural practices that conserve resources.

Table 6. Indicators of competitiveness and efficiency of the tomato production systems under protected agriculture. Scenarios with unsustainable and sustainable production practices.

Technological level	Unsustainable		Sustainable	
	Competitiveness (PCR)	Efficiency (DRC)	Competitiveness (PCR)	Efficiency (DRC)
Low	0.71	0.49	0.61	0.43
Intermediate	0.65	0.44	0.56	0.39
Intermediate (transition)	0.75	0.39	0.64	0.34
Advanced	0.50	0.43	0.43	0.37

Note. Calculated with the present value of revenue, cost and profit flows.

Conclusions and Recommendations

This study was an analysis of competitiveness and economic efficiency of protected tomato production systems in the state of Zacatecas, Mexico, considering the possibility of adopting sustainable production practices (alternative projects). In the current situation, all the production systems studied generated extraordinary profits for the producers. The systems are able to compete at market prices, which include the effects of policies and market failures. Likewise, all the technology used is economically efficient, that is, under a scheme of elimination of subsidies

and taxes and market distortions; with all the tomato growing technology studied, the production systems are able to compete at international prices.

Adopting production practices that make more efficient use of irrigation water in protected agriculture will help prevent environmental degradation, favor competitiveness of the producers and, in the case of elimination of subsidies to tradable inputs and domestic factors, the production systems will be able to remain in the market.

It is proposed that government aid for constructing protected agriculture production units be conditioned to the use of conservation practices, under constant supervision, to prevent resources from being diverted. Moreover, it is suggested that training be given to producers and technicians of these systems; training should include topics that support sustainable agriculture and contribute to create awareness of the impact over-extraction of aquifers has on the environment. Moreover, it is recommended that research and technological processes be oriented toward developing inputs and other products that minimize environmental deterioration.

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The Relationship between Information Exchange Benefits and Performance: Mediating the Effect of Supply Chain Compliance in the Chinese Poultry Chain

Guangqian Peng^a, Jacques H. Trienekens^b, S.W.F. (Onno) Omta^c, and Wensheng Wang^d

^a*Assistant Professor, Business Administration Department, Capital University of Economics and Business, Flower-Town, Fengtai District, Beijing, 100070, China*

^b*Professor, Business Administration Department, Wageningen University, Hollandseweg 1, Wageningen 6706 KN, The Netherlands*

^c*Professor, Business Administration Department, Wageningen University, Hollandseweg 1, Wageningen 6706 KN, The Netherlands*

^d*Professor, Agricultural Information Institute, Chinese Academy of Agricultural Sciences, Zhongguangcun South Street 12, Beijing, 100081, China*

Abstract

This paper aims to examine the relationships between information exchange benefits and company performance, and the mediating effect of supply chain compliance on this relationship. A sample of 165 buying companies and of 96 suppliers were analyzed by partial least square (PLS) path modeling. Five company characteristics, including company size, company age, company type, quality standard implemented, and administrative level of a location, were added as control variables in the model. The paper extends our understanding on the relationships between perceived communication benefits, supply chain compliance, performance and company characteristics. Managerial implications are generalized for buyers and suppliers respectively.

Keywords: Inter-organizational information exchange, perceived communication benefits, supply chain compliance, performance, company characteristics.

[Ⓞ]Corresponding author: Tel: + 86.10.83952195
Email: gqpeng@cueb.edu.cn J.H.Trienekens: jacques.trienekens@wur.nl
S.W.F.Omta: onno.omta@wur.nl W. Wang: wangwsh@caas.net.cn

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Introduction

The theory of Supply Chain Management asserts that the way companies pursue their objectives is to seek cooperation through supply chains (SC) (Lee, Padmanabhan, and Whang 1997; Sahin and Robinson 2002). Supply chain cooperation can bring with substantial benefits and advantages for companies, and raise performance levels above those attainable in spot-market operations (Lambert, Cooper, and Pagh 1998; Mentzer, Foggin, and Golicic 2000).

A basic enabler for tight supply chain collaboration is inter-organizational information exchange (IOIE) (Fawcett et al. 2010). Moreover, information exchange is an essential determinant of the successful strategic positioning of firm networks (Jarillo 1988). Information exchange is fundamental to business as carbon is to physical life (Reinsch 2001). This stands true especially for the food sector because of agri-product market globalization and given the specific characteristics of perishable foods, such as shelf life constraints and food safety. However, only limited research has been conducted on supply chain information systems in the food sector (Stock and Boradus 2006; Storer 2006).

Although significant achievements have been made with the research on information exchange, it is still difficult to find out from existing literature how information exchange leads to improved performance (Storer 2005). In practice, although the competitive value of information is widely heralded, few companies have fully harnessed information's abilities to enhance their company and SC performance (Fawcett et al. 2007). To narrow the gap, this study intends to re-examine the relationship between information exchange and performance.

During literature study, we found that the literature often equated the value of information exchange with improved company performance, thus, often examined the value of information exchange by taking use of the constructs of performance. For example, Fawcett et al. (2007) identified and analyzed two distinct dimensions of information sharing – connectivity and willingness. And they examined the impact of both dimensions on operational performance and competitive performance. Paulraj et al. (2008) found empirical support for the notion of inter-organizational communication as a relational competency that enhances buyers' and suppliers' performance.

Differently, we assume company performance such as a firm's profitability and competitive performance might partly be an indirect result of information exchange. Comparatively, direct results might be issues such as cost reductions, problem resolution, as well as delivery and quality control. For example, it would be hard for a manager to answer a question such as "does the communication with your main customer/supplier help to improve profitability and sale growth rate of your company?" However, it would be less difficult for a manager to answer a question such as "does the communication with your main customer/supplier help you to solve problem and to control product quality?" Thus, we propose that the value of information exchange should be operationalized in a way to measure the direct benefits that a company obtains from information exchange. Therefore, we proposed a new construct "perceived communication benefits" and distinguished between perceived communication benefits and company performance.

Then, we ask what is the relationship between perceived communication benefits and performance, and how perceived communication benefits impact on performance? As we can imagine, there should be diverse ways that information exchange may lead to improved performance. This study focuses on checking the mediating role of supply chain compliance on this relationship.

Last but not the least, most prior studies focused on the perceptions of buying firms only or suppliers only, and did not reflect the perceptions of both sides. However, as we know, buying firms and suppliers have different functions and powers. There are questions concerning whether both buyers and suppliers benefit from information sharing and collaboration (Nyaga, Whipple, and Lynch 2010). And we further question whether the benefits obtained by a company from information exchange with its suppliers and with its customers contribute to its performance without difference. This paper is among the first attempt to reflect both sides of the ‘coin’ of information exchange by collecting data on the focal companies’ relationships with their suppliers and with their customers respectively.

Thus, this paper intends to empirically test the relationship between perceived communication benefits and company performance, to explore the mediating role of supply chain compliance on this relationship, and to unfold how communication benefits help to improve company performance for food buyers and suppliers respectively.

The central research question is therefore: ‘what is the relationship between communication benefits and company performance? how do communication benefits help to improve performance?’ To answer this central research question and to achieve the desired research objective, the following specific research questions are formulated:

- RQ1. What is the relationship between perceived communication benefits and supply chain compliance?
- RQ2. What is the relationship between supply chain compliance and performance?
- RQ3. With regarding to the answers to RQ1 and 2, what are the similarities or differences for buying firms and suppliers?

As companies through a food supply chain from farm to fork often have diverse characteristics, we have added five company characteristics as control variables in the structural model in order to avoid potential bias and to examine the potential influence of company characteristics on the interrelationships between perceived communication benefits, supply chain compliance and performance. These company characteristics are: company size, company age, company type, quality standard implemented, and administrative level of a location.

This paper focuses on the poultry supply chain in China. In the last 26 years from 1985, the share of poultry has gradually increased in the total output of livestock products in China (Table 1). Correspondingly, per capital possession of poultry has gradually increased also during the last two decades (Table 2). Notably different from the highly integrated poultry chains in the West, fragmentation and integration coexist in the Chinese poultry supply chain. Table 3 shows that

small-scale, medium-sized, and large-scale poultry farms coexist. Thus, the Chinese poultry chain provides a new and meaningful context for the study and arouses our research interest.

Table 1. The output of poultry and other meat in selected years in China (10,000 tonnes).

	1985		1995		2005		2008	
	Output	%	Output	%	Output	%	Output	%
Poultry	160.2	8.3	724.3	17.8	1,344.2	19.4	1,533.7	21.1
Pork	1,654.7	85.9	2,853.5	71.0	4,555.3	65.6	4,620.5	63.5
Other meat	111.6	5.8	496.6	12.2	1,039.4	15.0	1,124.5	15.4
Total meat	1,926.5	100.0	4,074.4	100.0	6,938.9	100.0	7,278.7	100.0

Source. China Statistical Yearbook of Animal Husbandry 2009

Table 2. Per capita possession of poultry and other meat in selected years in China (kilograms).

	1990	1995	2000	2005	2008
Poultry	2.8	6.1	9.4	11.2	11.5
Pork	20.0	24.2	31.4	38.3	34.8
Total meat	25.1	34.5	47.8	59.2	54.8

Source. Chinese Yearbook of Meat 2008

Table 3. Poultry production scale for 2008 in China

Poultry production scale (Number of poultry / year)	Number of poultry at the end of the year (10,000 heads)	Percentage of the total poultry
Below 2000	144,668.9	18.4
2000 ~ 49,999	440,699.0	55.9
50,000 ~ 499,999	132,208.7	16.8
500,000 ~ 999,999	21,804.3	2.8
More than 1,000,000	48,640.8	6.2
Total	788,022.6	100.0

Source. China Statistical Yearbook of Animal Husbandry 2009.

In the sections to follow, this paper presents our hypotheses and the research framework. Then, based on empirical data analysis, a review of the findings is described. Afterwards, elaboration on the conclusions and discussions follows in the penultimate section. Finally, this paper ends with managerial and policy implications, research limitation, and future research.

Perceived Communication Benefits, Supply Chain Compliance and Performance

Perceived Communication Benefits and Supply Chain Compliance

A way companies pursue their objectives is to seek cooperation through supply chains (SC), and a basic enabler for tight supply chain collaboration is inter-organizational information exchange (IOIE). IOIE is looked as imperative glue that holds supply chain partners together (Mohr and Nevin 1990, 36), is the heart (Lamming 1996), lifeblood (Stuart and McCutcheon 1996), nerve center (Chopra and Meindl 2007), essential ingredient (Min et al. 2005), key requirement (Sheu, Yen, and Chae 2006), and foundation (Lee and Whang 2001) of chain collaboration. It is a critical factor in promoting SC compliance among firms, and is also a generic cure for SC ailments (Lee, Padmanabhan, and Whang 1997; Sahin and Robinson 2002). Effective and efficient

communication is vital to on-going channel relationships and successful inter-firm exchange (Paulraj, Lado, and Chen 2008). Correspondingly, communication difficulties are a prime cause of collaboration failures. Miscommunication could cause conflicts and misunderstanding among SC partners (Paulraj, Lado, and Chen 2008; Cao et al. 2010). Thus, to examine the influence of information exchange benefits on supply chain compliance, we herein propose the following hypotheses:

H₁: The level of perceived communication benefits is positively associated with the level of supply chain compliance.

‘Perceived communication benefits’ here refers to the extent to which a company perceives benefits directly from information exchange with its suppliers and customers. And ‘supply chain compliance’ here refers to the extent to which a company complies with its customers’ requirements for logistics activities and quality control.

Supply Chain Compliance and Performance

Previous studies have revealed that customers and suppliers that comply with business partners’ requirements, for example, in the area of logistics and quality, are likely to perform better. However, some of the findings are different or even conflicting in recent studies in the Chinese context. Lu (2007) studied the Chinese vegetable chain, and found that vegetable companies’ compliance with buyers’ delivery requirements had positive effects on quality and price satisfaction, on profitability, but not on efficiency, whereas companies’ compliance with quality requirements had no significant effect on any of these aspects of performance. Adversely, Han (2009) found that the association between integrated logistics management and performance was not supported in the Chinese pork chain, but the relationship between quality management practices and performance was supported.

We suppose these conflicting results might come from a sector effect. To scrutinize the relationship between supply chain management and performance further, the present study examines the Chinese poultry chain, and distinguishes not only different aspects of chain compliance including logistics compliance and quality compliance, but also different aspects of performance including customer satisfaction, external efficiency, and profitability and competitive edge. Thus, we propose:

H₂: The level of supply chain compliance of a company is positively associated with the level of company performance.

Figure 1 presents the research conceptual framework:



Figure 1. The research conceptual framework.

Methodology

Data Collection and Study Population

The study domain is the poultry chain in the Mainland China. Given the vast geographic size of China, this study focuses on three regions: Beijing (the capital) and Hebei province located in Northern China; Shandong, an eastern coastal province; and Guizhou, a province located in South-west China. Comparatively, Beijing, Hebei and Shandong represent the more developed regions, whereas Guizhou is a less developed province.

First, to optimise the validity of the questionnaire items, valuable insights were obtained through a series of pilot interviews, literature study and pre-test survey (Straub, Boudreau, and Gefen 2004; Churchill and Iacobucci 2010). These not only helped to construct the final structured questionnaires, but also provided valuable information on the Chinese poultry sector and the distribution status of poultry firms in the sampling areas.

The survey was conducted between October 2008 and June 2009. The respondent companies were selected based on multistage cluster sampling. Although an overall list of the companies in the poultry chains was not available, three main criteria were used to select candidate companies in order to obtain a representative sample. These criteria include firm type (supermarket, restaurant, trader, processor, intermediary and commercial farm), firm size (mini, small, middle, large, and super and international), and administrative level of a location ((national and provincial) capital city, other city, and county). Table 4 shows the locations, administrative levels of locations and firm size of the respondent companies. Other principles employed to select respondent companies are as follows:

1. For a supermarket or a restaurant with more than one store, the survey was conducted only with its head store or one of its major stores. Most supermarkets have individual consumers as their major customers, thus, we only asked them to fill in the part of the questionnaire concerning their most important suppliers. But for a few membership warehouses with organisations as their main customers, the researcher also asked them for information about their most important customers.
2. With regard to restaurants, though the whole population of restaurants is pretty huge, only those restaurants providing poultry as their sole or main products were targeted in this research. Meanwhile, the objective of this research is to examine inter-organizational information exchange, thus, we looked for those restaurants purchasing poultry products from organizations instead of those from individuals in wet markets.

Table 4. Locations, administrative level of a location, and firm size of the total sample: frequency (and percentage).

	Supermarkets	Restaurants	Traders	Processors	Intermediaries	Farms	Others ^a	All firms
Location								
Beijing & Hebei	9	28	15	14	11	12	2	91 (53%)
Shandong	5	2	2	4	3	3	-	19 (11%)
Guizhou	11	12	7	7	8	16	1	57 (33%)
Total	25	42	24	25	22	31	3	172 (100%)
Administrative level of the location								
(Provincial) capital city	6	35	21	11	10	11	3	97 (56%)
Other city	8	1	2	4	4	4	-	23 (13%)
County or town	11	6	1	10	8	16	-	52 (30%)
Total	25	42	24	25	22	31	3	172 (100%)
Firm size^b								
Mini	2	28	24	10	21	23	2	110 (64%)
Small	8	10	-	5	1	7	1	31 (18%)
Middle	8	2	-	5	-	1	-	17 (10%)
Large	3	2	-	2	-	-	-	7 (4%)
Super & international	4	-	-	3	-	-	-	7 (4%)
Total	25 (15%)	42 (24%)	24 (14%)	25 (15%)	22 (13%)	31 (18%)	3 (2%)	172 (100%)

^aOthers' refers to organizations of which the main activities include both scientific research and business transaction.

^b Firm size is partly based on the "National Criteria to Divide Big-, Middle-, and Small-sized Enterprises" (National Committee of Trade and Economics of China [2003]143).

We did not try sending a post mail survey, because companies in China are not used to it. The targeted firms were contacted mainly through informants in organizations such as Supermarket/ Restaurant Associations, Administration Offices for Industry and Commerce, and Centers for Animal Disease Control and Prevention. These organizations provide administrative or support services, so have close business contacts with the targeted companies. Most of the targeted companies were willing to take part in the survey. This contributed to a response rate of over 90%.

To minimize response bias, we have targeted top and key managers as the respondents within each focal company. We asked each respondent to select their most important supplier and customer, and answer the questions related to their most important supplier and customer. The questionnaires, together with the instruction letters, were sent out by various measures according

to the preferences of the respondents. They were mostly sent out by e-mail to the supermarkets, and by fax or e-mail to the processors, intermediaries and farms. As for most of the restaurants and traders, printed questionnaires were taken to them by the researcher and research assistants. Each returned questionnaire was checked timely and carefully. When a questionnaire was found incomplete or confusing, the researcher called or visited the respondents to confirm their answers, in this way to make sure that the respondents understood the questions correctly and provided answers precisely.

Finally, 165 questionnaires were obtained for the company-supplier sample, with answers from respondent firms on the relationships with their most important suppliers. Meanwhile, 96 questionnaires were obtained for the company-customer sample, with answers from the respondent firms on the relationships with their most important customers.

Company Profile

The sample consists of 172 respondent companies, including 25 supermarkets, 42 restaurants, 24 traders, 25 processors, 22 intermediaries, 31 commercial farms and 3 other firms (Table 5). Two (membership) supermarkets having organizations as their most important customers have contributed not only to the customer sample but also the supplier sample. Other supermarkets and restaurants have individual consumers as their major customer, thus have contributed only to the customer sample.

Table 5. Firm type and numbers of the company-supplier (CS) and the company-customer (CC) samples.

	Supermarkets	Restaurant	Traders	Processors	Intermediaries	Farms	Others	All firms
The CS sample	25 (=2 ^a +23)	42	23 (=21 ^a +2)	24 (=20 ^a +4)	22 (=20 ^a +2)	27 (=24 ^a +3)	2 (=2 ^a +0)	165 (=89 ^a +74)
The CC sample	2 (=2 ^a +0)	-	22 (=21 ^a +1)	21 (=20 ^a +1)	20 (=20 ^a +0)	28 (=24 ^a +4)	3 (=2 ^a +1)	96 (=89 ^a +7)
Total	25	42	24	25	22	31	3	172

Note. a. The number of the respondent firms that contribute to both samples.

Table 6 displays the profile of the respondent companies. It is shown that the average firm age was 8.8 years. The oldest organization, an institute with both breeding and selling chicken as main activities, was set up 52 years ago. The youngest organizations, including two restaurants and one farm, were set up just one year ago. The average ages of farms and restaurants are significantly younger than those of processors and the ‘others’.

Table 6. Profile of the total sample on firm age, respondent position, and poultry types: number (and percentage).

	Supermarkets	Restaurants	Traders	Processors	Intermediaries	Farms	Others	All Firms
Firm age in years: (mean and S.D.)	8.04 (5.02)	6.95 (5.29)	7.17 (4.43)	10.32 (6.47)	9.64 (5.43)	6.84 (5.21)	28.67 (20.60)	8.77 (7.52)
Respondent Position								
- senior or key employee	24	38	20	20	18	28	3	151(88%)
- others	1	4	4	5	4	3	-	21 (12%)
Poultry Type								
- chicks only	-	4	12	12	12	16	2	58 (34%)
- ducks only	-	-	1	5	1	4	1	12 (7%)
- other poultry only	-	1	-	-	-	2	-	3 (2%)
- at least two types of poultry	25	37	11	8	9	9	-	99 (58%)
Total	25 (15%)	42 (25%)	24 (14%)	25 (15%)	22 (13%)	31 (18%)	3 (2%)	172 (100%)

As for the profiles of the respondents, the results show that 87.8% of the respondents of the survey were senior employees or key employees (there is often no specific senior employee in a small company except the owner). This indicates a high quality of respondents, who should have a clear understanding of what practices their organizations employ with regard to their most important customers and suppliers.

With regard to poultry types, most respondent companies (57.6%) were involved in at least two types of poultry, while the second largest group of firms (33.7%) were involved in chick products only.

Measurements and Data Analysis Method

Grounded on previous studies, perceived communication benefits was operationalized with two constructs, including ‘perceived communication benefits for buyers’ and ‘perceived communication benefits for suppliers’. Supply chain compliance was operationalized with ‘logistics compliance’ and ‘quality compliance’. And company performance was operationalized with ‘customer satisfaction’, ‘external efficiency’, and ‘profit & competitive edge’. Appendix 1 presents a summary of these constructs and measurement items.

To analyze the data and test the hypotheses, partial least squares (PLS) path modeling technique was employed. Following Chin (1998b), we ran bootstrapping¹ with 500 resampling.

PLS path modeling is a type of structural equation modeling (SEM) technique. Supply Chain Management research very often involves an analysis of relationships among latent variables (LV). The advent of SEM techniques allowed social scientists to perform path analytic modeling with LV, and to simultaneously examine theory and measures. This in turn has led some to describe this approach as an example of ‘a second generation of multivariate analysis’ (Fornell 1987, : 408). Nowadays, SEM techniques are the most applied and consolidated means of testing relations and causality in the field of management information systems (e.g. Pavlou and Chai 2002; Dibbern et al. 2004), buyer-supplier relationships (e.g. Claro 2004), and marketing research (e.g. Steenkamp and Trijp 1991; Malhotra, Peterson, and Kleiser 1999).

There are two distinct families of SEM techniques: (1) the covariance-based SEM techniques, as represented by LISREL and AMOS; and (2) the component-based SEM techniques, also known as variance-based techniques, of which PLS modeling is the most prominent representative (Chin 1998b). Applying PLS modeling has some advantages over covariance-based SEM tools (Chin 1998b). The main characteristics of PLS path modeling, which have increased its popularity within the research community and motivated our choice in this study, include (Henseler, Ringle, and Sinkovics 2009):

1. PLS path modeling delivers LV scores, i.e. proxies of the constructs, which are measured by one or several indicators, namely, manifest variables (MV).
2. PLS path modeling avoid small sample size problems and can therefore be applied in some situations when other methods cannot (Chin and Newsted 1999).
3. PLS path modeling can estimate very complex models (i.e. models consisting of many LV and MV) without leading to estimation problems (Wold 1985).
4. PLS path modeling makes less stringent assumptions about the distribution of variables and error terms (Fornell 1982, 443; Bagozzi 1994); however, it does not make less stringent assumptions about the representativeness of the sample.
5. PLS path modeling can handle both formative measurement models and reflective ones (Chin 1998a; Diamantopoulos and Winklhofer 2001). Although the inclusion of formative measures in covariance-based SEM has been well documented (Jöreskog and Goldberger 1975; MacCallum and Browne 1993), analysts usually encounter identification problems.
6. PLS path modeling is methodologically advantageous to covariance-based SEM whenever improper or non-convergent results are likely to occur (i.e. Heywood cases; see (Krijnen, Dijkstra, and Gill 1998).

¹ Bootstrap is nonparametric approach to estimate the precision of the PLS estimates (Chin 1998). The general approach is to resample with replacement from the original data set. Parameter estimates are calculated for each instance, and the variation in the estimates are analysed. For details about bootstrap, see Efron and Gong (1983).

Empirical Results

Descriptive Statistics

Table 7 lists the means and standard deviations for each construct, calculated based on unweighted observed variables. Recalling that the observed indicators of perceived communication benefits and of supply chain compliance are measured using a 5-point Likert scale, ranging between 1 for ‘not agree at all’ and 5 for ‘totally agree’, the means being all above 3 indicate that the respondents agree with the relevant statements with regarding to perceived communication benefits and supply chain compliance. Meanwhile, the observed indicators of performance are measured using a 7-point Likert scale, ranging between 1 for ‘not agree at all’ and 7 for ‘totally agree’. Thus, the means being all above 4 indicates that the respondents agree with the relevant statements with regarding to performance.

Table 7. Construct mean and standard deviations (S.D.) for the respondent companies in relationships with their most important suppliers and customers.

The Company-Supplier Sample			The Company-Customer Sample		
Constructs	Mean	S.D.	Constructs	Mean	S.D.
1. Perceived communication benefits for the companies	4.08	.70	1. Perceived communication benefits for customers	4.18	.71
2. Perceived communication benefits for the suppliers	4.18	.67	2. Perceived communication benefits for the companies	4.16	.59
3. Logistics compliance	4.30	.65	3. Logistics compliance	4.57	.49
4. Quality compliance	4.17	.63	4. Quality compliance	4.46	.56
5. Satisfaction	5.93	.91	5. Satisfaction	5.96	.82
6. Efficiency	5.44	1.23	6. Efficiency	5.50	1.27
7. Profit & competitive edge	5.42	1.23	7. Profit & competitive edge	5.43	1.23

Note. The mean of quality compliance (**bold** and *italics*) of the company-supplier sample is significantly different from that of the company-customer sample.

Construct 1-4 are measured using a 5-point Likert scale, and construct 5-7 using a 7-point Likert scale.

The respondent companies from the two samples reported similar scores for most of the constructs except for ‘quality compliance’. Thus results seem to reflect that the surveyed companies have similar opinions concerning perceived communication benefits for themselves, perceived communication benefits for their suppliers and customers, logistics compliance and satisfaction. Thus, we can summarize the following in general.

The respondent companies tended to believe that the communication with their most important suppliers had produced high and almost equal benefits for themselves and for their main suppliers. Meanwhile, they tended to believe that the communication with their most important customers had also produced high and almost equal benefits for themselves and for their most important customers. These benefits obtained from communication had supported them in practices including problem resolution, quality control, timely and precise delivery, and pricing decisions. The results seem to prove that it might be advantageous for both a company and its

main customers, and for both a company and its main suppliers, to invest heavily and more or less equally in information exchange with each other.

The respondent companies were of the opinion that their main suppliers had complied well with their logistics and quality requirements. Meanwhile, the respondent companies tended to believe that they themselves had also complied well with their customers' logistics and quality requirements.

Companies in the chain were satisfied with their performance compared to their main competitors in the last twelve years. Specifically, they were satisfied with the product quality of and the prices paid to their suppliers. They had paid less money and had taken less time, thus they had realized higher (external) efficiency in the transactions with their main suppliers and customers. Further, they tended to believe that they had achieved better performance, compared to their main competitors in the last twelve months in terms of profitability, sales growth rate, and overall competitive edge.

Of particular interest is that the company-supplier sample has scored significantly lower than the company-customer sample for suppliers' compliance with customers' quality requirements. This might reflect that, although the companies have complied well with customers' quality requirements in general, they do not comply as well as that their customers think they should have. This finding is a valuable warning for companies in the Chinese poultry chain to pay more attention to improving their chain quality compliance, and to make sure that they do meet their customers' quality requirements and expectations.

Validity and Reliability of Measures and Constructs

We identified the constructs in the present study as reflective constructs, by following the four primary decision rules stated in (Jarvis and MacKenzie 2003) and based on insights obtained from the field research. Then, we examined content validity, discriminant validity, and nomological validity. Meanwhile, we also checked item multicollinearity for all of the constructs.

The content validity is based on the literature and further confirmed by experts, officers, and practitioners during interviews and the pre-test (Straub, Boudreau, and Gefen 2004). All of the correlation coefficients between the variables are well below the common cut-off of 0.8. This proves the discriminant validity, thus we can employ all of these constructs in one model. The nomological validity has been confirmed by estimating the structural equations in our theoretical models (Churchill 1979; Steenkamp and Trijp 1991). A number of significant relationships have been found between the constructs (see Figure 2) as they should be (Bollen and Lennox 1991).

To assess item multicollinearity, Pearson correlation has been applied to pairs of items of each constructs. The only problem found was that the correlation coefficients between 'market share' and 'overall competitive edge' for both the company-supplier and the company-customer samples are slightly higher than the threshold value of 0.80. Thus, the item of 'market share' has been dropped. As for all other constructs, the correlation coefficients lie well below the threshold

of 0.8, which exhibit no problem of item multicollinearity (Malhortra, Peterson, and Kleiser 1999; Diamantopoulos and Winklhofer 2001).

Relationship between Perceived Communication Benefits and Company Performance: The Mediating Effect of Supply Chain Compliance

The structural equation model on the influence of perceived communication benefits on company performance was tested by PLS path modelling. Figure 2 and 3 presents the results of the Communication-compliance-performance Model for companies in relationships with their most important suppliers and with their most important customers respectively. The overall model explains about 25.7% of the variance of the endogenous latent variables for the company-supplier sample and about 20.9% for the company-customer sample. This indicates that a satisfactory model fit is obtained for each sample. PLS provides standardised path coefficients, so we can compare the direction and the magnitude of the impacts based on the path coefficients.

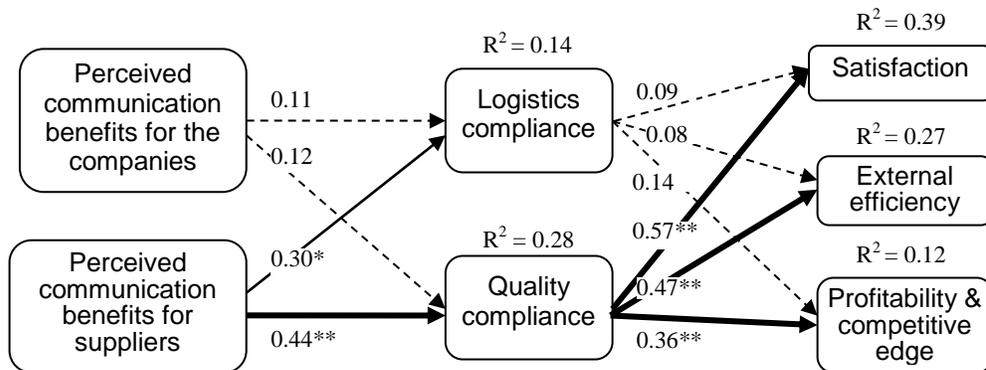


Figure 2. The Relationships in the Communication-Compliance-Performance Model for the Company-Supplier (CS) sample (N=165).

Note. **being significant at $p < 0.01$ level; * being significant at $p < 0.05$ level. Dotted lines show the tested relationships being *not* significant.

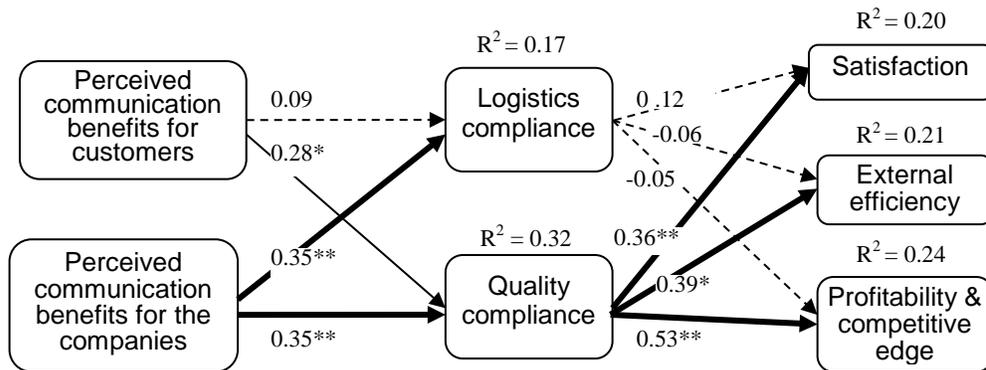


Figure 3. The Relationships in the Communication-Compliance-Performance Model for the Company-Customer (CC) sample (N=96).

Note. **being significant at $p < 0.01$ level; * being significant at $p < 0.05$ level. Dotted lines show the tested relationships being *not* significant.

When looking at the relationships between ‘perceived communication benefits’ and ‘supply chain compliance’, it appears that ‘perceived communication benefits for buyers’ and ‘perceived communication benefits for suppliers’ have different influences on ‘supply chain compliance’.

For a company in relationships with its most important suppliers, communication benefits obtained by the company (as the buyer) were not significantly associated with its suppliers’ compliance with its requirements. But communication benefits obtained by its suppliers were positively and significantly associated with the suppliers’ compliance with the company’ logistics and quality requirements. These results reflect that when a company communicates with its main suppliers, the benefits obtained by its suppliers are likely to help these suppliers to comply better with its logistics and quality requirements. Thus, it makes sense for a company to help its main suppliers to really benefit from the information exchange, if the company intends to improve its suppliers’ compliance with its requirements.

For a company in relationships with its most important customers, the communication benefits obtained by its customers do not necessarily help the company to comply better with the customers’ logistics requirements; however, they are likely to help the company to comply better with the customers’ quality requirements. Meanwhile, the communication benefits obtained by the company itself are likely to help it to comply better with the customers’ logistics and quality requirements. Thus, it makes sense for a company to ensure not only itself, but also its main *customers* to really benefit from the information exchange, if the company intends to improve its compliance with its customers’ requirements.

Based on the above empirical proofs from the buyer and the supplier sides, we may draw an important conclusion that it makes sense for a company to help not only itself, but also its important suppliers and customers to really realize benefits from their mutual information exchange. In this way, the company is likely to improve its suppliers’ compliance with its requirements and its own compliance with its customers’ requirements.

When looking at the relationships between ‘supply chain compliance’ and company ‘performance’, we can see from Figure 2 that for a company in relationship with its main suppliers, its suppliers’ logistics compliance does not necessarily influence its performance; however, its suppliers’ quality compliance is likely to improve each aspect of its performance. Similarly, we can see from Figure 2 that for a company in relationship with its main customers, its logistics compliance does not necessarily influence its performance; however, its quality compliance is likely to improve each aspect of its performance in term of customer satisfaction, external efficiency, profitability, and overall competitive edge. Thus, another valuable finding is that it appears that it is a company’s main suppliers’ compliance with its quality requirements, and its own compliance with its customers’ quality requirements, rather than logistics compliance, that make the company stand out from its main competitors.

Here logistics compliance does not yet show its potential value in improving company performance. A likely explanation is that there is limited implementation of logistics management in the Chinese poultry chain. Another possible reason is that logistics compliance does not necessarily make a company stand out from its main competitors, though it might

contribute to the improvement of company performance to certain extent. This would be worth examining further in future research.

When looking at the relationships between ‘perceived communication benefits’ and company ‘performance’, the results of total effects estimation show that for a company in relationships with its main suppliers, the communication benefits obtained by the company itself (the buyer) are not significantly associated with its company performance. However, the communication benefits obtained by its main suppliers are likely to make it stand out from its main competitors in satisfaction, external efficiency, profitability, and competitive edge. Similarly, the results of total effects also show that for a company in relationship with its main customers, the communication benefits obtained by its customers are not significantly associated with its performance. However, the communication benefits obtained by the company (the supplier) are likely to make it stand out from its main competitors in customers’ satisfaction.

Thus, we may draw a valuable conclusion as: communication benefits obtained by suppliers are likely to make themselves and their main customers stand out from their main competitors. Differently and notably, the communication benefits obtained by buyers do not necessarily make themselves or their main suppliers stand out from their main competitors, though such benefits might help to improve their own and their suppliers’ performance to certain extent.

Buyers are often with higher marketing and negotiation powers than their suppliers. They tend to less actively comply with their suppliers’ requirements while their suppliers tend to more actively comply with their requirements. However, the above results indicate that it is valuable for a buyer to actively help its main suppliers to realize benefits from their information exchange.

Effect of Company Characteristics on the Relationships between Information Exchange Benefits and Performance

To explore the effect of company characteristics on the relationships between information exchange benefits and performance, five control variables were then added to each endogenous construct in the Communication-compliance-performance Model. They are company size, company age, company type², quality standard implemented³, and administrative level of a location⁴. Other parts and paths of the model remained as the same. The overall model explains about 31.1% of the variance of the endogenous latent variables for the company-supplier sample, and 34.0% for the company-customer sample.

The results show a company’s characteristics are likely to influence in one way or the other how well it is likely to comply with the requirements of its main customers, and how well its comparative performance is likely to be achieved (Table 8). However, they do not necessarily

² Company type is modelled as a dummy variable: with 1 for companies having trading activities as main functions, being closer to end markets and with more market power; and 0 for companies having production activities as main functions, being farther from end markets and with less market power.

³ Quality standard implemented is represented by the highest quality standard adopted by a company.

⁴ Administrative level of a location is an ordinal variable: with 1 for town or county, 2 for other cities, and 3 for national or provincial capital cities.

change the significance of the relationships between the constructs in the model that is presented in Figure 3. Thus, we conclude that the results of the relationships between perceived communication benefits, supply chain compliance and performance found in this study are likely to be tenable for different companies with different characteristics.

Table 8. The significant effect of company characteristics on supply chain compliance and performance.

	The Company-Supplier Sample					The Company-Customer Sample				
	size	age	type	quality	location	size	age	type	quality	location
Logistics compliance							-	+		
Quality compliance				-		+				
Satisfaction					- [†]				-	- [†]
Efficiency					- [†]				-	- [†]
Profit & competitive edge			- [†]					- [†]		

Notes. a. The company characteristics examined are: company size, company age, company type, quality standard implied, and the administrative level of a location. Specifically, company type: 0 = production firms with lower market power; 1 = trading firms with higher market power. Administrative level of a location: 1 = town or country, 2 = medium-sized city; 3 = national or provincial capital city.

b.[†] The path coefficients being significant for both the company-supplier and the company-customer samples at p<0.05 level.

In general, the size, business age, and type of a company do not necessarily affect how well its suppliers are likely to comply with its logistics or quality requirements, but are likely to influence how well it is likely to comply with the logistics or quality requirements of its main customers. Meanwhile, the type, the highest quality standard employed, and the administrative level of the location of a company are likely to influence the level of each aspect of its performance compared to its main competitors.

For both the company-supplier and the company-customer samples, company type has interestingly shown negative and significant effects on ‘profit & competitive edge’. A trader or a retailer is likely to report a lower level, whilst a commercial farm or a processor is likely to report a higher level of profitability and competitive edge, compared to its main competitors in the last twelve months. The survey was conducted during the Financial Crisis (2008-2009). The researcher noticed that retailers complained about their sheer reduced sales due to the Financial Crisis, especially those in the eastern and coastal advanced regions in China. This result might therefore reflect the fact that traders and retailers, who normally sell multiple types of products, were confronted with higher challenges in sales than before, and thus tended to be pessimistic and score lower on their performance. Conversely, commercial farms and processors of poultry products, a type of basic consumption product, did not experienced much higher challenges in sales than before, and thus tended to be optimistic and score higher on their performance comparatively.

In contrast to our expectation, for both the company-supplier and the company-customer samples, the administrative level of a location has shown negative effects on performance including satisfaction and external efficiency. This might imply that a company located in a smaller city is likely to be more satisfied with the product quality of and the price paid to their main suppliers, and is likely to make its main customers feel more satisfied. Meanwhile, it is likely to spend less money and less time, thus be more externally efficient in the transactions with its main suppliers and customers. A likely explanation is that most production companies are located in small towns or cities because of lower costs and the environment protection policy. As mentioned above, they deal with poultry products, a type of basic consumption product. Therefore, they did not experience higher challenges during the Financial Crisis than before, and tend to make a positive assessment of their performance comparatively. However, most trading companies are located in middle or large cities being important end markets. They normally deal with multiple products including luxury goods. Therefore, they faced more challenges during the Financial Crisis than before, and tend to make a pessimistic assessment of their performance. However, there might have been unexpected effects of the Financial Crisis that were not measured in this study. To explain these findings, further research will be necessary.

Of particular interest, when a company employs a higher level of quality standard, it tends to be stricter and unsatisfied with its suppliers' compliance with its quality requirements. Meanwhile, possibly due to increased costs, higher prices and more negotiation, it is likely to suffer a lower level of customer satisfaction and a lower level of external efficiency. These findings might imply that companies and consumers in the Chinese poultry chain are more sensitive to product price than product quality. These might also reflect and explain why there is so little motivation for players in the Chinese food chain to improve food quality. This finding is a warning that new or adjusted food policy is needed to stimulate the self-motivation of the companies to employ higher levels of quality standards.

For companies in relationships with their customers, a larger firm is likely to comply better with the quality requirements than a smaller firm, but does not necessarily comply better with the logistics requirements of its main customers. A likely explanation is that a larger company is able and willing to invest to comply better with the quality requirements, in order to safeguard its long-term reputation and markets; Meanwhile, the logistics compliance has limited implementation and is still in its early stages, and this situation holds true for both small and large firms in the Chinese poultry chain.

For companies in relationships with their customers, company age has shown to be negatively associated with logistics compliance. A younger firm is likely to comply better with the logistics requirements of its main customers. A likely explanation is that chain logistics management is a relatively new practice in Chinese food chains. It might be harder for an old firm to change its old operation habits.

Company type has shown to be positively associated with logistics compliance. This might reflect that compared to a commercial farm or a processor, a trader or a retailer being closer to end markets is likely to comply better with its customers' logistics requirements. This finding is a warning for farms and processors which also have to produce and transport products to customers. They should particularly pay attention to improve their knowledge and practices in

logistics management, and in turn they might obtain particularly huge development space and competitive advantage.

Conclusions

This paper intends to reveal the relationship between perceived communication benefits and company performance, the mediating role of supply chain compliance on this relationship, and the difference for buying companies and suppliers.

This paper has proposed a Communication-compliance-performance Model (see Figure 2 and 3), which is composed of three main parts: perceived communication benefits, supply chain compliance, and company performance. The model can be used to understand, examine, and assess how communication benefits obtained by companies and by their suppliers/buyers help to improve supply chain compliance, and further contribute to better performance for the company and for its suppliers and buyers.

Another theoretical contribution of this paper is its extension of existing research on the value of information exchange. This paper appears to be the first to propose and examine the benefits of information exchange for buyers (i.e. perceived communication benefits for buyers) and for suppliers (i.e. perceived communication benefits for suppliers) respectively, and further to distinguish their different influence on different aspects of company performance. Previous studies often equate the value of information exchange with company performance, or often examined the relationships of information exchange with limited aspects of performance. However, we assume company performance might not be a direct but rather partly an indirect result of information exchange, and company performance itself is a broad concept covering diverse aspects.

Thus, we hereby checked the relationship between the direct benefits of information exchange (i.e. perceived communication benefits) and the indirect results of information exchange (i.e. company performance). The results of this study support that perceived communication benefits and company performance are two different constructs and could be checked in one model. Therefore, we call future research to distinguish between the direct benefits of information exchange and company performance.

Meanwhile, we examined the mediating effects of supply chain compliance on this relationship by taking the insights of Supply Chain Management. The results support the significant and positive mediating effect of quality compliance on the relationship between perceived communication benefits and company performance. However, the expected mediating effect of logistics compliance is not supported here. We call future research to check the potential mediating effect of logistics compliance in other chains in China or in the West.

In general, the most important findings are: (1) Communication benefits obtained by a company are likely to help the company and its main suppliers to improve compliance in a chain. (2) Communication benefits obtained by a company and its improved compliance with its customers' quality requirements jointly lead to better performance for the company and for its main customers. (3) A company's compliance with its main customers' quality requirement is a

key to improve the performance of the company and of its customers. (4) In contrast to our expectation, a company's compliance with its main customers' logistics requirements here is not significantly linked with company performance. This might reflect the fact that there is limited implementation of logistics compliance and this holds true for both small and large companies in the Chinese poultry chain.

This paper also contributes to the extension of our knowledge on the effects of company characteristics on the interrelationships between perceived communication benefits, supply chain compliance, and performance. An important finding is that the five company characteristics are likely to affect the levels (magnitude) of supply chain compliance and performance, but do not necessarily change the interrelationships between perceived communication benefits, supply chain compliance, and performance. Thus, the interrelationships between perceived communication benefits, supply chain compliance and performance that were revealed in this study (see Figure 2 and 3) are likely to be tenable for different companies with different characteristics.

Managerial and Food Policy Implications

Based on the major findings of this study, we draw the following managerial implications. First, in order to advance from realizing potential communication benefits to standing out from its main competitors, a company should not only commit to realizing the potential communication benefits for itself, but also commit to helping its main suppliers and customers realize the potential benefits as well.

In practice, some companies are unwilling to share information or they only share under pressures from business partners. Some companies doubt the value of information communication compared to the financial, physical and human costs. Some are afraid that information provided to their customers or suppliers may be abused and place their organizations at a competitive disadvantage (Fawcett et al. 2007). However, what managers can learn from this study and should always bear in mind that it is not only the communication benefits obtained by a company itself, but also those by its main suppliers and customers that make it stand out from its main competitors. When a company's main suppliers obtain communication benefits, they can comply better with the company's logistics and quality requirements; and when the company's main customers obtain such benefits, they can help the company comply better with their quality requirements, thus significantly contribute to the company's performance ultimately.

Second, a company should pay great attention to quality management in its supply chain. It should commit to ensuring that its main suppliers comply well with its own quality requirements, and also ensuring that it complies well with its customers' quality requirements. These will jointly make it stand out in performance compared to its main competitors.

Third, for Chinese poultry managers aiming to achieve better performance than their main competitor, learning to improve their own logistics compliance and that of their suppliers' appears to be a great challenge but a huge potential opportunity for further performance improvement.

Fourth, by examining the influence of company characteristics, we find that the level of supply chain compliance and company performance should be evaluated on the basis of company characteristics. By cross-checking with their main counterparts and competitors with similar characteristics, a company could have a clearer understanding of how well it has performed in the area of supply chain compliance and company performance.

For food policy makers, explicit attention should be paid to how to improve the self-motivation of food companies to implement quality standards. The results of this study indicate that companies adopting higher quality standards are likely to suffer from lower customer satisfaction and lower external efficiency. This might imply that there is no much motivation in the Chinese poultry chain to adopt higher levels of quality standards. And this lack of self-motivation might be a main reason why food quality incidents happen more frequently in China than in the developed countries.

Thus, an important means of solving the food quality problem might be to facilitate companies' self-motivation to adopt quality standards by adjusting the trade-off that is brought by the quality standards. Particularly, it might be valuable to carry out relevant food policy that encourages retailers to adopt high quality standards. In the face of very powerful retailers, food production companies and logistics companies are likely to comply with the retailers' increased quality requirements.

Limitations and Future Research

First, it is worth remarking that the main findings and conclusions of this study are based mainly on the poultry chain in Mainland China. In general, they may be valuable for other non-highly integrated meat chains. However, some of these conclusions should be carefully examined if they are to be generalized to non-meat chains or highly integrated chains in the developed countries. For instance, the expected positive association between logistics compliance and performance was neither supported in the Chinese poultry chain in this study, nor in the Chinese pork chain (Han, Trienekens, and Omta 2009), however, was found in the Chinese vegetable chain (Lu et al. 2007). Therefore, we expect that the positive association between logistics compliance and performance might not exist in other Chinese meat chains, but might exist in the Chinese fruit chain which has similar logistics requirements to the vegetable chain, and might exist in food chains in the West. Thus, we also assume that it would be valuable to conduct a comparative study in the future between the non-highly integrated food chains in China and the highly integrated food chains in the West.

Second, this study focused on the relationships between companies and their most important suppliers, and their most important customers. However, we assume that the information and compliance relationships between companies and their less important business partners might take on a different picture. Based on the polarization of power and benefits, there might be more bargaining than collaboration between companies and their less important business partners. And managers have to think more carefully about the trade-off between benefits and costs of communication and chain compliance, and adjust their communication and compliance strategy based on the trade-off. Thus, we call for future research on the communication and compliance of companies with their less important customers and suppliers, which is absent from the

literature. Third, this study has examined the mediating effect of supply chain compliance on the relationships between perceived communication benefits and performance. However, the mediating effect of logistics compliance was expected but not supported in this study. Additionally, there should be diverse ways that information exchange leads to performance. Therefore, we call future research to study the mediating effects of logistics compliance and other variables (such as governance structure) on the relationships between perceived communication benefits and performance.

Fourth, the results of this study reveal that some differences exist between buying companies and suppliers with regard to information exchange. This is reasonable considering that buying companies and suppliers have different functions and often different market and negotiation powers. Thus, we call for more dyadic study on supply chain information management in the future.

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Appendix. Measurements and Constructs

Note: each company was asked to select its most important supplier and customer of poultry product, and to answer the following questions related to the selected supplier and customer.

Perceived communication benefits

(5-point Likert scale, from '1 = totally disagree' to '5 = totally agree')

Perceived communication benefits for buyers (BenefitB)

We (our most important customers) get information from our most important supplier (us), which supports us (it) directly in:

BenefitB 1: Problem resolution

BenefitB 2: Product quality control

BenefitB 3: Timely and precise delivery

BenefitB 4: Product price decision

Perceived communication benefits for suppliers (BenefitS).

We (our most important supplier) get information from our most important customers (us), which supports us (it) directly in:

BenefitS1: Problem resolution

BenefitS 2: Product quality control

BenefitS 3: Timely and precise delivery

BenefitS 4: Product price

Supply Chain Compliance

(5-point Likert scale, from '1 = totally disagree' to '5 = totally agree')

Logistics compliance (LC)

LC1: Our most important supplier (We) delivers products timely and precisely to us (to our most important customer).

LC2: Our most important supplier (We) packages products according to the requirements of us (our most important customer).

Quality compliance (QC)

QC1: Our most important supplier (We) will help us (our most important customer) if we (they) meet quality problems or troubles.

QC2: Our most important supplier (We) provides products which fit quality requirements of us (our most important customer).

QC3: Our most important supplier (We) provide products with better quality than its (our) major competitors.

Firm Performance

(7-point Likert scale, from '1 = totally disagree' to '7 = totally agree')

Satisfaction (Satis)

Satis1: We (Our most important customer) are satisfied with the product quality of our most important supplier (us).

Satis2: We (Our most important customer) are happy with the price paid to our most important supplier (us).

Efficiency (Effi)

Effi1: It costs us less money when we purchase (sell) poultry from our most important supplier (to our most important customer).

Effi2: It costs us less time to finish an order with our most important supplier (customer) than with others.

Profit & Competitive edge (P&C)

Comparing to our main competitors in the last 12 months, we achieved better business of poultry products in term of:

P&C1: Profitability.

P&C2: Sale growth rate.

P&C3: Market share. (Dropped)

P&C4: Overall competitive edge



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Segmenting Consumers to Inform Agrifood Value Chain Development in Nepal

Rajendra Prasad Adhikari^a, Ray Collins^b, and Ximing Sun^c

^a*PhD Student, School of Agriculture and Food Sciences, The University of Queensland, Gatton, 4343, Australia*

^b*Professor of Agribusiness, School of Agriculture and Food Sciences, The University of Queensland, Gatton, 4343, Australia*

^c*Research Fellow, School of Agriculture and Food Sciences, The University of Queensland, Gatton, 4343, Australia*

Abstract

The Nepalese government is piloting agricultural projects that are described as taking a value chain approach to development. Although consumer value lies at the core of value chain management principles, none of these projects adopts a consumer perspective. This is an example of a more widespread gap in both the literature and practice as to how consumer perspectives can be used in the development of agrifood value chains in developing countries. This paper addresses this gap by surveying consumers of tomatoes in Nepal, segmenting them using cluster analysis and demonstrating how consumer segmentation can provide strategic direction for value chain development. The research identifies four distinct segments of tomato consumers in Kathmandu. The high value consumer segment, which is also the largest segment, places most importance on credence-based attributes that cannot be ensured unless a whole-chain effort is employed, indicating that developing value chains would be necessary if this need is to be met, and that such effort would pay off. An analysis of existing supply chains shows discrepancies between consumer expectations and the delivery of value, suggesting improvement opportunities to develop these chains.

Keywords: value chain, consumer segmentation, agrifood, developing countries, Nepal

[Ⓞ]Corresponding author: Tel: +61.7.54601093
Email: rajendra.adhikari@uqconnect.edu.au
R. Collins: ray.collins@uq.edu.au
X. Sun: x.sun@uq.edu.au

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Background

In Nepal, both the government and donors have put concerted efforts into developing fresh vegetable value chains through a series of donor funded projects within the last five years (World Bank 2009; Shrestha 2010). Tomato, the most widely used fresh vegetable in Nepal, is identified in most of these projects as having high potential for value chain development (Full Bright Consultancy 2008).

The value chain concept has been described as a shift in mindset from a conventional producer-focused supply-push approach to a consumer-oriented demand-pull approach (Collins 2009; Fearn 2009). Thus, in principle, value chain development should take into account consumer perspectives and should be guided by value as defined by consumers themselves.

The lack of a consumer perspective in chain development could negatively impact both the development objectives of government and donors, and the business objectives of commercial actors in the chains. Past development efforts without a value-based perspective have resulted in problems such as oversupply or lack of response to market needs. At the same time, when consumerism has driven agribusiness actors to align their business strategies and structures to ensure greater consumer value (Boehlje 1999, Moser, Raffaelli, and Thilmany-McFadden 2011), agrifood value chains that are more responsive to consumers become more effective, and thereby more competitive (Trienekens 2011; Soosay, Fearn, and Dent 2012).

In spite of this evidence in the literature, a review of the Nepalese projects referred to above showed no evidence of the adoption of a consumer perspective in the development of value chains. In 2008, the Commercial Agriculture Development Project carried out a 'Product Chain Study' for ten different agricultural commodities (including tomato) to explore value chain development opportunities (Full Bright Consultancy 2008). None of these included consumers in the analysis. Similarly, no other consumer-based study with a value chain development perspective can be found in Nepal.

Therefore, this paper uses tomato as a case study crop to demonstrate how knowledge from consumer research can be used in the development of fresh tomato value chains. First, the paper segments consumers of tomato to explore value preferences for different segments of consumers. Second, the structures and processes of existing tomato chains are examined. Then, implications of the value preferences of different consumer segments are used to identify development opportunities for existing chains.

Objectives

The broad objective of this paper is to identify needs and opportunities of value chain development in the agrifood industry of Nepal using tomato as a case study crop. The specific objectives are to segment consumers of tomato according to their characteristics and value preferences, and to explore improvement opportunities in existing tomato chains based on knowledge about consumer value. To guide the research process, these specific objectives are expressed in the form of the following three research questions:

1. What are the different segments of tomato consumers in Kathmandu and their characteristics and value preferences?

2. What are the structures and processes of existing tomato chains that cater for these consumers?
3. What are the implications of these analyses for tomato value chain development in Nepal?

Research Approach I: Consumer Segmentation

A two-pronged methodological approach was used in this research. First, a consumer survey was conducted to identify segments of consumers and their preferences on the attributes of tomato. Second, the structure and processes of existing chains that cater to the surveyed consumers were examined to identify the improvement opportunities.

The following sections highlight the methods used to understand segmentation of consumers and their preferences.

Questionnaire Design

A checklist of product and process-based attributes of agrifood products in general and tomatoes in particular was drawn from literature (Johansson et al. 1999; Sun and Collins 2002, 2007; Kennedy et al. 2008; Collins 2009). Two focus group discussions were conducted amongst tomato consumers in Kathmandu, the nation’s capital city, to identify relevant attributes for use in the research design. As a result, eighteen product and process-based attributes were included in a questionnaire (see Appendix 1) whose purpose was to identify the relative importance that consumers attach to these attributes in their tomato purchasing decisions. Attributes included 12 intrinsic and six extrinsic product attributes, or 10 search, three experience and five credence attributes (Ford, Smith and Swasy 1988; Grunert et al. 2005; Moser, Raffaelli and Thilmany-McFadden 2011) (Table 1). Consumers’ attitudes and perceptions towards these 18 variables were measured using a 5 point rating scale where 4 = very important, 3 = important, 2 = less important, 1 = unimportant and 0 = do not know. The questionnaire also included questions about consumers’ socio-demographic characteristics.

Table 1. Taxonomy of Variables Used in the Analysis

Attribute	Search	Experience	Credence
Intrinsic	Color	Shelf-life	Freshness
	Size	Cooking quality	Pesticide residue
	Ripeness	Taste	Production location
	Presence of peduncle ¹		Organic production
	Pest-free		
Extrinsic	Price		Traceability
	Packaging		
	Pack size		
	Shopping location		
	Display in shop		

¹ The stalk that supports the tomato fruit

Primary Data Collection

Data was generated by market intercept consumer surveys conducted in May and June 2010 in Kathmandu. Using a replacement lottery method (Kalton 1983), samples were drawn from the pool of 51 representative retail outlets until 423 individual shopper samples had been allocated to the respective outlets. In each selected outlet, consumers were interviewed randomly by selecting the first and subsequently available tomato buyers whom the enumerator met at the exit of the store. Out of the total 423 random samples drawn, 394 questionnaires were completed (see Appendix 2).

Method of Segmentation

There is little research on segmentation techniques to guide value chain development in any sector in developing countries, and especially little that relates to the agrifood sector (Cunningham 2001). By comparison, in developed countries, consumer segmentation approaches have been frequently used in marketing to devise customized strategies (Smith 1956; Dickson and Ginter 1987; Bock and Uncles 2002; Flint, Woodruff and Gardial 2002; Palmer and Millier 2004; Verbeke, Vermeir and Brunsø 2007; Zhang et al. 2008; Zhang et al. 2010). Segmentation was used in this research to develop value chain strategies focused on meeting the differing needs of discrete segments among tomato consumers. A cluster analysis (CA) approach was used, as it is a well-established method of multivariate analysis for consumer segmentation (Kettenring 2006).

In a heterogeneous market, CA segments consumers into homogeneous sub-groups (Hair et al. 2010) based on the variables used to classify them. CA is used in this research for the exploratory purpose of developing a taxonomy of fresh tomato consumers and profiling them in terms of their value preferences and socio-demographic characteristics. Such an approach has two implications. First, it establishes baseline consumer value profiles in the Kathmandu fresh vegetable market for comparison against future segmentation studies. Second, it demonstrates that consumer segmentation studies can contribute to customized value chain strategies, thereby contributing to value chain development among the actors and stakeholders of the system.

Design Issues in Cluster Analysis

Research design issues relevant to CA have been identified as adequate sample size, detection of outliers, selection of similarity measures, and standardization of the data (Hair et al. 2010). Addressing these issues is important in increasing the robustness of the analysis. The sample size of 394 was large enough to draw valid conclusions since a minimum of 100 observations is sufficient to perform segmentation using CA (Hair et al. 2010). An agglomeration schedule, which is an output of CA, was used to detect outliers and no sample was found to have any role in destabilizing outputs. A squared Euclidean distance measure was used as the measure of distance. Standardization of the data was not needed since the unit of measurement was the same for all variables.

A bivariate Pearson's correlation coefficient (r) analysis revealed that three pairs of attributes, namely packaging and pack size, taste and cooking quality, and organic production and production location, were correlated ($r > 0.5$) (Allen and Bennett 2010). To reduce the effect of

multicollinearity, three attributes with low rating values in each set, i.e. pack size, cooking quality and production location, were dropped in the final analysis.

Hierarchical cluster analysis was used initially to identify the appropriate cluster size (Everitt et al. 2011). Because hierarchical cluster analysis can provide as many cluster solutions as the number of cases, the agglomeration schedule and dendrogram were used to derive a potential range of appropriate cluster sizes. The agglomeration schedule revealed that a four or five cluster solution maximized between-cluster heterogeneity without a large decrease in intra-cluster homogeneity. The shape of the dendrogram supported this result since a slight shift along one axis reduced cluster numbers from nine to five, a further small shift reduced cluster numbers to four, but a shift of almost twice that distance was required to reduce cluster numbers to three. Thus both the agglomeration schedule and the shape of the dendrogram supported either a four or five cluster solution.

In the next stage, non-hierarchical cluster analysis using the k-means technique, which is more robust (Pena, Lozano and Larranaga 1999; Hair et al. 2010; Everitt et al. 2011), was used to segment consumers based on four and five-cluster alternatives. K-means analysis minimizes the variance within clusters by continuing to reassign cases to the cluster whose centroid lies closest to the case (Punj and Stewart 1983). It also fine tunes existing cluster solutions derived from the hierarchical algorithm (Hair et al. 2010) and segments observations relatively evenly. Table 2 summarizes the distribution of cases for four and five-cluster solutions.

Table 2. Cross-Tabulation between Clusters for Four and Five-Cluster Solutions

		Cluster Number of Cases (Five-cluster solution)					Total
		1	2	3	4	5	
Cluster number of cases (Four-cluster solution)	1	1	3	67	0	86	157
	2	49	0	0	0	1	50
	3	0	1	10	111	0	122
	4	0	52	13	0	0	65
Total		50	56	90	111	87	394

In this research the four-cluster solution was selected because from a management perspective, a solution with fewer clusters would be preferred for ease of interpretability (Trocchia and Janda 2003) and parsimony in strategic implementation (Hair et al. 2010).

Results of Consumer Segmentation

Cluster Characteristics

Clusters are characterized by analyzing the pattern reflected in the mean and mean-centered values for each cluster as shown in Table 3, Figure 1 and Figure 2.

Cluster 1

Cluster 1 contains 40% of the observations and is distinguished by relatively high means for the credence attributes of freshness, presence of pesticide residue, traceability, and organic production. This cluster has above average ratings for all attributes except packaging. A distinguishing feature of this cluster is the lowest mean value for price, indicating that this group values quality over price. Members of this group appear to be discerning consumers who look for premium products. Being the largest cluster and attaching such importance to credence attributes, this cluster has strategic significance from a value chain development perspective.

Cluster 2

Cluster 2 contains 13% of the observations and is most distinguished by the lowest mean value for the presence of pesticide residue. Consumers in this group are more concerned about extrinsic attributes, primarily the shopping location and the overall look of the product, and are less concerned about credence and process-based attributes, such as traceability and organic production. This group of consumers may be relatively unresponsive to health and food safety initiatives.

Cluster 3

Cluster 3 comprises 31% of total observations and is the second largest. Its most distinguishing feature is that consumers in this cluster place the highest importance on price compared with other clusters and have the highest mean values for physical product attributes such as color, size, shelf-life and ripeness and the lowest means for credence attributes such as traceability and organic production.

Cluster 4

Cluster 4 contains 16% of total observations. The distinguishing feature of this cluster is that it has the lowest means for product external and physical attributes such as color, size, ripeness and pest free status. Although consumers in this group gave below average ratings for most other attributes, they are second to cluster 1 in their preferences for presence of the peduncle, traceability and organic production, which are considered important features associated with health and food safety. Thus the most notable feature of this cluster is that its consumers seem concerned about features that add value to health and food safety, while being below average on preferences for other attributes.

The underlying structures of these observations reveal that cluster 1 consists of consumers who place importance on most of the product and process-based attributes and are less concerned about price compared to other attributes. Cluster 2 comprises consumers who have the least concern about pesticide residues and more concern about where they shop and the physical appearance of the product. Consumers in cluster 3 are relatively sensitive to physical attributes, less concerned about production related processes, and most concerned about price. Consumers in cluster 4 are below average for most attributes but are highly concerned about product features that are associated with food safety and health.

Table 3. Means Values and Mean-Centered Values from K-Means Cluster Analysis

Variable	Mean Values				Mean-Centered Values				F	Sig	Total
	Cluster Number:				Cluster Number:						
	1	2	3	4	1	2	3	4			
Importance of the attribute											
Color	3.13	3.12	3.37	2.72	0.00	-0.01	0.24	-0.41	9.359	.000	3.13
Freshness	3.82	3.58	3.85	3.28	0.11	-0.13	0.14	-0.43	18.089	.000	3.71
Size	2.91	2.76	3.17	2.43	0.02	-0.13	0.28	-0.46	12.590	.000	2.89
Shelf life	3.40	2.82	3.54	2.28	0.21	-0.37	0.35	-0.91	44.916	.000	3.19
Ripeness	2.83	3.04	3.39	2.11	-0.08	0.13	0.48	-0.80	33.898	.000	2.91
Presence of peduncle	2.95	1.68	1.90	2.52	0.56	-0.71	-0.49	0.13	37.173	.000	2.39
Price	3.20	3.48	3.57	3.40	-0.18	0.10	0.19	0.02	6.252	.000	3.38
Packaging	2.11	1.62	.93	1.46	0.53	0.04	-0.65	-0.12	53.941	.000	1.58
Pest-free	3.82	3.60	3.50	2.46	0.35	0.13	0.03	-1.01	73.216	.000	3.47
Pesticide residue	3.50	.84	3.04	2.72	0.61	-2.05	0.15	-0.17	152.224	.000	2.89
Taste	3.26	3.32	3.69	1.82	0.10	0.16	0.53	-1.34	96.034	.000	3.16
Shopping location	2.89	2.68	1.27	2.49	0.60	0.39	-1.02	0.20	95.207	.000	2.29
Traceability	2.54	1.56	.89	2.18	0.69	-0.29	-0.96	0.33	84.546	.000	1.85
Display in shop	2.55	2.56	1.83	1.94	0.32	0.33	-0.40	-0.29	19.623	.000	2.23
Organic production	3.27	2.00	1.84	2.57	0.72	-0.55	-0.71	0.02	69.189	.000	2.55

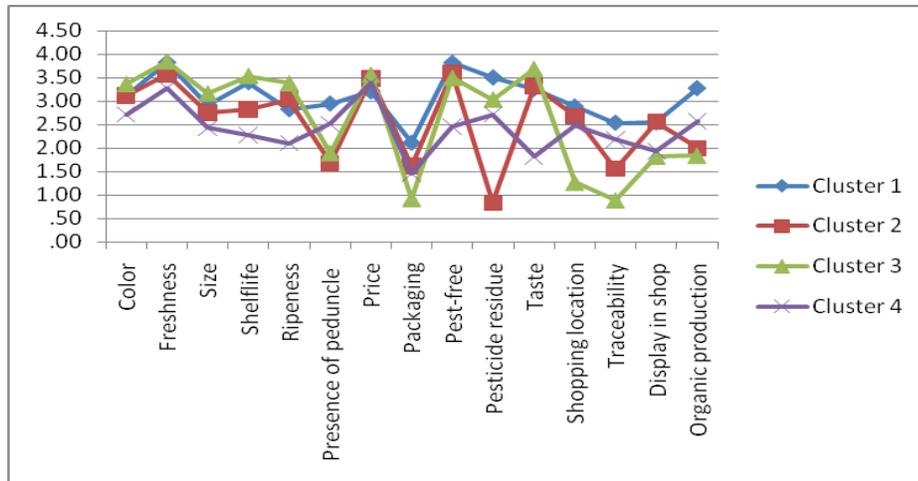


Figure 1. Distribution of Mean Values of Clustering Variables in Four-Cluster Solution

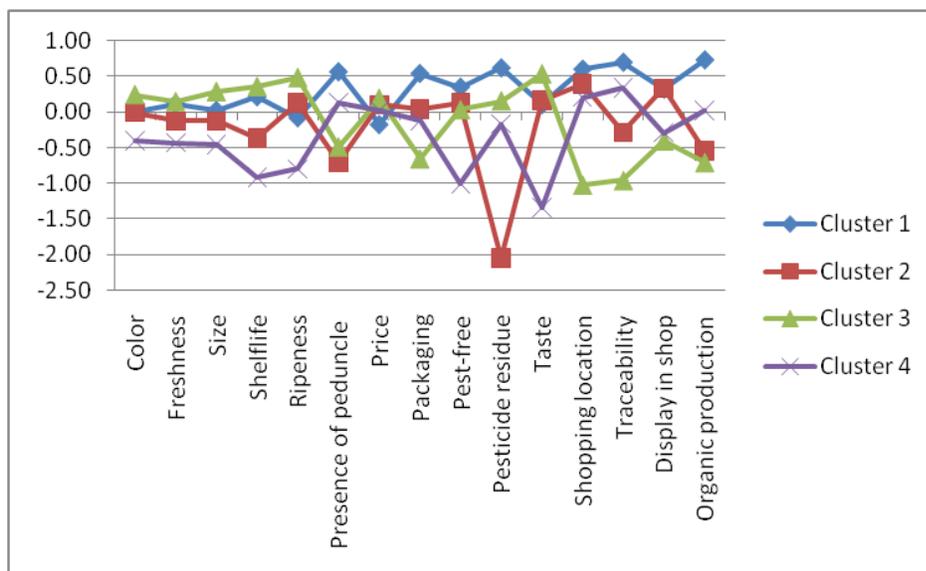


Figure 2. Distribution of Mean-Centred Values of Clustering Variables in Four-Cluster Solution Consumer Profiles

Having characterized the clusters on the basis of consumers’ responses to product and process-based attributes, they can be characterized by the socio-demographic profile of their membership to examine underlying relationships between the preferences to attributes and the socio-demographic profiles of their consumer members.

Table 4 presents a result of Chi-square tests that compare clusters against gender, education, family structure, preferred shopping location and income. Education, family structure, preferred shopping location and income were statistically significant in explaining variations in the preferences of consumers, a result that supports the distinctiveness of the clusters.

Table 4. Chi-Square Test of Consumer Segments against Socio-Demographic Variables

	Value	df	Asymp. Sig. (2-sided)
Gender	5.942	3	.114
Shopping location	64.545	15	.000
Education	60.625	12	.000
Family Income	59.364	15	.000
Family composition	12.860	3	.005

Chi-square (X^2) = $p < .05$

Further, a cross-classification of clusters based on the socio-demographic features by which the clusters differ significantly (shopping location, education, family income, and family composition) provides a profile of each consumer segment. Based on the cross-classification analysis, the four resulting segments of consumers are labeled as high-value discerning consumers, low-value institutional consumers, price-centric non-informed consumers and low-value rational consumers.

High-Value Discerning Consumers

Consumers in this cluster are discerning individuals who value premium products over price. Their main concerns are about process and credence attributes such as freshness, organic production, traceability and pesticide residue. Approximately 85% of consumers in supermarkets fall into this category, indicating that supermarket consumers have greater concerns about food safety and health. About 50% of consumers who purchase tomatoes in corner shops are also in this category. Since prices are usually more expensive in supermarkets and corner shops when compared to other outlets, the expressed low concern of these consumers about price in favor of other attributes is consistent with their actions. Almost 75% of these consumers come from higher income brackets and 90% of them are either high school or college graduates. At the household level, 47% of consumers whose family size is less than 4 are in this cluster. This cluster therefore represents consumers who are educated, have higher incomes, prefer to shop in specific permanent locations such as supermarkets and corner shops, and seek and are willing to pay for a premium product. Thus they are labeled 'high value discerning' consumers.

Low-Value Institutional Consumers

The most striking feature of the consumers in the second cluster is their lowest rating for concern about pesticide residues and highest rating for product display in the shop. Combined with their major concern for low price and ripeness, it is possible that the importance they attach to display in the shop is associated with being able to buy ripe fruit for a low price. Based on observations during the survey period, consumers in this cluster are institutional buyers who were purchasing over-ripe tomatoes towards the end of each day at low prices. The local vegetable market is the preferred buying location for 46% of these consumers, and none of them shop at supermarkets. Educationally, around half of them are high school graduates and only 8% have a university degree. More than 80% of them are in the middle income bracket. Interestingly, no respondent

who earns less than NRs5,000 (USD59.44²) per month (the low income bracket) is in this cluster. This group also has the largest family size of any cluster.

Data reveals that many consumers in this cluster are consumers who operate institutions such as low-standard hotels and catering services. They buy over-ripened tomatoes at low prices but their preferred shopping locations do not include street vendors and pedestrian markets, which are low value markets in the Nepalese context. They want regular suppliers who can consistently supply very ripe tomatoes, so they choose wholesale and local vegetable markets because of the high volumes transacted and the associated high levels of over-ripeness and waste. Thus they are labeled in this analysis as 'low-value institutional' consumers.

Price-Centric Non-Informed Consumers

Consumers grouped in cluster 3 are very price-sensitive and most concerned about the product's external physical attributes. While they express some concern about pesticide residues, they show low levels of concern for health and food safety related credence attributes. Given that informed consumers tend to place high importance on credence attributes (Verbeke, Vermeir and Brunsø 2007), consumers in this group appear to have little knowledge of, or concern for, the attributes about which today's more informed consumers are most sensitive. In terms of education, this cluster contains diverse membership. Among consumers with no formal education, 45% are in this cluster, yet half the cluster's members are university graduates. A little more than half (52%) of the consumers in this cluster are in the income bracket of NRs10,000-20,000 (USD118.88-237.76) per month, which is below the poverty line in Nepal for a family of four members or more. Most of them (57%) prefer shopping in local vegetable markets, where they get a wide range of choices on price. In this cluster, 58% have a relatively large family size of more than 4 members. This group of consumers is labeled as 'price-centric non-informed' consumers.

Low-Value Rational Consumers

Consumers in cluster 4 express below average ratings for all variables except presence of the peduncle, shopping location, traceability and organic production. Their ratings for intrinsic attributes of the product, such as color, freshness, size, shelf-life, ripeness, and taste, and extrinsic attributes such as packaging, are the lowest among all clusters. However, their rating for traceability and organic production is higher, and for price is lower, than 'low value institutional' consumers and 'price-centric non-informed' consumers. Their higher rating for health and safety related attributes, traceability and organic production, and low rating for price demonstrates a level of rationality at a time when consumers are becoming very sensitive to these issues.

A distinguishing socio-demographic characteristic of this group is that around 80% of them are low income earners. In spite of this, they do not believe that price is the most important attribute in buying tomatoes and they place greater importance on products' credence attributes than physical attributes. With a low ability to pay high prices, yet high value attached to credence attributes, these consumers are labeled as 'low-value rational' consumers.

² Dollar equivalence is based on an NR100:USD1.18 exchange rate of as at 17 January 2012 (Source: www.oanda.com)

Implication for Value Chain Development

The segmentation analysis shows that the largest segment of consumers place value on credence attributes such as freshness, pesticide residue, traceability and organic production. These are attributes that can only be delivered and guaranteed by a whole of chain approach. Individual firms must play a role, but no firm in isolation can guarantee freshness, food safety, traceability, freedom from residues, and so on. Zero tolerance for pesticide residues, mandatory systems for food safety and product traceability and increasing interest in organic production are becoming common features of food retailing (e.g. Gil, Gracia and Sanchez 2000; Porter, Baker and Agrawal 2011). As similar concerns among consumers become evident in the analysis, the need to adopt value chain approaches becomes more obvious. Delivering these attributes requires more aligned processes, more reliable information and greater collaboration among chain members – the building blocks of value chain management. Further, this analysis demonstrates that value chains that are responsive to consumers can generate more income. The ‘high value discerning consumer’ segment places less emphasis on price and more on the product’s credence attributes, suggesting that these consumers would pay a premium price for credence attributes. These findings, therefore, could be useful in stimulating value chain development among actors wishing to target higher value consumers, the largest segment of the consumer population in this study and the segment which places greatest importance on credence-based attributes. The next section examines the structures and processes of tomato chains which catered for the population of consumers from which the survey samples were drawn.

Research Approach II: Examining Tomato Supply Chains

The following sections examine the structures and processes of existing tomato chains which serve consumers in Kathmandu. Results are based on interviews with 27 actors in existing tomato chains and observations of the chains’ operations. Fieldwork was carried out between April and September 2010. These case study chains originated from Kavre and ended in retail outlets in Kathmandu. Kavre is one of the major tomato growing districts, and Kathmandu is the most populated city in Nepal. Checklist-based observations during value chain walks, in-field observations and semi-structured interviews with the actors of the chains, and additional memos generated during data collection and analysis, constitute the sources of data.

Structures

The purpose of the analysis was to identify improvement opportunities within existing chains through the lens of consumer value. Chains that are guided by a knowledge of consumers become more responsive, effective and competitive (Bonney et al. 2007; Collins 2009; Soosay, Fearn and Dent 2012), with the potential to become value chains. A value chain is a relationship-based governance structure, focused on value creating activities (Boehlje 1999) which bring a product or service from its origin to its end use (Kaplinsky and Morris 2001) in such a way that the process efficiently and effectively delivers value as defined by the consumers (Collins 2009). The tomato chains in this study comprised of actors in five different roles: farmers, commission agents, wholesalers, wholesaler cum supplier, and retailers. Chain processes start from farmers who have been producing tomatoes commercially for more than two decades. They supply the product to wholesalers either directly or through commission agents who collect and assemble the product from farmers and deliver to wholesalers. Wholesalers are individual traders operating

at the country's largest fresh produce wet market. They link chain activities between the upstream and downstream actors, supplying products to the retailers.

Consumers buy tomatoes mainly from retailers, and occasionally from wholesalers. There are five different categories of retail outlets: supermarkets, vegetable corner shops, local vegetable markets, pedestrian markets, and street vendors. Supermarkets and vegetable corner shops are characteristically similar and are considered as high end retail market for fresh vegetables, generally targeted by convenience and quality seeking consumers. Local vegetable markets are wet markets where a number of retailers operate side by side. This is the preferred shopping location for bargain seeking consumers with no time constraints. Pedestrian markets and street vendors are considered low end retail markets. Pedestrian markets are roadside markets with a less hygienic market environment. Street vendors purchase low quality or low priced product from wet markets and offer door to door services to consumers.

Depending on the types of retail outlets involved, the product reaches consumers through three different types of chain: one that serves retailers in the local vegetable markets, one that serves supermarkets/vegetable corner shops and another that serves pedestrian markets or street vendors. Except for the chain that involves supermarkets in which a wholesaler-cum-supplier links between the wholesalers and the supermarket, the structures are similar across these chains. Although the majority of actors in these chains are engaged in continuous transactional relationships, there is no evidence of collaboration at any stage of the chain. Each actor is structurally and functionally independent.

With respect to the volumes of product and future growth prospects, chains that lead to local vegetable markets and supermarkets are significant. The majority of tomato production flows through local vegetable markets. Although the supermarket share of total volume was negligible at the time of data collection, it was growing rapidly. There was only one supermarket which had fresh vegetables as a product line in 2010. This supermarket had two retail outlets with a daily volume of transaction around 100 kg from each outlet. The number of outlets increased to five within the two years between 2010 and 2012. With a growing middle income population in the country, the potential for supermarket growth seems high. Therefore, these two chains are included in the further analysis.

Processes

The matrix presented in Table 5 summarizes the main processes of the tomato supply chains related to product flow (column 1), major activities within each process and their relative importance (column 2), and improvement activities (column 3). Based on their impact on creating or adding value to the final product, activities in column 2 are further sub-divided into value-adding activities, necessary but not value-adding activities and waste activities (Bonney et al. 2007). An activity that adds value to the final product is defined by the consumer as value-adding. This activity relates to final product attributes that consumers value. Necessary but not value-adding activity is activity that does not directly add value to the product but which cannot be removed under the prevailing state of technology. Waste is activity that either reduces product value or is unnecessary, and which can be removed without compromising the value of the final product. Improvement activity is that activity which, if incorporated in the existing process, can improve the efficiency or effectiveness of the chain.

Table 5. Product Flow Processes: Important Activities and Improvement Opportunities

Processes	Relative importance of prevailing activities			Improvement opportunities
	Value-adding activities	Necessary but not value-adding	Waste	
Input management	Managing seed	Managing fertilizer, irrigation and pesticide		Managing post-production activities
Production	Selecting variety and producing tomato, Staking during production	Nursery, transplanting seedling, mulching, fertilizing, irrigating, harvesting	Using excessive amount of pesticides	Sorting and grading, applying proper harvesting timing and technique such as picking in time and with stalk
Logistics	Transporting product in time	Managing crates, collecting product from field, loading in vehicle, and unloading	Transferring into crates, over filling into crates, putting other vegetables on top of loaded crates while transporting	Using specialized vehicles such as refrigerated van and improvising vehicles to transport plastic crates
Wholesale		Selling product early in morning	Assembling tomatoes from different sources, transferring from crate to crate thereby increasing handling and reducing quality, consuming more labor and time	Assembling products according to quality, establishing channel to redirect quality product directly to retailers
Supply to Supermarket		Collecting required quantity on search quality, sorting, delivering to supermarket		Buying product directly from farmers having capability to supply quality products
Retail: local vegetable market		Displaying and transacting		Grading and labeling with credence attributes
Retail: supermarket		Grading, packaging, displaying in clean environment, delivering quality based on search attributes		Promoting credence attributes, labeling products with credence attributes, supplying fresh product

Source. Field Survey 2010

The matrix shows that the chains' processes are not aligned so as to assure consumers that the products are fresh, pesticide free, traceable and organic, leading to a mismatch between the expectations of the highest value consumer segment and the delivery of product attributes by existing supply chains. This could be a reason for tomato being a low value commodity across the chains. These chains' processes, however, are delivering the majority of the value for other segments of consumers. The chains measure the quality of the products based on search attributes of product such as size, color and pest damage. Segmentation analysis reveals that the other segments of consumers generally value these search attributes in tomatoes.

Support Functions

Government and development partners have long been important stakeholders of agricultural development in Nepal (Mellor 1995; NPC 2007; Shrestha and Adhikari 2010). Generally they support farmers on technology transfer and social mobilization, and traders on market infrastructure development and management support. Farmers in these chains have not yet received any direct support from government. Indirectly, one government policy has helped these farmers to buy some fertilizer from a semi-government institution. Similarly, the market where these wholesalers operate was developed by the government with support from the United Nation's Capital Development Fund. Established by a government regulation, a market development board manages the wholesale market's operations. Except for these examples of indirect support, no actors in these chains have received any support from government or development partners that would help them to develop value chains.

Indirect support from government also does nothing to add specific value to the product as defined by high value discerning consumers. Rather, some of the government regulations have created wastage. Vehicles carrying fresh vegetables are allowed to enter the wholesale market only between 6 p.m. and 7 a.m. Despite carrying perishable products, they are not exempt from non-stop movement on the highway. If a vehicle cannot enter the market before 7 a.m. due to stoppage at a checkpoint or an incident on the highway, the lead time for vegetables to reach consumers increases, leading to waste creation in the chain.

Results from the Analysis of Chains

The research suggests that existing chains are responsive to the value attributes of all consumer segments other than the largest segment, which contains high value discerning consumers. These chains are incapable of meeting the expectation of the most valued consumers for the following reasons.

First, the chains are lengthy. A longer chain increases the lead time of product flow to the consumer. This also increases the frequency of handling of the product, and thus increases the chances of product damage. In this case, the longer the chain the lower its efficiency. Further, it becomes more difficult to establish the product's credence attributes in a longer chain.

Second, stages in the chain after production are not adding significant value to the product, though they capture a large proportion of the product's retail value. Since there is little value addition after production, tomato is traded as a commodity throughout all retail outlets. Having identified different segments of consumers with different value preferences and multiple uses of

the product, the analysis shows that tomato has untapped potential for product differentiation. Not even the supermarket, a high end retail outlet, has added value to the product according to the preferences of its consumers. For example, it is sourcing tomatoes from wet markets where traceability disappears.

Third, government and development partners are providing indirect support at the production and marketing stages, but there is no direct support and no chain-wide support. The product flow matrix shows that government policy can add to, or therefore reduce, wasteful activities. The analysis offers the following managerial and policy implications with respect to improvement in existing chains so as to cater for the needs of high value consumer segments.

Managerial Implications for Actors in the Chains

The findings offer prospects for improvement both in chains that are significant from a growth perspective (supermarkets) and a volume perspective (wet markets). Chains involving supermarkets can target high value consumers and there is some prospect of shortening these chains. Few actors are involved in creating or adding consumer value, most of which is determined in the production stage. Findings provide a rationale for chain members to engage in shorter but more collaborative value chains to deliver attributes that high value consumers will pay for. Shortening the length of chains also reduces lead time, improving freshness, and improves the assurability of credence attributes.

The brand image of supermarkets requires vigilance in offering products that are safe and healthy. Supermarkets can quickly lose market share if there is food safety incident, thus they stand to benefit by engaging with their supply chains. Likewise, upstream actors aspire to develop value chains with supermarket to gain access to high end retail outlets and their high value consumers. Unfortunately, developing chain relationships with supermarkets is challenging, and actors must demonstrate their ability to reliably deliver a quality product. Greater collaboration with government and development partners may help upstream actors develop these abilities. Since these stakeholders are committed to developing fresh vegetable value chains through funded programs, commercial actors have an opportunity to develop the necessary attitudes, skills and resources to re-orient themselves to value chain ways of doing business. Therein lies shared value for all. By delivering higher value to consumers and by reducing costs, the value chain development objectives of government and development partners can be achieved. At the same time, actors would become more competitive and consumers would receive greater value.

Chains that involve wet market retailers can improve their chain performance by reducing the waste at each stage. These chains are already delivering the majority of the attributes identified by other segments of consumers, but could do so more efficiently. Lowering costs improves competitiveness.

Policy Implications for Stakeholders of the Chains

Although the government is offering competitive grants to develop fresh vegetable value chains, the actors in chains have not benefited from these opportunities. Findings from consumer segmentation suggest that the greatest payoff from value chain development will come from efforts to target high value discerning consumers. Since these consumers will pay for value that is

largely created at the production stage but must be delivered and guaranteed at modern retail outlets, future support from the government and donors may be targeted at building examples of such chains.

Relatively small interventions from the government can also address wastage and inefficiency (Adhikari 2008) such as injudicious use of pesticides, actors' dependence on input-suppliers for technical knowledge, losses during transport due to use of inappropriate transport materials, and increased transport times.

Furthermore, segmentation analysis reveals that 'low value institutional consumers' are acting with a level of ignorance. Having knowledge that such a segment does exist, government can devise policies that minimize such moral hazards, in partnership with development partners who can implement awareness programs targeting these consumers. During data collection, it was observed that consumers were buying tomatoes with visible traces of pesticides and later confirmed that they lacked knowledge about the dangers of pesticide residues. Thus consumer awareness of credence attributes could become a strategic objective for public stakeholders in fresh produce value chain development.

Conclusion

In earlier sections, findings from consumer segmentation established a need for value chain development in the context of this study. The results show that tomato consumers in Kathmandu clearly differ in their preferences and characteristics. Perhaps surprisingly, high value consumers represent the largest segment, which provides an incentive for chain actors to change their practices. As these consumers seek attributes that can only be delivered through whole of chain efforts, a value chain approach applied to this segment might serve as a demonstration of the benefits of such an approach more widely in the agrifood sector of Nepal.

Findings from the segmentation analysis, along with the analysis of existing chains, reveal gaps between the expectations of consumers and the ability of actors to deliver desired product attributes. This gap is most prominent in the high value consumer segment and in chains servicing high value retail outlets. Consumer segmentation analysis identifies value expectations of consumers, while chain analysis guides where and how value attributes can be created.

With growing knowledge among consumers, more awareness by stakeholders and actors in agri-food chains, a growing middle income population, and more supermarkets in developing countries, the numbers of consumers who attach value to credence attributes are expected to increase in the future. At the same time, even in a least-developed country such as Nepal, more strict food safety and quality regulations are expected to be enacted in response to incidences of food borne diseases in Nepal and elsewhere. Greater knowledge from consumer segmentation, as shown in this study, when combined with these forces driving food safety and quality, will enhance opportunities for value chain development in Nepal. This is an approach that government and development partners are promoting in the country as a means of achieving commercialization in agriculture, but limitations in existing programs where consumer value is not taken into account, must be addressed, as shown in this study.

Limitations, Future Research and Contributions

Limitations and Future Research

Yankelovich and Meer (2006) argue that the three constraints that limit the benefits of segmentation are distraction from production features to consumers' identity, little emphasis on actual consumer behavior, and undue emphasis on technical features of segmentation rather than on practical implication. This study addresses the first and third constraints by using product and process-based attributes for segmentation, and applying simple and frequently used methods of segmentation. Taking Yankelovich and Meer's (2006) perspective, this study does not account for consumers' actual purchase behavior directly, but by conducting surveys in actual market settings immediately after consumers' purchase actions, it was expected that their survey responses were a close reflection of their actual behavior. A design that could have included both perceptions and actual behaviors may have further strengthened the study's validity.

This study has used variables related to consumers' preferences for product benefits as the basis for segmentation because the objective of the study was to identify different consumer value profiles. Choice barriers, which refer to consumers' inability to maximize their utility due to lack of knowledge (Bock and Uncles 2002), were not used as a basis for segmentation in this study. Verbeke et al. (2007) argue that consumers who are involved with product quality and have greater confidence to evaluate that quality, tend to place higher value on credence-based attributes than search attributes. This implies that ratings for credence-based attributes such as traceability, food safety and responsible production systems, would be higher for more informed consumers. The lower importance attached to some of these attributes in this study by a majority of consumers suggests a possible choice barrier among Nepalese tomato consumers. Future research may include choice barriers as a basis for segmentation to further refine the analysis. Also, the roles of different stakeholders such as government and development partners in reducing choice barriers could be explored.

Further research might also explore similarities and differences among the actors and stakeholders in agrifood chains in terms of their understandings of consumer value preferences and the impacts these differences have on partner selection and collaboration in value chain development.

Contribution

This study contributes to the segmentation literature by including both product and process-based attributes specific to tomato consumers in Nepal, a developing country. The study also demonstrates how consumer research can be useful in developing or improving value chains for a fresh agricultural product. The approach adopted in this study would provide a basis for developing value chain management strategies in similar country and industry contexts. Most importantly, this study is among the first to link consumer segmentation to value chain development in a developing country.

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Appendix 2

Distribution of Samples According to Market Outlets

Market Outlets	No. of Samples	% of Samples
Supermarket	13	3
Local vegetable corner shop	84	21
Vegetable wholesale market	33	8
Local vegetable market	182	46
Pedestrian market	53	13
Street vendor	29	7
Total	394	100



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Are Organic Growers Satisfied with the Certification System? A Causal Analysis of Farmers' Perceptions in Chile

Carlos Padilla Bravo[Ⓐ], Achim Spiller[Ⓑ], and Pablo Villalobos[Ⓒ]

[Ⓐ] *PhD Student, Department of Agricultural Economics and Rural Development, Georg-August-Universität Göttingen, Platz der Göttinger Sieben 5, 37073 Göttingen, Germany*

[Ⓑ] *Professor, Department of Agricultural Economics and Rural Development, Georg-August-Universität Göttingen, Platz der Göttinger Sieben 5, 37073 Göttingen, Germany*

[Ⓒ] *Assistant Professor, Department of Agricultural Economics, University of Talca, 2 Norte 685, Casilla 747, Talca, Chile*

Abstract

This study addresses farmer satisfaction with organic certification and its determinants. The findings show that the majority of the interviewees are satisfied with the certification system. Furthermore, the perceived benefit in terms of farm income is the most important factor determining satisfaction, suggesting a need to improve communication of other potential benefits such as market access. The perceived bureaucracy associated with organic certification negatively affects farmers' expectations, indicating that the simplification of the certification process and harmonisation of organic standards should be considered in the political debate. Surprisingly, the perceived reliability of organic certification has no significant effect on satisfaction. This study discusses market and policy implications.

Keywords: certification, satisfaction, organic standard, reliability, Chile

[Ⓐ]Corresponding author: Tel: +49.0.551.394825
Email: cpadill1@uni-goettingen.de
A. Spiller: a.spiller@uni-goettingen.de
P. Villalobos: pvillal@utalca.cl

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Introduction

Organic production is classified as a process-oriented attribute that cannot be detected in the end product (Giannakas 2002; Jahn, Schramm, and Spiller 2004a; Jahn, Schramm, and Spiller 2005). This means that information about the nature of these products is asymmetric, allowing opportunistic behaviour through e.g. mislabelling. While producers know whether the product is organic or not, consumers and even retailers do not (Giannakas 2002). To reduce market failure in the food market and to ensure that the end product meets the appropriate process and product standards, third-party certification¹ (TPC) has arisen as an institutional framework for monitoring and enforcing compliance with food quality and safety regulations (Lohr 1998; Giannakas 2002; Hatanaka, Bain, and Busch 2005; Jahn, Schramm, and Spiller 2005; Anders, Souza-Monteiro, and Rouviere 2007, Hatanaka and Busch 2008). In the organic market, third party certifiers monitor farmer compliance through criteria set by certification standards. In the case of a positive appraisal, a certificate indicating compliance with the standard is issued.

Given that certification as an institutional mechanism is relatively young in the food industry, there have been some attempts to evaluate the performance of various certification standards and quality assurance systems in the agribusiness sector from different perspectives (e.g. Jahn, Schramm, and Spiller 2004a, 2004b; Jahn, Schramm, and Spiller 2005; Gawron and Theuvsen 2006; Enneking, Obersojer, and Kratzmair 2007; Jahn and Spiller 2007a, 2007b; Schulze et al. 2008; Albersmeier, Schulze, and Spiller 2009; Albersmeier et al. 2009; Karipidis et al. 2009; Herzfeld, Drescher, and Grebitus 2011). However, few studies have investigated certification in the organic food sector. These include an assessment by Schulze and Spiller (2010) of farmers' acceptance of organic certification in the German market. Albersmeier, Schulze and Spiller (2009) analyse farmers' perceptions of the reliability of the organic scheme in Brazil and Costa Rica. Barrett et al. (2002) and Garcia Martinez and Bañados (2004) focus on the impact of organic standards on exports in developing countries. To the best of our knowledge, no study has analysed farmers' perceptions of organic certification in Chile. Specifically, this is the first attempt to analyse farmer satisfaction with the organic certification process in less developed organic markets.

Chile has a long tradition as a producer and exporter of agricultural products, supplying the most important food markets worldwide. According to official statistics, exports of agricultural products² accounted for US\$ 8,897.4 million in 2011, which represents 11% of the Chile's total exports (Banco Central de Chile, 2012). Organic farming is now becoming an attractive alternative production method for Chilean growers. Advantages such as geographical location and phytosanitary status place Chile in a privileged position to promote and expand organic farming. In addition, the political debate on organic farming in recent years has resulted in the implementation of an official law³ that currently regulates organic farming and certification

¹ Certification is defined as "the (voluntary) assessment and approval by an (accredited) party on an (accredited) standard" (Meuwissen et al. 2003). Similarly, according to Giannakas (2002) certification is "a process through which unobservable product characteristics (such as the process through which they have been produced) are guaranteed to consumers through a label. To avoid conflicts of interest, the guarantee is usually issued by an independent third (private or public) party whose ability to verify producer claims is greater than that of an individual".

² Official statistics do not currently distinguish between conventional and organic products.

³ On 24th December 2007, the Chilean organic Law N° 20.089 came into force, together with its regulations and technical standards. This law establishes a national certification system for agricultural organic products. According

activities in Chile. As a result, the current organic standard provides a legal regulatory framework to encourage conventional farmers to convert to the organic sector. Despite Chile's potential for organic farming and the establishment of an official regulation, organic production still represents a small proportion of Chilean agriculture. According to official statistics, there are around 151,000 ha under organic cultivation in Chile (ODEPA 2011a). This represents 0.5% of the area covered by livestock and agricultural production⁴. As the market for domestic consumption is still undeveloped, Chile's organic production is export-oriented (ODEPA 2011b). This means that organic growers must comply not only with the local organic regulation, but also with organic standards and certification processes imposed by foreign customers.

In particular, farmers may perceive both advantages and disadvantages from the use of certification (Gawron and Theuvsen 2006; Getz and Shreck 2006; Lazo, Jahn, and Spiller 2007; Dorr and Grote 2009; Hammoudi, Hoffman, and Surry 2009; Karipidis et al. 2009). Disadvantages may be especially relevant for farmers in developing countries, where legislation and institutions governing organic food production are usually weaker and farm resources more limited than in industrialized economies. Perceived costs associated with the use of organic certification and an unreliable inspection system may damage farmers' expectations of the performance of the control scheme, with detrimental consequences for farmer satisfaction. Dissatisfaction with the organic certification system may encourage farmers to change their certification agency or shift back to conventional agricultural practices, with the latter having negative implications for the private and public sector. In addition, dissatisfied farmers could also deter other potential customers through negative communication by word of mouth. In this context, it is useful to critically assess farmer satisfaction with the certification system and the factors driving it. Therefore, this research develops and analyses a structural equation model using data collected in Chile. In particular, this investigation tests the causal relationships in the proposed model using partial least squares (PLS) analysis. The following sections of this article provide information about determinants of satisfaction with quality assurance systems and describe the research hypotheses of the study, followed by the data collection procedure and statistical approach. The article then reports the results and discusses market and policy implications. Finally, this study draws conclusions for the organic sector in Chile.

Satisfaction with Certification Schemes and Reported Determinants

The core variable in this study corresponds to farmer satisfaction with organic certification. Satisfaction in this study is conceptualised as the affective reactions of individuals toward the use of organic certification. Satisfaction is defined as the fulfilment of certain prior expectations related to a product or service (Raboca 2006). Kotler and Keller (2006) similarly refer to satisfaction as "a person's feeling of pleasure or disappointment resulting from comparing a product's perceived performance (or outcome) in relation to his or her expectation". In other words, satisfaction reflects the degree to which a person believes that the position and/or use of a system evoke positive feelings (Rust and Oliver 1994).

to this regulation "the objective of this system is to ensure and certify that organic products are those elaborated, packed and handled in accordance with standards set by this Law and its Regulations".

⁴ The agricultural census carried out in Chile in 2007 indicates that the area being utilized for livestock and agriculture activities is 29,781,690.81 ha (INE 2011).

Although customer satisfaction studies are restricted in many cases by monetary and time constraints, they are relatively common in the agrifood sector (e.g. Juhl, Kristensen, and Østergaard 2002; Gilbert et al. 2004; Mai and Ness 2006; Spiller, Bolten, and Kennerknecht 2006; Lülfs-Baden et al. 2008). However, there are few studies that address issues of farmer satisfaction with certification schemes in the food industry. Enneking, Obersojer and Kratzmair (2007) addressed the study of farmer satisfaction, and its determinants, with three different quality assurance systems in Germany. They reported that improvements in image, sales and production efficiency are key factors influencing farmer satisfaction. Using regression analysis to assess organic farmers' acceptance of organic certification in Germany, Schulze, Jahn and Spiller (2007) found that the perceived bureaucratic costs, effectiveness and usefulness of organic certification are major factors determining farmer satisfaction. In addition, Schulze et al. (2008) reported that the cost/benefit ratio, the evaluation of the catalogue of requirements, the perceived communication of the standard owner, the perceived expertise of the auditor and the perceived costs of the certification significantly affect the overall evaluation of the International Food Standard. In this case, managers and quality assurance staff from European agrifood companies participated in the study. Using causal analysis to evaluate farmer satisfaction with organic certification in Germany, Schulze and Spiller (2010) also indicate that the perceived bureaucratic costs, effectiveness and usefulness of the system are key determinants of farmer satisfaction.

In the following, we present a model and a set of hypotheses that, from our perspective, can hypothetically describe the effects of several factors on farmer satisfaction with organic certification schemes. Unlike the study carried out by Schulze and Spiller (2010), this research further focuses on the analysis of the perceived reliability of organic certification and its potential drivers, as well as addressing farmers' perceptions in a less mature organic market, i.e. Chile.

Factors Influencing Farmer Satisfaction with Organic Certification

Perceived Reliability of Organic Certification

Despite the usefulness of TPC in reducing information asymmetry within the organic market, it is susceptible to opportunistic behaviour (e.g. the mislabelling of conventional foods as organic) (Giannakas 2002). Cases of mislabelling in the organic food sector have been reported by several authors (Giannakas 2002; Jahn, Schramm, and Spiller 2005). Given that the success of any certification system mainly depends on 'trust relationships' (Jahn Schramm, and Spiller 2005), opportunistic behaviour negatively affects consumer perception of the scheme and, therefore, has detrimental consequences for the market acceptance of organic food products (Giannakas 2002). In addition, occurrences of opportunistic behaviour can affect farmers' perception of the reliability of the control procedure. We define perceived reliability in this study as the respondent's judgement that the monitoring system is capable of detecting non-compliance with the organic standard. Perceived low reliability of organic certification may create conflicts and distrust amongst the different actors within the organic food supply chain on the one hand, and affect farmer loyalty and the adoption of the organic standard due to the scheme's low acceptance on the other hand. Therefore, we hypothesize that:

H₁: The greater the perceived reliability of the organic certification scheme, the greater the satisfaction with the organic certification process.

Perceived Benefits of Using Organic Certification

As mentioned above, customers of certification services may perceive benefits and costs of using certification standards. Benefits can be divided into internal (e.g. improvements in firm management, increasing income) and external benefits (market access and improved client relationships) (Karipidis et al. 2009). Unlike previous empirical studies (Schulze, Jahn, and Spiller 2007; Albersmeier, Schulze, and Spiller 2009; Schulze and Spiller 2010), we decompose the perceived benefit or usefulness of the certification system into three main constructs and evaluate their effects on satisfaction separately. Thus, we hypothesise that:

H₂: The better the perceived farm management, the greater the satisfaction with the organic certification process.

H₃: The better the perceived relationship with buyers and access to market, the greater the satisfaction with the organic certification process.

H₄: The higher the perceived farm income, the greater the satisfaction with the organic certification process.

Perceived Costs of Using Organic Certification

Certification incurs economic and bureaucratic costs. While bureaucratic costs are commonly related to the use of quality assurance schemes (Theuvsen 2004), economic costs also arise from the implementation of the standard (e.g. new infrastructure, personal training) and the fee customers must pay for the inspection service (Dorr and Grote 2009, Karipidis 2011). Schulze and Spiller (2010) found that bureaucratic costs negatively affect organic farmers' satisfaction in Germany. Similar results have also been reported in the German dairy system (Jahn and Spiller 2007b). The cost of the inspection fee is of special interest in developing countries because in most cases farmers must use internationally accredited inspection bodies, which increases the cost of certification (Barret et al. 2002; Vogl, Klicher, and Schmidt 2005). Considering this, we postulate that:

H₅: The higher the perceived economic costs, the lower the satisfaction with the organic certification process.

H₆: The higher the perceived bureaucratic costs, the lower the satisfaction with the organic certification process.

Experience in the Organic Sector

Empirical studies have reported that the number of years' experience in the organic sector significantly affect farmer satisfaction with organic certification in some Latin American countries (Albersmeier et al. 2009a). According to Ferguson, Wenssen and Storey (2005), less experienced organic growers in Canada are less satisfied with third-party organic certification. Based on this, we hypothesise that:

H₇: The more experience farmers in the organic sector have, the greater the satisfaction with the organic certification process.

Factors Influencing the Perceived Reliability of Organic Certification

Perceived Reputation of Inspectors and Certification Bodies

According to Jahn, Schramm and Spiller (2005) and Anders, Souza Monteiro and Rouviere (2007), the objectivity, experience and independence of the executive certification body (CB) are crucial determinants of the reliability of TPC. This is also valid for auditors or inspectors in charge of carrying out inspections at the producer's property. In developing countries supplying organic food products to high-value markets, reliable certification is critical (Anders, Souza-Monteiro, and Rouviere 2007). Nevertheless, the outbreak of food-borne diseases and continuous scandals affecting the food industry demonstrate that CBs and audit processes are sometimes susceptible to failure. Poor inspection quality may not only undermine the reputation of a particular CB or auditor but also negatively affect the reliability of the whole system because the probability of mislabelling is higher. In other words, the reliability of the certification process depends on the way auditing is carried out (Jahn, Schramm, and Spiller 2004b). However, the thoroughness of the audit process often varies considerably amongst different third-party certifiers (Jahn, Schramm, and Spiller 2005). Empirical evidence shows that there are significant differences between the auditing judgments issued by different certification bodies in the organic (Zorn, Lippert, and Dabbert 2010) and conventional food industries (Albersmeier et al. 2009). Considering this information, we hypothesise that:

H₈: The better the CB's reputation, the higher the perceived reliability of the organic certification scheme.

H₉: The better the auditor's reputation, the higher the perceived reliability of the organic certification scheme.

Perceived Risk of Fraud in the Organic Sector

Mislabelling and cheating in the organic sector can increase potential negative market effects (e.g. decrease in consumer demand). If farmers perceive that fraudulent practices by other growers are frequent in the organic sector, i.e. an increase in farmers' risk perception of fraud, they may negatively evaluate the reliability of the certification system. Therefore, we postulate that:

H₁₀: The higher the perceived risk of fraud in the organic sector, the lower the perceived reliability of the organic certification scheme.

Perceived External and Internal Sources of Pressure

Finally, some sources of internal and external pressure enforcing compliance with the organic standard may positively affect farmers' perception of the reliability of the certification process. In terms of organic certification, the government is the standard-setting institution (Garcia

Martinez and Bañados 2004). Therefore, we can expect that governmental institutions play a key role in monitoring compliance with the rules. Getz and Shreck (2006) highlight the importance of farm associations and farmers in enforcing compliance with organic standards. Furthermore, suppliers of organic products are under constant pressure because of the great number of different demands from customers (buyers) (Jahn, Schramm, and Spiller 2004b). Similar to farmer associations, the families of organic growers have a special interest in the correct functioning of the certification system since they may also suffer from economic losses in the event of fraud (Albersmeier, Schulze, and Spiller 2009). Considering this background, we hypothesise that:

H₁₁: The greater the perceived buyer pressure, the higher the perceived reliability of the organic certification scheme.

H₁₂: The greater the perceived government pressure, the higher the perceived reliability of the organic certification scheme.

H₁₃: The greater the perceived farmers pressure, the higher the perceived reliability of the organic certification scheme.

H₁₄: The greater the perceived family pressure, the higher the perceived reliability of the organic certification scheme.

Figure 1 summarises the proposed research model.

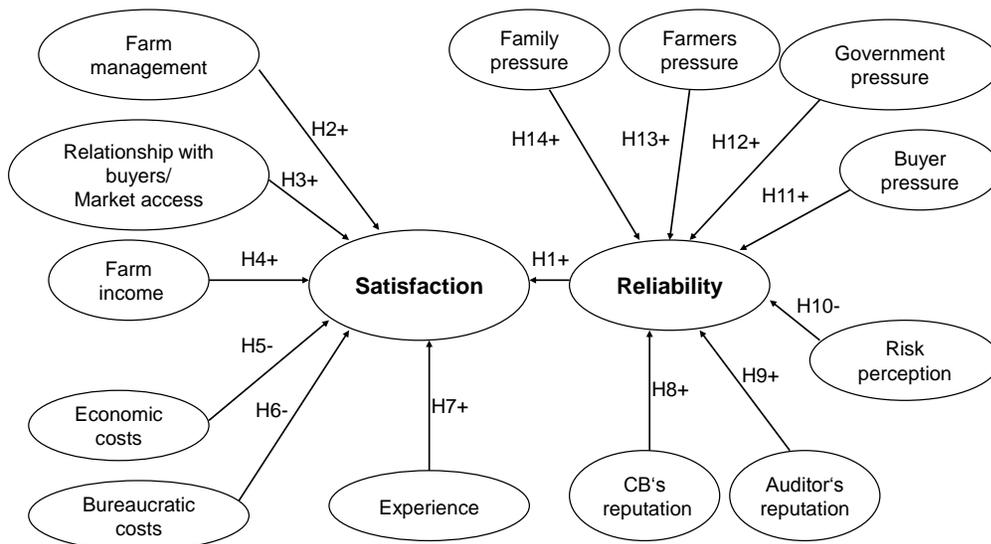


Figure 1. Research Model

Methodology

Data Collection

Between August and October 2008, face to face interviews were conducted in the Ñuble and Curicó provinces of Chile. A total of 60 subjects were consulted about their perceptions of

organic certification. In addition, the whole sample was composed of certified organic farms. With regard to the sampling procedure, respondents in this study were not randomly selected. Instead, a convenience sample was used. Therefore, the results reported in the following sections must be interpreted from an exploratory research perspective.

In order to test our hypotheses, a structured questionnaire with multiple scale items was designed. Personal and farm structure aspects were also recorded for each respondent. The questionnaire was designed in English. It was subsequently translated into Spanish and special attention was paid to ensure it contained wording typically used in Chile. Before administering the questionnaire, a pilot test was performed in order to check for inconsistencies.

Sample Description

The survey provided information from organic farmers working with different types of berries (raspberry, blackberry, blueberry, etc.), vegetables and some major crops. In addition, most of the farms (87%) are affiliated to one of the most important certification bodies operating in the country (BCS ÖKO-GARANTIE GMBH). It was mainly farm owners (73.3%) that took part in the survey. Respondents who went to primary or secondary school accounted for 68.3%, while subjects holding a bachelor degree or who went to technical schools accounted for 30% and 1.7% respectively. On average, the subjects surveyed were 49.1 years old and had practiced organic farming for 7 years. The farms covered an area of 21.7 ha on average and the number of workers was on average 9.5. The high standard deviations for the number of ha and workers indicate that the sample includes both small and medium/large organic operations (Table 1). In terms of sales, almost half of the sample achieved less than \$15 million Chilean pesos⁵, while around 18% reached over \$75 million. The rest of the respondents (30%) declared sales between \$15 and \$75 million. The majority of the respondents are organised as independent bodies (80%). The main marketing channels are the agroindustry (45%) and export companies (50%).

Table 1. Sample Characteristics.

Age (years)	Gender (female/male)	Experience with organic farming (years)	Size of farm (ha)	Number of workers/employees (#)
49.1	8/52	7.0	21.7	9.5
<i>12.3^a</i>	13.3%/86.7%	5.2	37.7	16.6

^a Standard deviation in *italics*.

Measures

Items used to capture the latent variables of the structural model (see Table 4 in Appendix) were adopted from measurement scales that have been tested in previous studies dealing with farmers' acceptance and their assessment of different quality assurance systems (e.g. Jahn and Spiller 2007a, 2007b; Schulze, Jahn, and Spiller 2007). The selected statements or items were assessed by respondents on a seven-point Likert scale (-3 'totally disagree', -2 'disagree', -1 'partially disagree', 0 'neither agree nor disagree', +1 'partially agree', +2 'agree', +3 'totally agree'). All were examined beforehand using exploratory factor analysis (principal component analysis,

⁵ USD\$ 1 = Chilean pesos \$ 518.66. Central Bank of Chile (www.bcentral.cl) (accessed on 21st December 2011).

VARIMAX rotation). Items with double loading and those loading on improper factors were excluded from further analysis.

Statistical Approach

Structural equation modelling (SEM) is a general analytic framework that allows the identification of causal relationships through the combination of multiple regression, path analysis, and confirmatory factor analysis (Tomarken and Waller 2005). Estimation of causal models with latent constructs can be performed either by covariance-based or variance-based SEM techniques (Gefen, Straub, and Boudreau 2000; Reinartz, Haenlein, and Henseler 2009). In this study, partial least squares (PLS), a variance-based method, was used because it is appropriate for exploratory studies with small sample sizes and relaxes the distributional assumptions required by covariance-based approaches (Gefen, Straub, and Boudreau 2000; Henseler, Ringle, and Sinkovics 2009; Reinartz, Haenlein, and Henseler 2009; Hair, Ringle, and Sarstedt 2011). The analysis and interpretation of PLS models comprises two steps: i) the assessment of the reliability and validity of the measurement model (outer model); and ii) the assessment of the goodness of fit of the structural model (inner model) (Hulland 1999; Henseler, Ringle, and Sinkovics 2009; Hair, Ringle, and Sarstedt 2011). The statistical software SmartPLS version 2.0 M3 (Ringle, Wende, and Will 2005) was used to analyse the data.

Results

Satisfaction with Organic Certification

The majority of respondents seem to be satisfied with the organic certification process. While 23.3% and 36.7% partially agree or agree, 30% totally agree with the statement “*I am satisfied with the organic certification scheme*”.

Reliability and Validity of the Measurement Model

The reliability of the measures takes into account the factor loadings of each measurement item on their respective latent construct (see Table 4 in Appendix). The majority of measure loadings are consistent with the recommended value of 0.7 (Chin 1998a; Hulland 1999; Henseler, Ringle, and Sinkovics 2009; Hair, Ringle, and Sarstedt 2011).

The evaluation of construct reliability considers Cronbach’s alpha and composite reliability (Table 2). However, Cronbach’s alpha usually exaggerates the unreliability of measurements and thus composite reliability provides a better judgement of construct reliability (Baumgartner and Homburg 1996; Henseler, Ringle, and Sinkovics 2009; Hair, Ringle, and Sarstedt 2011). No matter which reliability coefficient is used, the recommended threshold for sufficient construct reliability in early stages of research is 0.7 or above (Nunnally and Bernstein 1994). Convergent validity considers the evaluation of average variance extracted (Fornell and Larcker 1981). This research reports satisfactory values (greater than 0.5) for average variance extracted for all the assessed constructs. In other words, the latent variables are able to explain more than half of their indicators’ variance on average.

Table 2. Assessment of the measurement model.

Variables	N° items	CRA^a (>= 0.7)	CR^b (>= 0.7)	AVE^c (>=0.5)
Auditor's reputation	3	0.53	0.76	0.52
Bureaucratic costs	3	0.58	0.77	0.53
Buyers pressure	2	0.63	0.84	0.73
Relationship with buyers/Market access	4	0.80	0.86	0.61
CB's reputation	2	0.40	0.75	0.61
Economic costs	2	0.62	0.82	0.70
Experience	1	1.00	1.00	1.00
Family pressure	1	1.00	1.00	1.00
Farm income	2	0.56	0.81	0.69
Farm management	3	0.57	0.76	0.53
Farmer pressure	3	0.61	0.79	0.56
Government pressure	1	1.00	1.00	1.00
Reliability	3	0.62	0.79	0.57
Risk perception	3	0.59	0.77	0.52
Satisfaction	1	1.00	1.00	1.00

^a Cronbach's alpha.

^b Composite reliability.

^c Average variance extracted.

Discriminant validity considers the performance of the Fornell-Larcker criterion (Fornell and Larcker 1981) and the evaluation of cross loadings. The Fornell-Larcker criterion postulates that a latent construct should share more variance with its assigned indicators than with another latent variable in the structural model (Hair, Ringle, and Sarstedt 2011). We found no evidence of correlation between any two latent constructs larger than the square root of the average variance extracted from these two constructs (see Table 5 in Appendix). A second criterion requires that an indicator's loading with its associated construct should be higher than its loadings with all the remaining constructs (Hair, Ringle, and Sarstedt 2011). Data analysis shows that there is no evidence of cross loadings (data not shown). Therefore, discriminant validity is supported, which means that all constructs in the research model are indeed measuring different concepts.

Goodness of Fit of the Structural Model and Determinants of Satisfaction

The assessment of goodness of fit for the model focuses on R^2 scores and the algebraic sign, size and significance of the path coefficients (Baumgartner and Homburg 1996; Henseler, Ringle, and Sinkovics 2009; Hair, Ringle, and Sarstedt 2011). There is good structural fit for the model when i) there is high explanatory power (R^2) and ii) there are statistically significant t-values associated with the path coefficient estimates.

The structural model explained 51% of the variance in the perceived reliability of the organic certification process and 47% of the variance in satisfaction. In PLS models, R^2 scores of 19, 33 and 67% are considered weak, moderate and substantial respectively (Chin 1998b). Recently, Hair, Ringle and Sarstedt (2011) provided more restrictive criterion for assessing R^2 values (25, 50, and

75%). Given the explorative character of this study and the small sample size, reported R^2 values in this study are acceptable.

The significance of path estimates (Table 3) was determined by using the SmartPLS bootstrapping routine with 5,000 sub-samples and 60 cases (Henseler, Ringle, and Sinkovics 2009; Hair, Ringle, and Sarstedt 2011).

Table 3. Structural path estimates.

Variables	Endogenous constructs	Parameter estimate	Standard error	t-statistic
<i>Perceived reliability</i>				
H1 Reliability	Satisfaction	0.06	0.17	0.34 ^{ns}
<i>Perceived benefits</i>				
H2 Farm management	Satisfaction	0.18	0.14	1.28 ^{ns}
H3 Relationship with buyers/Market access	Satisfaction	0.20	0.15	1.32 ^{ns}
H4 Farm income	Satisfaction	0.38	0.12	3.11 ^{**}
<i>Perceived costs</i>				
H5 Economic costs	Satisfaction	-0.05	0.10	0.48 ^{ns}
H6 Bureaucratic costs	Satisfaction	-0.22	0.10	2.13 [*]
<i>Experience in the organic sector</i>				
H7 Experience	Satisfaction	-0.03	0.09	0.36 ^{ns}
<i>Perceived reputation</i>				
H8 CB's reputation	Reliability	0.18	0.17	1.08 ^{ns}
H9 Auditor's reputation	Reliability	0.19	0.18	1.04 ^{ns}
<i>Perceived risk of fraud in organic sector</i>				
H10 Risk perception	Reliability	-0.30	0.12	2.53 [*]
<i>Perceived external and internal pressure</i>				
H11 Buyers pressure	Reliability	0.32	0.15	2.15 [*]
H12 Government pressure	Reliability	0.14	0.14	1.00 ^{ns}
H13 Farmer pressure	Reliability	0.30	0.11	2.78 ^{**}
H14 Family pressure	Reliability	-0.12	0.13	0.95 ^{ns}

* Parameter is significant at $p < 0.05$; **parameter is significant at $p < 0.01$; *** parameter is significant at $p < 0.001$; ns = parameter is not significant.

The results reveal that among the perceived benefits, the perceived improvement in farm income due to the use of organic certification shows a significant influence on farmers' satisfaction. In addition, this variable has the highest impact on satisfaction in the model. Although other perceived benefits show the expected sign, they are not significant. As postulated, the costs associated with the certification process, i.e. economic and bureaucratic costs, negatively affect farmer satisfaction. Nevertheless, only bureaucratic costs significantly affect this endogenous variable. Surprisingly, the perceived reliability of the certification process is not a significant determinant of satisfaction. The perceived risk of fraud in the organic sector and external as well as internal sources of monitoring arise as significant determinants of the perceived reliability. To an even greater extent, the perceived monitoring by buyers is the most important factor affecting reliability. Neither the perceived reputation of the auditor nor the perceived reputation of the CB

significantly influences the perceived reliability of the organic scheme, although they show the expected sign.

Discussion with a Focus on Market and Policy Implications

The findings of this study must be analysed with caution. The explorative character of this research limits the interpretation of the results to the sample we analysed in the Chilean case. Nevertheless, important lessons can be taken from this study.

Satisfaction with Organic Certification

The results show a high level of farmer satisfaction with organic certification. In other words, the performance of the certification scheme meets farmers' expectations. This is supported by the fact that the majority of the subjects surveyed (71.7%) have never changed their CB (data not shown). Previous empirical evidence indicates that farmers' acceptance of the organic certification scheme is higher and less controversial in Latin American countries than in more developed organic food markets (Albersmeier, Schulze, and Spiller 2009). This is a good signal for the CBs operating in the region because the long term competitiveness and success of firms depends to some extent on customer loyalty to the product or service, which is in turn shaped by customer satisfaction (Bayol et al. 2000; Spiller, Bolten, and Kennerknecht 2006; Lülfs-Baden et al. 2008 Anderson and Swaminathan 2011). However, as mentioned previously, 87% of the farms surveyed are affiliated to the same single CB. This fact prevents the development of a clear picture of the assessment of the organic certification process by organic farmers affiliated to other CBs. Empirical evidence shows that there are differences between the auditing judgments of different CBs in the organic food industry (Zorn, Lippert, and Dabbert 2010). In addition, Ferguson, Wenssen and Storey (2005) point out that there are large differences in farmers' satisfaction across different CBs in the Canadian organic market. Therefore, future studies analysing farmer satisfaction with organic certification should consider the use of a more heterogeneous sample in terms of CBs. Another limitation in relation to this sample is the fact that it did not consider farmers who reverted back to conventional agriculture. Additionally, given that satisfaction is a complex multidimensional construct (Raboca 2006), further investigations should include more statements to assess farmer satisfaction. This could provide a more accurate evaluation.

Determinants of Satisfaction

Surprisingly, the perceived reliability of organic certification is not a significant predictor of farmer satisfaction in this study. Maybe the perceived good reputation of CBs (or at least BCS ÖKO-GARANTIE GMBH) and auditors (see Table 4 in Appendix), as well as the absence of major public scandals in the local organic industry, may be focusing the attention of local farmers on other factors (e.g. perceived benefit in terms of farm income) when assessing their expectations regarding the use of organic certification.

The findings also indicate that the perceived benefits are more important than the perceived costs. Previous studies have reported similar results in the conventional food industry (e.g. Enneking, Obersojer, and Kratzmair 2007). However, the picture seems to be different for small farmers (Karipidis et al. 2009). As previously mentioned, the perceived benefit in terms of farm income is

the most important factor affecting satisfaction. This is not unusual because Chile's organic production is export-oriented and therefore deals with high-value markets (Garcia Martinez and Bañados 2004). Moreover, there is evidence from Latin America indicating that farmers who have adopted certification schemes have a higher net income compared with non-certified farmers (Dorr and Grote 2009). The findings also reveal that other potential benefits such as a good relationship with buyers, market access and improvement in farm management may not have been well communicated to organic farmers so far. Access to information and good communication promotes the adoption of certification standards (Dorr and Grote 2009). If local policy makers aim to encourage the adoption and increase acceptance of the organic control scheme in Chile then they should properly communicate the benefits associated with the use of it. This matter is particularly critical when considering small farmers, who normally have more difficulty accessing information.

As expected, farmers perceive the certification process as a bureaucratic burden negatively influencing farmer satisfaction. Although this finding is in line with previous studies carried out in developed food markets (e.g. Theuvsen 2004; Jahn and Spiller 2007b; Schulze and Spiller 2010), there is also contradictory empirical evidence reported in developing countries (Lazo, Jahn, and Spiller 2007). The use of farmer associations might be a way to reduce bureaucracy (Getz and Shreck 2006) because it allows economies of scale and reduces transaction costs. Reaching equivalence⁶ between Chile's organic law and the standards ruling the most important organic markets might also mitigate the bureaucratic process. According to Barret et al. (2002), being recognized as a 'Third Country' by EU organic legislation facilitates the export process by reducing bureaucracy. However, the process of harmonization for organic regulations should consider differences in regional farming techniques and integrate the knowledge of local farmer groups to ensure effective environmental and health protection goals (Vogl, Klicher, and Schmidt 2005). In addition, the integration of regional or local aspects during the process of harmonization would help to guarantee the participation of small farmers in the international organic market and promote sustainable development in organic farming. Another way to reduce bureaucratic costs and, consequently, increase satisfaction with the organic control scheme is the encouragement of direct marketing through the establishment of local farmer markets. In terms of direct local marketing, no equivalence of national organic rules with European, etc., regulations is needed (Vogl, Klicher, and Schmidt 2005). Nevertheless, the establishment of direct marketing channels in less developed organic markets needs to be accompanied by a promotional strategy for organic food in order to capture local consumer attention and ensure a minimum level of consumer demand.

Although the perceived economic costs have a negative influence on farmer satisfaction, they do not exert a significant effect. The use of only one construct dimension (certification fee) may have affected the performance of this variable in this study. Thus, future studies should incorporate more variables associated with economic costs (e.g. costs related to new infrastructure, personal training) into the analysis. This could provide a clearer picture of the impact of economic costs on satisfaction.

⁶ Equivalence means that the norms regulating the production, processing, documentation, inspection and certifications systems in import markets are equally as effective as those in export markets, but not necessarily that they have to be identical (Garcia Martinez and Bañados 2004).

Determinants of Perceived Reliability

As the findings show, the reliability of the certification scheme depends on several factors. The perceived external control carried out by buyers and the perceived internal control undertaken by farmers or farmer associations both play a critical role in determining reliability. This is consistent with the findings of Albersmeier, Schulze and Spiller (2009), who point out that these types of organisations can perform a social monitoring function. In addition, they are more effective in this aspect than public authorities in Latin American countries. This indicates that the responsibility for monitoring is moving from the public sector to non-state actors. As Hatanaka and Busch (2008) argue, “the state is withdrawing from direct oversight and monitoring, and increasingly regulating food and agriculture indirectly”. Also, the lack of harmonization between the local organic legislation and those standards demanded by export markets (e.g. EU and USA), the existence of weak institutional regulatory structures and the undeveloped character of domestic organic markets in several Latin American countries may help to explain the perceived poor performance of the public sector as a monitoring body.

The risk perceived by farmers regarding fraud practices in the organic sector is also a determinant of the perceived reliability. This is not unusual since opportunistic behaviour and cheating in the organic food business, including third-party inspection activities, are still an important area of discussion in the international arena (Giannakas 2002; Jahn, Schramm, and Spiller 2005; Hatanaka and Busch 2008).

Unlike the suggestions from previous studies (e.g. Jahn, Schramm, and Spiller 2004b; Jahn, Schramm, and Spiller 2005; Anders, Souza-Monteiro, and Rouviere 2007; Albersmeier, Schulze, and Spiller 2009), neither the perceived reputation of the inspector nor the perceived reputation of the CB determine the perceived reliability of the organic control scheme in the research model. However, the results partially agree with those reported by Schulze and Spiller (2010) in Germany, who concluded that neither the perceived thoroughness of the CB nor the perceived expertise of the auditor significantly affect the effectiveness of the organic control system. Although the items used to evaluate CB and auditor reputation in this study were adapted mainly from earlier empirical research, the number of latent constructs describing these factors differs from those used in other studies. Therefore, differences in model specification may partially explain the variation in results. Another explanation is the fact that the majority of farms surveyed in this study are affiliated to the same CB, which apparently seems to enjoy a good reputation. Either way, the effect of reputation issues on farmer satisfaction deserves more empirical research at a local market level.

Conclusions

According to the findings of this study, organic farmers in Chile are satisfied with organic certification. However, extending this result to the whole domestic organic industry requires an analysis of a more heterogeneous sample.

Perceived benefits are more important determinants of farmer satisfaction than perceived costs, as the perceived improvement in farm income is the most important variable driving satisfaction and the perceived bureaucratic cost is the central barrier to increasing the acceptance of the organic control scheme. In this context, public authorities and other stakeholders may play a central role

in reducing bureaucracy by e.g. negotiating equivalence of the local legislation. In this way, farmer satisfaction with and acceptance of the monitoring system may increase. Adequate communication of other potential benefits (e.g. market access) may also help to increase farmer satisfaction.

Surprisingly, the perceived reliability of organic certification does not play an important role in determining farmer satisfaction. However, this may be an unusual case in the organic food industry, due to the apparently good reputation of the main CB in this study and the absence of major public scandals in Chile's organic industry, which may focus the attention of farmers on other factors.

The findings also reveal that the perceived performance of the state as a monitor is poor. In contrast, customer (buyer) demands and the internal control carried out by farmers or farmer associations both suggest that the industry is able to self-regulate its monitoring activities.

Contrary to the evidence reported in the literature, neither the perceived reputation of the inspector nor the perceived reputation of the CB determines the perceived reliability of the organic control scheme. However, more evaluations at a local market level should provide support to validate this argument.

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Appendix 1

Table 4. Measurement items for the variables in the research model

Variables and measurement items ^a	Mean	Standard deviation	Factor loading ^b
<i>Satisfaction with organic certification</i>			
I am satisfied with the organic certification scheme.	1.68	1.41	1.00
<i>Perceived reliability of organic certification</i>			
The certification process is reliable.	1.58	1.36	0.86
Cheaters are discovered during the inspections.	0.78	1.65	0.77
Inspectors are able to notice if other farmers sometimes do not follow the guidelines.	1.27	1.38	0.60
Perceived benefits			
<i>Farm management</i>			
Organic certification standards enhance the effectiveness of my organic practices.	1.57	1.43	0.87
The auditor gives me good ideas to improve the management of my farm.	1.05	1.90	0.69
The organic certification standard improves my productivity.	0.67	1.82	0.59
<i>Relationship with buyers/Market access</i>			
The direction our business is going in became clearer through the certification process.	2.03	1.15	0.84
I have a better relationship with my buyers since I got organic certification.	1.90	1.35	0.83
Since I farm organically, my business relations have increased.	1.80	1.56	0.81
I need organic certification to be able to sell my products.	2.20	1.26	0.63
<i>Farm income</i>			
My income has increased since I got organic certification.	0.78	1.74	0.90
I had more gains with conventional agriculture than with organic agriculture. ^c	0.92	1.81	0.75
Perceived costs			
<i>Economic costs</i>			
The fee for the certification process is not so high. ^c	1.48	2.02	0.96
The cost for the organic certification scheme is too high.	2.48	0.85	0.69
<i>Bureaucratic costs</i>			
The time expenditure for the certification process is too high.	0.38	2.09	0.82
The organic certification control system is very bureaucratic.	1.62	1.49	0.78
The required documentation for the organic certification scheme is too much.	0.42	2.04	0.56
Experience in the organic sector			
<i>Experience^d</i>			
For how many years have you been practicing organic agriculture?	7.0	5.2	1.00
Perceived reputation			
<i>CB's reputation</i>			
I chose this CB because it has a good reputation.	1.20	1.25	0.92
In comparison to other CBs ours is more thorough.	0.45	1.13	0.61
<i>Auditor's reputation</i>			
The performance of the auditor during the inspection is very correct.	1.80	1.12	0.88
Our auditor tries to find the weak points in my farm.	1.95	0.95	0.65
The auditor is an expert in organic production.	1.07	1.76	0.61

(Continued)

Table 4. (Continued)

Variables and measurement items ^a	Mean	Standard deviation	Factor Loading ^b
Perceived risk in the organic sector			
<i>Risk perception</i>			
Nowadays there are more farmers who do not follow the organic guidelines.	-0.30	1.28	0.76
Not every organic farmer has the same level of reliability.	1.72	1.22	0.72
I do not believe that all organic producers are trustworthy.	1.63	1.18	0.70
Perceived external and internal sources of pressure			
<i>Buyers pressure</i>			
My buyer warns me frequently about the consequences of cheating.	1.37	1.86	0.88
My buyer makes sure that I keep close to the guidelines.	1.68	1.75	0.82
<i>Government pressure</i>			
The government does not monitor if farmers comply with organic certification.	0.90	1.69	1.00
<i>Farmers pressure</i>			
If my neighbours discover that I am doing something wrong they would report me.	1.27	1.73	0.84
My organic certified neighbours monitor that I comply with the requirements of the certification.	0.00	1.77	0.69
Producers are aware that if any of them cheat then it could be detrimental to the name of the association.	2.18	1.10	0.71
<i>Family pressure</i>			
My family cares that I fulfil the requirements of organic farming.	1.85	1.39	1.00

^a Respondents assessed each item using a seven-point Likert scale with totally disagree (-3) and totally agree (+3) as anchors.

^b Results of the PLS confirmatory factor analysis.

^c A negative statement, the scale items were reverse coded.

^d Years.

Appendix 2

Table 5. Discriminant validity analysis based on the Fornell Larcker criterion.

Variables	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1. Auditor's reputation	0.72^a														
2. Bureaucratic costs	-0.01	0.73													
3. Buyers pressure	0.20	0.03	0.85												
4. Relationship/Market a.	0.36	-0.27	0.31	0.78											
5. CB's reputation	0.52	0.00	0.31	0.36	0.78										
6. Economic costs	-0.10	0.01	-0.01	-0.15	-0.09	0.84									
7. Experience	0.09	0.04	-0.08	0.11	0.26	-0.08	1.00								
8. Family pressure	0.45	-0.03	0.32	0.44	0.48	-0.13	0.11	1.00							
9. Farm income	0.43	0.02	0.30	0.43	0.24	-0.10	0.25	0.31	0.83						
10. Farm management	0.38	-0.09	0.39	0.35	0.45	-0.13	0.01	0.43	0.27	0.73					
11. Farmer pressure	-0.01	0.04	0.32	0.11	0.00	-0.04	-0.33	0.22	-0.08	0.30	0.75				
12. Government pressure	-0.22	-0.03	-0.17	-0.05	-0.18	0.13	-0.11	-0.07	-0.36	-0.29	-0.08	1.00			
13. Reliability	0.33	-0.22	0.49	0.48	0.32	-0.24	-0.01	0.28	0.24	0.43	0.46	-0.05	0.75		
14. Risk perception	-0.24	0.16	-0.15	-0.30	-0.07	0.17	-0.01	-0.22	-0.32	-0.29	-0.34	0.14	-0.46	0.72	
15. Satisfaction	0.36	-0.30	0.21	0.52	0.35	-0.16	0.08	0.62	0.52	0.41	0.15	-0.21	0.38	-0.33	1.00

^a Diagonal values in bold are the square roots of the average variance extracted.

CB: Certification body.



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Analyzing Consumers' Preferences for Apple Attributes in Tirana, Albania

Engjell Skreli^a and Drini Imami^b

^a *Associate Professor, Department of Agricultural Economics and Policy, Faculty of Economics and Agribusiness, Agriculture University of Tirana, Koder-Kamez, Tirana*

^b *PhD, Lecturer, Department of Agricultural Economics and Policy, Faculty of Economics and Agribusiness, Agriculture University of Tirana, Koder-Kamez, Tirana, Albania*

Abstract

This paper reports the findings of a study conducted on consumer preferences for apple fruits in Tirana, Albania. Consumer preferences were analyzed using a Conjoint Choice Experiment and Latent Class Analysis. For each identified consumer class, preferences for the chosen attributes and their willingness to pay for such attributes were estimated. Marketing and policy recommendations are provided for the sector stakeholders, with particular focus on producers and policy-makers.

Keywords: apples, Conjoint Choice Experiment, consumer preferences Albania

[ⓐ]Corresponding author: Tel: + 355686014986
Email: eskreli@ubt.edu.al
D. Imami: dimami@ubt.edu.al

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Introduction

Apple production is an important economic activity for the Albanian agricultural sector; apples are the most commonly cultivated fruit tree in Albania which falls under the category of labor intensive activities. With a rather high labor to land ratio, as in case of Albanian agriculture, labor intensive industries are an economically justified alternative. On the demand side, Albanian consumers' expenditures on apples are ranked as the second highest for all fruits and vegetables combined, following tomatoes (USAID's AAC 2008).

The Albanian Ministry of Agriculture, Food and Consumer Protection (MAFCP) is currently supporting the fruit sector through an investment support scheme, by providing subsidies for new fruit (apple) plantations. From a policy perspective, fruit production, including apple production, is one of the four priority sectors of the new Programme for Rural Development in Albania 2012 – 2013 (MAFCP 2011a). This sector has also received attention from key donor projects operating in the agriculture and rural sector in Albania, such as USAID's AAC (Albanian Agriculture Competitiveness) Program, SNV (Netherlands Development Organisation), and MADA (Mountain Areas Development Agency).

Farmers are exploiting the economic opportunity presented by apple production. Domestic production of apples in Albania has rapidly increased in recent years (more than quadrupling between 2000 and 2010), as shown in Table 1. Production is expected to further increase in the coming years, due to new plantations, stimulated by the investment support scheme, and motivation from high domestic consumers demand. The per capita consumption of apples in Albania increased 1.5 times between 2000 and 2007, estimated currently at 18 kg per capita (FAOSTAT 2012).

Table 1. Dynamics of apple production and supply in Albania.

Category	Unit/ Year	2000	2005	2006	2007	2008	2009	2010
Production	Mt	12,000	16,000	27,566	36,000	45,000	47,202	54,604*
Import	Mt	28,163	38,417	33,723	22,516	15,641	12,928	17,702
Export	Mt	0	0	0	147	34	109	1,097
Supply ¹	Mt	40,163	54,417	61,289	58,369	60,607	60,022	71,209
Export/import	%	0.0%	0.0%	0.0%	0.7%	0.2%	0.8%	6.2%
Production/supply	%	29.9%	29.4%	45.0%	61.5%	59.1%	78.6%	76.7%
Import/supply	%	70.1%	70.6%	55.0%	38.6%	41.0%	21.5%	24.9%

Source. FAOSTAT (production), UNSTAT (import – export), *MAFCP (2011b)

Apple domestic production currently covers more than three-fourths (76.7%) of the domestic supply; its share has increased substantially as compared to the year 2000, when domestic supply was dominated by imports while domestic production covered only less than one-third of the domestic supply (Table 1). Though the share of imports to domestic supply has dramatically fallen from 70.1 percent in the year 2000 to 24.9 percent in the year 2010, it is still high based on the potential to increase production. The still high presence of imports can be partially explained by

¹ Supply = Production – Export + Import

the seasonality of domestic supply, and partially by preferences of (certain) consumers (classes) for specific apple varieties sourced by imports.

While several studies have been conducted on the apple value chain by a number of organizations (DSA (Development Solutions Associates), SNV, USAID's AAC), there is currently a need for an in depth consumer analysis to identify consumer preferences for apple attributes.

Understanding consumer preferences and behavior is important in the decision-making process of key stakeholders, including apple producers and traders, MAFCP, as well as donor agencies that operate in the sector. It is particularly important in a context where import substitution is considered more feasible than export promotion, based on the development stage of private actors and public competitiveness enhancing institutions (MAFCP 2007). Furthermore, so far, MAFCP subsidy schemes have disregarded the importance of varieties (eg. supporting apple or fruits plantation in general and not specific types of apple varieties which are mostly demanded by the market). Therefore providing information on varieties of apples which are mostly demanded by various market segments (including their size and willingness to pay) might be useful to prepare more specific and efficient support schemes.

Objectives

The goal of this study is to assess consumer preferences for apple fruits in Tirana, Albania. Specifically, the research objectives are:

1. Group consumers according to their preferences for the main apple attributes.
2. Assess consumer preferences of each identified class and their willingness to pay for such attributes.
3. Provide marketing and policy recommendations for the sector's stakeholders, with particular focus on producers and policy-makers. Consequently, apple producers may base their production and marketing decisions guided by consumer preferences, taking into consideration the respective market segment size and willingness to pay for the given attributes.

Methods and Procedures

The proposed method for this research is Conjoint Analysis (CA) which originated theoretically from Lancaster (1966) who posited that the consumer utility is based on the bundle of attributes a product represents. Later, CA has been widely used to assess consumer preferences beginning with Green and Rao (1971) and Johnson (1974). The advantage of CA, compared to other methods, stands in the fact that CA is based on different product attributes. For each attribute there are several levels which enable assessment of consumer preferences for the products through partial contribution of product features (Hauser and Rao 2003). Louviere and Woodworth (1983) improved conjoint analysis introducing choice based experiments or conjoint choice experiment (CCE). The main advantage of CCE over conventional CA is that in CCE

respondents have to choose the most preferred option out of several choice sets and thereby the trade-off can be measured in line with the respondents' weight in choosing one attribute over another (Haaijer 1999).

This approach enables us to obtain consumer classes—each class including information on the preferred product attributes and based on which *willingness to pay* can also be derived. As result, various producers and traders can identify the most suitable market niche/segment to target, given consumer preferences by classes. From a practical standpoint, if a producer cannot produce a particularly preferred product due to already planted traditional cultivars then the information from the study enables them to judge the value of trade-off between currently planted cultivars and new cultivars that could replace them, to meet consumer demand.

CCE has been used before for fruits (Barber et al. 2008, Evans 2008) and for apple specifically in other countries (Wirth et al. 2011; Novotorova and Mazzocco 2008; Sun and Wang 2002; Jerko and Kovačić 2008; Manalo 1990). CCE has also been used extensively in Albania on other food products, such as olive oil (Chan-Halbrendt et al. 2010), lamb meat (Imami et al. 2011), table olives (Zhllima et al. 2011) and wine (Zhllima et al. 2012). These studies have grouped consumers by their preferences for various product attributes and have assessed willingness to pay, thus providing important indications and recommendations to agrifood marketing enterprises and to policy-makers. Therefore we have chosen CCE with Latent Class Analysis (LCA) for studying consumer preferences for apple in Albania.

There are four stages in the designing of conjoint choice experiments resulting in a survey. Once the survey is administered to the respondents, the data are analyzed using latent class analysis to determine Tirana consumer preferences for apples.

Conjoint Choice Design

First and Second Conjoint Choice Design Stage: Selecting Product Attributes and their Levels

Product attributes and their levels have been selected based on literature review, expert assessment and focus group discussions. Two focus groups discussions were organized; one focus group with consumers and another one with agrifood marketing experts. As a result, the most important apple attributes and their respective levels were identified. The attributes identified were: color (variety), origin, price, and fruit size.

Color (variety). Color has consistently been an important attribute in previous fruit and vegetable analyses. The relative importance for color of apples was 20 percent in Manalo's study (1990) and 17.98 percent in Jerko and Kovačić study (2008). In our study we have chosen to make a linkage between color and apple variety. According to the focus group findings, most consumers in Albania do not recognize apple by variety name, but by color. Therefore we use color as an attribute instead of variety – the later is observed indirectly through color.

Origin. Origin is quite an important attribute for agrifood products. Jerko and Kovačić (2008) found that relative importance of origin for apple was 20.94 percent. Dentoni et al. (2009) found that consumers prefer local grown apple over imported ones in USA. Consumer surveys in

Albania on other agrifood products such as olive oil (Chan-Halbrendt et al. 2010), and lamb meat (Imami et al. 2011) show a preference and significant willingness to pay for locally grown products.

Price. Although price is not technically a product attribute, it is commonly included as an attribute in conjoint analyses because it is a major factor in product buying choice. Price is also necessary to compute willingness to pay.

Size. Expert opinions and focus groups identified size as an important attribute for apple. Large fruits may be preferred to small ones because larger sizes may imply a higher quality. On the other hand, large fruit size may also be perceived as being produced using hormones. It may be possible that small fruits are preferred to larger ones because they may be considered as organically produced or because of convenience in consumption, according to the focus group findings. Apple fruit size is considered as an important attribute in several studies conducted on apple consumer preferences (Manalo 1990; Richard and Smith 2004).

Other studies have included the method of production and environmental practices as product attributes. Novotorova and Mazzocco (2008) as well as Sun and Wang (2002) found that consumers in USA rank method of production as highly important – there is an overall preference for organically produced versus conventionally produced apples. Also Jerko and Kovačić (2008) conclude with similar finding for Croatia. In Albania, consumers largely perceive domestic agrifood products as organically produced while genetically modified (GM) apples are practically nonexistent – therefore the method of production was not included in the survey. Other important attributes like freshness, safety and quality were judged to be difficult to assign precise attribute levels. Moreover, for practical reasons, the number of attributes could not be extended beyond the four already selected, as adding more attributes makes survey implementation more complicated.

The attributes included in the study are represented by categorical variables which imply a decision to be made about the number of attribute levels. Four colors (red, yellow, green and red yellow stripped) corresponding to the four most common varieties currently in Albania (Red-chief, Golden Delicious, Grany Smith and Fuji) represent the four levels of attribute “color” (Table 2). Domestic and imported are the two levels for the attribute “Origin”. Including also the main regions of apple origin within Albania as attribute levels was declined in order to avoid respondents’ fatigue. Two levels of fruit size – 5 and 8 cm – were selected based on consumers perception of “small” and “large” fruits” in Albania. The decision on fruit size attribute levels is based on focused group discussions and by consulting fruit wholesalers and retailers. The levels of apple price were decided by the research team given the price interval and its distribution team based on Agriculture Market Information System.

Table 2. Apple attributes and levels.

		Attributes			
		Color (Variety)	Price (ALL ² /Kg)	Origin	Fruit size
Attribute level		Red (Starking)	50	Imported	Large (8 cm)
		Yellow (golden)	80	Local	Small (5 cm)
		Green (Granny Smith)	110		
		Red yellow striped (Fuji)	150		

Third and Fourth Conjoint Choice Design Stage: Choice of Experimental Design and Construction of Choice Sets

In this study, a Conjoint Choice Experiment (CCE) was used to design the survey and Latent Class Analysis (LCA) was used to analyze the data. Sawtooth Software SSI Web v 6.6 was used to design the survey and to prepare the data for processing, while Sawtooth Software Latent Class for CBC v 4.0.8 was used for data processing. Table 3 gives a brief description of the design stages of a CCE.

Table 3. Design stages for a CCE

Stage	Description
<i>Selection of attributes</i>	Selection of apple attributes has been done based on the literature review, expert interview and focus group discussions.
<i>Assignments of attributes level</i>	The range of attributes is also based on literature review, expert interview and market conditions. The attribute levels have been assigned such as to be reasonable and realistic.
<i>Choice of experimental design</i>	Fractional factorial design is used to reduce the possible combinations which combine the levels of the attributes that reduce respondents fatigue and also provide efficiency in model estimation.
<i>Construction of choice sets</i>	The concepts identified by the experimental design are then paired and classed into choice sets to be presented to respondents.

Source. Chan-Halbrendt et al. 2010

The idea that all goods can be described by their characteristics, also known as attributes, is the basis of CCE. For CCE, the most important attributes and their levels have to be determined when designing the study.

Using the CCE method in designing the survey with LCA to analyze the data collected, is an improvement on the traditional (i.e. one class) aggregated model analysis. The standard aggregated model has to deal with the independence of irrelevant alternatives problem, which affects the predictions of market niches. Latent classes take into consideration different segments with different utility preferences within a certain group or class (Magidson and Vermunt 2003). In LCA,

² Note. ALL stands for the Albanian Currency. Approximately 100 ALL = 1 USD during the time when the survey was carried out.

respondents are grouped, according to their choices in the CCE. The choices that respondents made are considered mainly based on their attribute preferences and their socio-demographics. In our study, we have not included socio-demographic variables affecting consumer choice because of software limitations.

Questionnaire Design, Sampling and Data Collection

Questionnaire Design

The questionnaire has been designed based on literature review, expert knowledge consultation, focus groups and brainstorming within the research team. The core part of the questionnaire consists of choice sets. After apple attributes have been selected and attribute levels assigned, the later have been combined into choice sets of triple concepts or profiles, as seen in Figure 1:

Apple Type		
Yellow (Golden) Domestic Big (larger than 8 cm) ALL 80 per kg	Green (Granny Smith) Imported Small (less than 8 cm) ALL 50 per kg	Red yellow striped (Fuji) Imported Small (less than 8 cm) ALL 110 per kg
I would choose		
↓ <input checked="" type="checkbox"/>	↓ <input type="checkbox"/>	↓ <input type="checkbox"/>

Figure 1. Example of choice sets used in the survey.

Twelve choice sets (profiles) of triple concepts were included in each questionnaire, and each respondent was asked to choose 12 concepts, one for each triple choice sets. The minimum number of choice sets or profiles depend on the number of attributes and attributes levels (Novotorova and Mazzocco 2008) which determine the number of parameters. The number of parameters is equal to the total number of attribute levels minus the total number of attributes plus one. In our case with 12 attribute levels (2x4+2x2) and 4 attributes, the number parameters is 9 and the number of choice sets should be 13.5.

Sampling

A sample size of 250 questionnaires was deemed as an appropriate sample size to provide reliable estimates. Green and Srinivasan (1978) suggest a minimum sample of 100 respondents for conjoint analysis types of studies. Xu and Yuan (2001) suggest using the ratio of the number of respondents to the number of parameters when identifying the sample size; a ratio between 5 and 10 is a recommended ratio. In our study, the number of parameters is 9, and therefore a sample size to result in reliable results is between 45 and 90. Our sample of 250 is considered large enough to produce reliable results; similar sample size has been used in other similar surveys in Albania (Chan-Halbrendt et al. 2010; Zhllima et al. 2012).

Interviews were conducted in Tirana. We chose Tirana for three reasons: (i) purchasing power is concentrated mainly in Tirana, the country's capital; (ii) Tirana has a reasonably good demographic representation of the country as a whole (during the last twenty years, Tirana has grown from 200,000 to around 700,000 inhabitants as people from all over Albania have migrated to Tirana); and, (iii) interviews in Tirana reduce travel costs substantially. The interviews were carried out at various sites within Tirana as suggested by the focus groups. Interviews took place close to green markets and supermarkets – people were approached randomly in a face-to-face interview and after completing the interview, interviewers would approach the next closest person who walked by.

Table 4 (below) shows the gender and age structure of Tirana survey respondents. The study's population showed that older people are a bit over-represented in the survey when compared to the real population. Younger people and females are slightly under-represented in this study, as in Albania it is more common for men to do the food shopping, particularly for older generations. Such sample is in line with previous research on consumer behavior carried out in Albania (Imami et al. 2011; Zhllima et al. 2012).

Table 4. Socio- demographic comparison of survey respondents with Tirana's population.

		Survey Respondents	Tirana Population
		(%)	(%)
<i>Gender</i>	Female	46.1	50.14
	Male	53.9	49.86
<i>Age</i>	18-24	1.9	12.89
	25-30	3.2	7.66
	31-35	4.6	10.74
	36-40	5.1	11.40
	41-45	7.4	11.75
	46-50	14.8	10.48
	51-55	18.1	8.59
	56-60	17.1	6.67
	61-64	10.6	6.54
	65 and up	17.1	13.34

Source. INSTAT (for the Tirana population's figures)

Data Collection

Data have been collected by well trained and motivated interviewers and the process was closely monitored by the research staff. The questionnaire was properly coded in order to better manage data entering and data processing. A data entry file was prepared and entered in a SPSS database.

Data Analysis: Conjoint Choice Model Using LCA Approach

This is the final stage of the research design. As discussed in the literature review, conjoint choice method using LCA is an improvement on the traditional aggregated or one class model. In latent class analysis, the different segments that have different utility preferences are accounted for and hence better market predictions can be made.

The Latent Class Model is a random utility model. Building on the seminal work of McFadden (1973), consumer utility can be represented as follows:

$$U_{ijt} = \beta X_{ijt} + \varepsilon_{ijt} \quad (1)$$

where the subscript i refers to individual i , j refers to concept j and t refers to choice set t . The utility level U_{ijt} is a linear function of observable vector of attributes \mathbf{x}_{ijt} and its coefficient to be estimated, β . ε_{ijt} is a random error term, which captures all unobservable attributes and factors that influence the choice process.

McFadden (1974) showed that the probability that concept j in choice set t is chosen by individual i is given as:

$$P_{ijt} = \frac{\exp(X_{ijt}\beta)}{\sum_{k=1}^J \exp(X_{ikt}\beta)} \quad (2)$$

The numerator is the exponent of the observable utility of concept j in choice set t , and the denominator is simply a collection of observable utility from all available concepts.

In our study, only product attributes (color/variety, origin, size and price) have been considered, therefore an individual's probability of choosing concept j was considered as a function of apple attributes. The socio-demographic variables have not been considered, due to software limitations, as abovementioned.

Results and Discussions

Selection of the Model with Optimal Number of Distinct Classes

Consistent Akaike Info Criterion (CAIC) was used to determine the best model. Based on CAIC, the *four class model* was chosen over the three class and five class models. CAIC decreases substantially when passing from three class model to four class model, showing that four class model matches better the data, as shown in Table 5. CAIC is also smaller in the five class model compared to the four class model, but the rate of decrease is less significant. Additionally, the five class model contains two quite small classes of consumers, as shown in Annex 2. These criteria suggest that the four class model is the best model.

Table 5. Summary criteria of best replications.

Classes	Replication	Pct Cert	CAIC	Chi Sq	Rel Chi Sq
2	4	16.25	4907.22	929.6	71.51
3	3	19.94	4757.95	1140.92	57.05
4	5	22.4	4679.37	1281.56	47.47
5	5	24.51	4620.59	1402.39	41.25

Class Sizes and Importance of Attributes

The Class 1 represents almost half of the respondents (namely 44.7 percent) while the Class 2 represents 30.5 percent – these are the two largest classes and together make up more than $\frac{3}{4}$ of the total number of respondents. The Class 3 and 4 represent respectively 14.3 and 10.6 percent of the respondents. Details on respondents' class sizes and the importance of attributes for the four class model are described below in Table 6.

Table 6. Class sizes and importance of attributes.

	Class 1	Class 2	Class 3	Class 4
Share of each class	44.70%	30.50%	14.30%	10.60%
Importance of attributes (%)				
Variety	44.5	3.6	52.9	83.9
Origin	35.2	10.2	4.1	5.3
Size	12.0	6.1	22.6	1.8
Price	8.3	80.1	20.4	8.9

Variety and origin are the most important attributes for *Class 1*; the level of importance for these attributes is 44.5 and 33.2 percent respectively. Based on too low importance attached to price, one may infer that this class of consumers is composed of healthier consumers. Though we have not included consumers income in our analysis, based on micro-economic theory (higher consumers' income lead to higher prices), we interpret the too low importance attached to price as a tolerance to pay higher prices for preferred attribute. Therefore one can support that that Class 1 is composed of rather healthier and/or wealthier consumers.

Price is the most important attribute for *Class 2* – level of importance for this attributes is 80 percent. One may argue that Class 2 is made up by less wealthy or lower income consumers (high importance attached to price and low important attached to other attributes). Origin is also rather important for members of this class.

Variety is the most important attribute for *Class 3* whose level of importance is 53 percent. Class 3 members attach a high importance to fruit size; this is the class with the highest importance attached to fruit size. It is argued that Class 3 is composed of medium income consumers (rather significant importance attached to price).

Variety is by far the most important attribute for *Class 4* – level of importance for this attributes is 84 percent. As in case of *Class 1*, this class is composed of healthier consumers (less importance attached to price).

Origin is very important for the two largest classes (*Class 1* and *Class 2*) which actually make up $\frac{3}{4}$ of consumers. There is currently an overall preference for Albanian products. Recent studies confirm the overall preference of Albanian consumers for domestic products such as lamb, olive oil, table olives, and wine (Imami et al. 2011; Chan-Halbrendt et al. 2010; Zhllima et al. 2011, Zhllima et al. 2012).

Consumer Preferences

Members of *Class 1* prefer green apple (Granny Smith variety) to yellow (Golden) and red yellow striped apples (Fuji variety). Additionally, they prefer domestic apples to imported ones, and bigger size apples to smaller ones (Table 7). We name this class as “*Local green*”.

Table 7. Parameter estimates

Variety	Class 1		Class 2		Class 3		Class 4	
	Utility(β)	t	Utility(β)	t	Utility(β)	t	Utility(β)	t
Red (Starking)	-0.01	-0.12	-0.08	-0.78	-0.01	-0.13	2.09**	12.61
Yellow (Golden)	-0.30**	-4.88	-0.11	-1.11	1.37**	11.90	0.05	0.35
Green (Granny Smith)	0.57**	10.89	0.09	0.83	-0.76**	-5.61	-1.22**	-6.03
Red Yellow Striped	-0.27	-4.48**	0.10	0.97	-0.60**	-4.69	-0.92**	-5.08
Origin								
Domestic	0.34	10.22**	0.30**	4.67	0.08	1.20	-0.11	-1.11
Imported	-0.34	-10.22**	-0.30**	-4.67	-0.08	-1.20	0.11	1.11
Size								
Big (8 cm)	0.12	3.58**	0.18**	3.18	-0.46**	-6.51	0.04	0.39
Small (5 cm)	-0.12	-3.58**	-0.18**	-3.18	0.46**	6.51	-0.04	-0.39
Price								
Price	-0.05	-1.83	-1.58**	-20.47	-0.27**	-4.28	0.12	1.37

** Significance at 0.01 levels

Members of *Class 1* are not price sensitive and prefer less sugar content apples. It can be inferred that *Class 1* is composed of healthier consumers (not price sensitive) whose choice is affected by their health concerns (they prefer less sugar content apples). The recent data from Albanian Ministry of Health (MoH) support that 3 in four deaths are caused by cardio-vascular and tumor diseases and three in five deaths are caused by cardio-vascular diseases alone (MoH 2012); both kinds of diseases are also associated with eating habits.

Price is the most important attribute for *Class 2*, a reason for us to name it as “*Price sensitive*” class. Price has significant negative value. Consumers in this class are oriented primarily towards lower price (cheaper) apple. This class is composed most probably of less healthy consumers.

Similar to Class 1, domestic apples are preferred to imported ones, and bigger size apples to smaller ones.

Variety is the most important attribute for *Class 3*. Members of *Class 3* prefer yellow to green and red-yellow apples (we name it “*Yellow Class*”). Additionally, they prefer small size to large size apples, while show no significant preference to the attribute of origin.

Variety is by far the most important attribute also for *Class 4*. Consumers in *Class 4* prefer red apple (we name it “*Red Class*”) to green and red-yellow apple in comparison to other varieties. Consumers in this class show no significant preference for the attributes of the origin and size.

Utilities and Consumers' Willingness to Pay

Table 7 summarizes part worth utilities (parameters) and their significance. Based on these estimates, one may compute consumers' willingness to pay for each attribute level and calculate premium for choosing one attribute level over another.

As discussed by Lusk and Schroder (2004) and Colombo (2008), *willingness to pay (WTP)* is derived by the price difference necessary to invoke indifference between two alternatives. Total WTP for attribute o_n (in case of origin attribute, n takes the values of 1 for domestic and 2 for imported) versus “none” option is simply calculated as the ratio of the attribute specific constant (part worth utilities) to the price coefficient: β_{on}/α . Marginal WTP for attribute level 1 versus attribute level 2 can be calculated as a ratio of the difference between total WTP for attribute level 1 and total WTP for attribute level 2 and the price coefficient, or as the ratio of the difference between alternative specific constant (part worth utilities) of attribute *level 1* and 2 and the price coefficient: $(\beta_{o1}-\beta_{o2})/\alpha$; as explained, o stands for product origin.

The consumers in the *first class* are willing to pay ALL 13.6 more for each kg of domestic apple as compared to imported apple $((0.34-(-0.34))/(-0.05))$. Additionally, they are willing to pay ALL 17.4 per green apple versus yellow apples and 4.8 ALL per kg of big apples versus small apples. The *third class* of consumers is quite the opposite of the first class; consumers in this class are willing to pay ALL 7.9 more for yellow apples versus green apples, and 3.4 ALL for small apples versus big apples. The consumers of the *fourth class* show a strong preference for red apples, since they are ready to pay ALL 27.6 more per kg of red apples versus green apple.

Conclusions

This study aims to identify consumer classes and their preferences for main apple attributes, such as variety, origin, size and price in order to provide marketing and policy recommendations.

Findings on consumer preferences are essential for private actors throughout the apple value chain and policy-makers. Information on market segmentation and segments' sizes, benefits private actors in terms of learning about apple attributes (varieties, fruit sizes) preferred by consumers; it benefits also policy-makers, particularly MAFCP, in terms of better orienting its current investment support scheme toward varieties that have higher demand.

Study results reveal that origin, variety, and size are quite important attributes. *Variety/color* is so important that the first class can be named “green class”, the third class can be named “yellow class” and the fourth class is named “red class”. Class 1 (which is also the largest) is willing to pay more than 17 ALL per kg of green apple versus yellow apple. Apple color is found to be important by Jerko and Kovačić (2008).

There is a clear preference for *domestic versus imported* apples in three out of four classes. For the first (largest) class of consumers, there is a clear preference for domestic versus imported apple, and willingness to pay a premium of ALL 13.6 for each kg of domestic apple as compared to imported apple. The preference for domestic apples is supported by other studies conducted in Albania (USAID’AAC 2010). Jerko and Kovačić (2008) as well as Novotorova and Mazzocco (2008) have also found that consumers rank origin among the most important attributes, preferring locally produced apples, respectively in Croatia and USA.

The distinction between domestic and imported apples does not seem to be very objective however. While more than 1/3 of consumers (35.5 percent) believe to be able to distinguish domestic from imported apple by themselves, and 41.5 percent make the decision on origin by asking the trader, a related in-depth survey (USAID’AAC 2010) has found that there is a preference for domestic apples before testing and lack of recognition for imported and domestic apples after testing.

Our study finds that fruit *size* comes out to be important in three out of four classes. It is important to emphasize that the preference for large size apples (the first and second class of consumers) and for small size apples (third class of consumers) implies consumers’ willingness to pay for that attribute. Manalo (1990), using a CCE and Richard and Smith (2004) using a hedonic pricing model found willingness to pay for large apples. Apple size is associated with either apple quality or production method. According to the focus groups, larger size, when preferred, implies better quality phrased as “better appearance” or “better taste”, and smaller size, when preferred, implies a “more naturally” grown fruit or more convenience in consumption.

Thus, our study findings are in line with previous apple consumer studies conducted elsewhere. On the other hand, our study adds new knowledge on apple consumer preferences compared to existing studies (Wirth et al. 2011; Jerko and Kovačić 2008; Manalo 1990), and goes one step further by analyzing consumer preferences for each of the identified consumer classes. This study provides detailed information for preferred product attributes to agrifood value-chain stakeholders. Additionally, the WTP was calculated for each of the main attributes, which was not done in the abovementioned studies, provides useful information to the apple sector decision-makers.

The *implications* should be considered from both marketing and policy viewpoints. Apple variety and fruit size are quite important attributes in marketing. It is important that actors throughout the apple value chain (farmers, collectors/traders) think not in terms of producing and selling simply “apples”, but producing and selling “green apples”, “yellow apples” and “red” apples. This is important for targeting different consumer segments. We discussed that consumers belonging to Classes 1 and 4 are healthier consumers, and Class 3 consumers are medium income consumers. Study results show that the members of these classes are willing to pay a premium

for preferred apple attributes. The importance attached by consumers to fruit size should have an adequate response by both private actors in terms of grading policy.

In terms of policy, this study suggests that government should pay due attention to supporting domestic apple promotion and design awareness raising campaigns stressing the importance of apple consumption for healthy diet. Three-fourths of the consumers represented in Classes 1 and 2 (Table 6), consider production origin a valued attribute. Regarding origin, a highly important recommendation should be considered: there is a difference between subjective preference for domestic apples and a lack of objective differentiation between domestic and imported apples. Therefore, designing a certification program for “domestically produced apples” is likely to better channel customer preferences to domestically produced apples. Regional branding coupled with producers identification information is already instituted as the most important producing apple area in Albania. The preference of consumers to less sugar content apples suggests that health concerns are important. The government may therefore need to consider designing and implementing a consumer education policy, including school curriculum improvement.

Related literature and expert opinions – as discussed in this paper – support the hypothesis that other apple attributes such as freshness, safety, quality, method of production and regional origin within Albania are also important. Additionally, socio-economic determinants of consumer choices were not fully addressed in this study. Further studies may address them. Finally, being limited only to the Tirana market— despite arguments that Tirana market is rather representative – may have somewhat biased the study results, and therefore some precaution is advised when generalizing the results at a country level.

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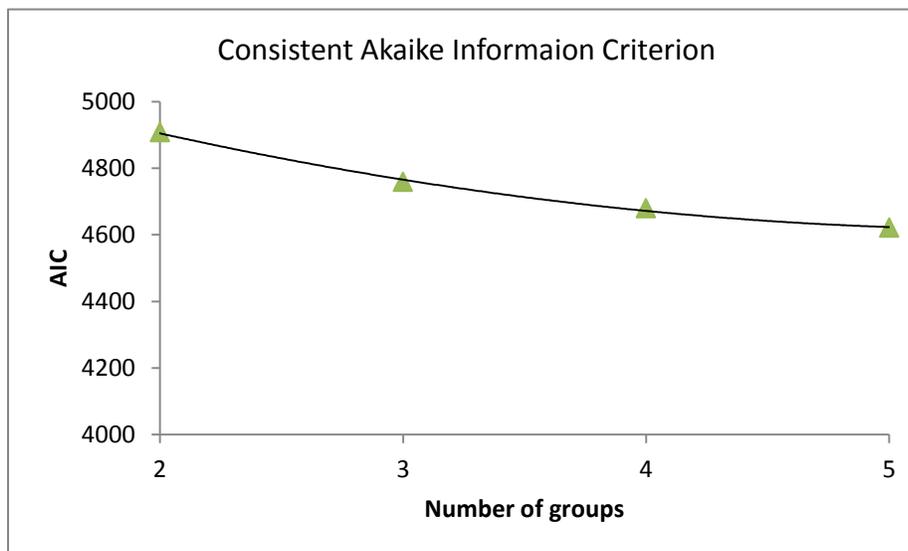
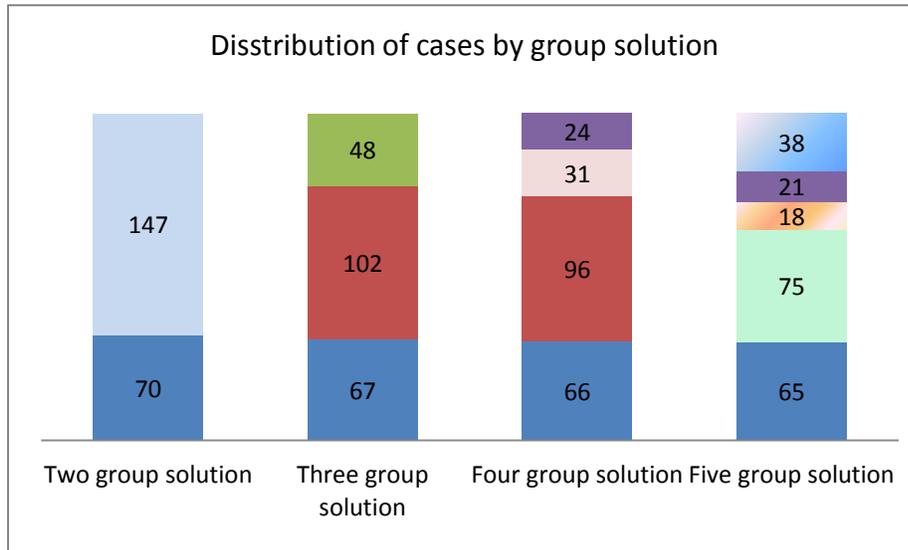
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Appendix 1. Summary of Results

Summary of Best Replications

Classes	Replication	Pct Cert	CAIC	Chi Sq	Rel Chi Sq
2	4	16.25	4,907.22	929.60	71.51
3	3	19.94	4,757.95	1,140.92	57.05
4	5	22.40	4,679.37	1,281.56	47.47
5	5	24.51	4,620.59	1,402.39	41.25
Solution for 4 Classes (Replication 5)					
Percent Certainty			22.40		
Consistent Akaike Info Criterion			4,679.37		
Chi Square			1,281.56		
Relative Chi Square			47.47		
Segment Size					
		0.14	0.11	0.45	0.31
Part Worth Utilities					
Red (Starking)		-0.01	2.09	-0.01	-0.08
Yellow (Golden)		1.37	0.05	-0.30	-0.11
Green (Granny Smith)		-0.76	-1.22	0.57	0.09
Red Yell Strip (Fuji)		-0.60	-0.92	-0.27	0.10
Local					
Imported		0.08	-0.11	0.34	0.30
Imported		-0.08	0.11	-0.34	-0.30
Big (8 cm)					
Small (5 cm)		-0.46	0.04	0.12	0.18
Small (5 cm)		0.46	-0.04	-0.12	-0.18
Price					
Price		-0.27	0.12	-0.05	-1.58
t Ratios					
Red (Starking)		-0.13	12.61	-0.12	-0.78
Yellow (Golden)		11.90	0.35	-4.88	-1.11
Green (Granny Smith)		-5.61	-6.03	10.89	0.83
Red Yell Strip (Fuji)		-4.69	-5.08	-4.48	0.97
Local					
Imported		1.20	-1.11	10.22	4.67
Imported		-1.20	-1.11	10.22	-4.67
Big (8 cm)					
Small (5 cm)		-6.51	0.39	3.58	3.18
Small (5 cm)		6.51	-0.39	-3.58	-3.18
Price					
Price		-4.28	1.37	-1.83	-20.47
Attribute Importance					
Variety		52.89	83.90	44.55	3.62
Origin		4.05	5.33	35.19	10.18
Size		22.64	1.84	11.99	6.14
Price		20.41	8.93	8.27	80.06

Appendix 2. Summary of Best Replications, Graphical Representation





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Driving a Fishery along the Bumpy Ride of Today's Globalization: The Case of the Australian Southern Rock Lobster Association

Domenico Dentoni[ⓐ], Jianyong Lu^ᵇ, Francis English^ᶜ, Rebecca McBride^ᵈ

^ᵃ *Assistant Professor, Management Studies Group, Wageningen University and Research Centre, Hollandsweg 1, KN6707, Wageningen, The Netherlands*

^{ᵇ,ᶜ,ᵈ} *Researcher, School of Agriculture, Food and Wine, The University of Adelaide
North Terrace, 5000 Adelaide, South Australia*

Abstract

The case of the Australian Southern Rock Lobster Association describes real issues faced by the Market Development Manager of a collective agri-food organization (SRL) representing all the southern rock lobster fishermen in Victoria, South Australia and Tasmania. The case deals with recent globalization issues faced by the Australian rock lobster industry: the rise of China as a vital and risky market of high-end food products; the financial crisis that affected the US starting from 2006 and the rise of sustainability issues that constrained the rock lobster supply. This case is designed for advanced BSc and MSc in agribusiness and international business. It is relevant for both for strategic management and supply chain management courses. In this case, managers, policy-makers and academics find challenging questions that are still open and can be similarly posed to other agribusiness industries worldwide attempting to compete collectively in international markets.

Keywords: lobsters; seafood; Seafood CRC; China; Australia; US market.

[ⓐ]Corresponding author: Tel: +31.3174.82180
Email: domenico.dentoni@wur.nl

IFAMA Agribusiness Case 15.4

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“I am young and intend to be in this business for long time. I think about where this industry is going in the future—not only next year—but more importantly, where we will stand thirty years from now.”

Matthew Muggleton, Market Development Manager, Southern Rock Lobster Limited

Introduction

Matthew Muggleton, is the Market Development Manager of Southern Rock Lobster (SRL) Limited, an organization representing the fishermen’s associations in the states of Victoria, Tasmania and South Australia. Matthew is a charismatic self-starter who has been working with SSL Members since 2003 to raise awareness on the following key points:

1. Selling the most precious product category (lobsters weighing 2 kg or less <2kg) to one single channel (importers in Hong Kong) and to one single market (China) was too risky. Therefore, *diversifying into new markets* with complementary products through other channels was necessary.
2. Helping members see how they are better off working together rather than competing to develop *a collective brand* on Australian Southern rock lobsters in a highly differentiated market designed to move the fishermen from commodity suppliers to marketers.
3. Linking Australian fishermen and the *lobster supply chain* to new markets must be adapted to fit the collective brand strategy. Moreover, changing market conditions may require further adaptive changes in the supply chain.

Supported by the financial backing of SRL members and the public Research & Development (R&D) agencies at the state and national level, Matthew connected their product (lobsters larger than 2 kg, >2kg) with the market channel: the Super-Premium Fine Dining (SPFD) sector in the US in 2006. He spearheaded the logistics, brand-marketing process and established the market channels into the US between 2006 and 2009.

Yet, things did not go exactly as Matthew expected. Until 2009, the revenues yielded from the US SPFD sector did not cover the costs of transporting and distributing live lobsters to the West Coast restaurants. At the same time, increasing the quantity supplied in order to lower the average costs was not an option for the following reasons:

1. A progressive reduction in the harvesting quota to prevent depletion of the existing lobster population was self-imposed by SRL members since 2008 (see detail on SRL harvesting quotas in Section 2 below) and;
2. All the lobsters below 2kg were already sold to Chinese importers in Hong Kong, which was guaranteeing enough profit margins to fishermen. So there were not enough lobsters available to be sold in the US market. When in 2009 he founded his own distribution company in the US acting as market platform for SRL and selling a basket of seafood products to a broader range of customers, the number of Matthew’s detractors increased, accusing him of pursuing his own interests rather than the interest of SRL.

Responding to these pressures and complaints, Matthew responds adamantly, “Opening up an alternative market channel to China was crucial for our lobster industry, and we did it. So far we made little money, but we secured an alternative market channel for our lobster supply.” And looking towards the future: “We need to keep the channel open. If we have no lobsters, we keep selling other selected products from our basket. The important thing is to maintain the relationships built with customers. Shutting the channel down would be a real waste of money.”

Although most of the Australian lobsters are currently bought by the Chinese market, Matthew believes that an alternative channel in the US needs to be ready to absorb the Australian lobster supply should future shocks occur in the Chinese market, (see detail on historical trends of Chinese demand for Australian lobsters in Section 2).

According to Matthew, a further investment in relationship-building and brand communication is needed with continuous support by the public R&D institutions and by the SRL members to keep this second US SPFD channel open. Today, Matthew is willing to consider alternative opportunities of market diversification along with the US SPFD sector. He knows that he could have made better and decisions in the past and is willing to learn from past mistakes. He must now make strategic decisions for his future and that of the Australian lobster industry.

The case study is organized as follows: the next section provides background information on the southern rock lobster, the Australian Fishermen Association and its status in the early 2000s. Details are provided on the SRL between 2003-present and final section discusses the problems currently faced by Matthew, SRL and their stakeholders.

Southern Rock Lobsters and the Australian Industry

The southern rock lobster (*Jasus edwardsii*)—also called red rock lobster or spiny rock lobster, is a species of spiny lobster found throughout the coastal waters of southern Australia and New Zealand. Rock lobsters resemble common lobsters (*Homarus Americanus* and *Gammarus*), but lack the large characteristic pincers on the first pair of walking legs (Figure 1). Mature Southern rock lobster can weigh from 800grams up to 10 kg, although the most valuable are considered the ones below 2 kg. Chinese restaurants value lobsters below 2 kg more since they are easier to stock and serve in plates. Also, Australian consumers can freeze smaller lobsters in their houses especially for use at Christmas dinner or similar events.



(a)

(b)

Figure 1. a. The American Lobster (*Homarus Americanus*). b. The Southern Rock Lobster (*Jasus edwardsii*)

Internationally, Southern rock lobsters represent a narrow minority of world lobster production and therefore a rare and highly valuable crustacean. The world production of rock lobsters (including both western, southern and eastern rock lobsters) was equal to 26,000 tons, which is around 6% of the total world production of all lobsters equaling 430 million tons in 2006 (SRL 2012). Australia catches more than half of the rock lobster production, with 16,000 tons in 2006 and the remaining 10,000 tons caught in New Zealand. Out of these 16,000 tons, only 4,500 tons are Southern rock lobsters: they represent a well-defined niche, with a slightly harder meat due to the colder ocean water which is widely recognized by its *habitué* consumers. While the average price across all types of lobster equaled 15 AUD/kg for frozen and 20 AUD/kg for live in 2006, the average price of southern rock lobster equaled 25 USD/kg for frozen and 33.3 USD/kg for live. However, the price of southern rock lobsters varies significantly depending on the color, size and seasonality. Specifically, prices decrease during the harvest season (from November to April) as there is more availability. The days preceding Christmas are an exception, since prices rise sharply due to increased demand. In contrast, prices increase when supply decreases between April and October.

Because of its high value, the southern rock lobster industry is the most valuable wild-catch fishery in Australia, making up 54% of the total value of exports of crustaceans and mollusks. The southern rock lobster industry in Australia comprises around 700 small owner/operator businesses across three states: South Australia, Tasmania and Victoria (Figure 2 and 3), plus only a few operators in Western Australia. The impact of the southern rock lobster industry extends beyond the initial effects of the income received by the fishers at the wharf, flowing on through the purchases of inputs such as fuel, bait, boats and services. It is estimated that for every fisher catching southern rock lobster, another seven jobs are created (Seafood CRC 2012).



Figure 2. The catching area of Southern Rock Lobsters in Australia

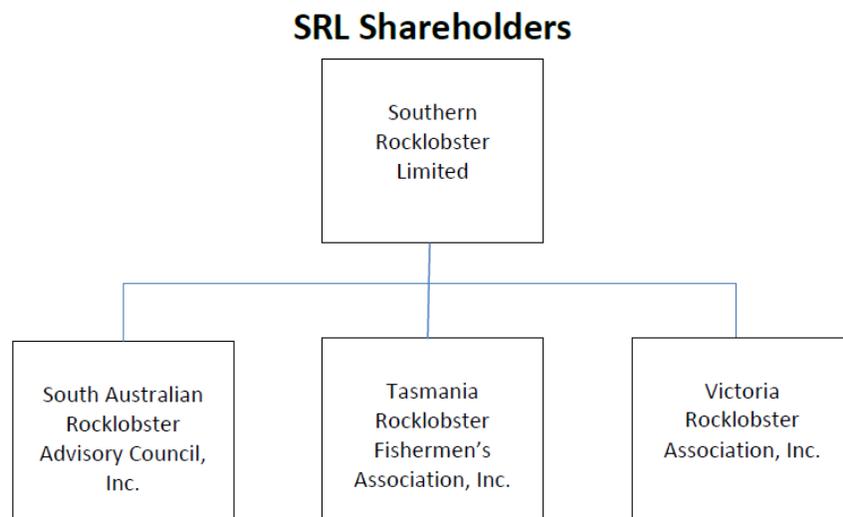


Figure 3. The structure of the Southern Rock Lobster (SRL) Association in Australia

Despite its high value and importance for Australian economy, both the quantities produced and the price of southern rock lobster have been strongly fluctuating in the latest ten years, creating problems for the sector and for the entire upstream chain (see Appendix, Exhibit 1). Production volumes of rock lobsters were highest in 1999/2000 at 20,000T. They reached a low of 14,000 T in 2001/02, came back to almost 20,000 T in 2003/04 but have dropped back to under 14,000 T in 2007/08.

Southern rock lobster prices have also been fluctuating strongly since the late 1990s. Nearly 30% of these were southern rock lobsters. The value of southern rock lobsters was highest at the start of the 2000s with 633 AUD million in 1999/2000. Then the value dropped to its lowest point of 516 AUD million in 2003/04. It stabilized to reach 560 AUD million in 2005/06 but dropped down to 512 AUD million again in 2007/08. Consequently, the lives of fishermen and their employees become difficult and uncertain when the production value of southern rock lobsters and the related profit shrinks.

Starting from 1993 and 1995, the South Australia, Tasmania and Victoria introduced a harvesting quota on southern rock lobsters, which is commonly referred to as Total Allowable Commercial Catch (TACC). TACC was part of a fishery management system including a combination of input and output controls to avoid the depletion of marine biomass. Along with the TACC, these controls include limited licenses, restricted seasonal harvests (depending on the year, around 100 days sometimes between November and April), equipment gear restrictions and requirements, a minimum size limit of 0.8 kg (but no maximum size limit) and a monitoring system requiring documentation and real time reports to license holders. Year-by-year, the state governments in consultation with the industry agree on TACC increases or reductions. Based on the recommendations of the local university, Tasmania voluntarily reduced TACC in recent years, from 1,524 tons in 2008/2009 to 1,103 in 2011/2012 (Gardner et al. 2011). This was mainly a decision taken to reduce the increasing harvesting costs (measured in terms of catch per unit of effort, CPUE), which increase as the number of lobsters in the ocean is decreasing

(Appendix, Exhibit 2). On the other hand, South Australia maintained the TACC at 1,900 tons/year throughout the 2000s.

There appeared to be a slightly negative correlation between the quantity of catch and the price of southern rock lobsters, although, catch volumes were not the only factor determining price fluctuations. China represented around 90% of the total market of Australian southern rock lobsters and 99% of exports. Importantly, China imported the most expensive and demanded they be: live, of intense red color and only smaller than 2kg. As a result, price and revenues from Australian southern rock lobsters strongly depend on factors affecting China. For example, SRL managers and industry experts are convinced that the SARS outbreak in China in 2002 was the major cause of a 50% collapse in the price of live lobsters in China. According to SRL managers, the decreased consumer spending and the fear of food contamination led to the collapse of the restaurant trade in Hong Kong and China which in turn impacted the industry. Such a market shock in China provoked a drop in the international price for live lobsters from 38 AUD/kg to 25 AUD/kg, with an estimated fall in the value of export revenues to 50 AUD Million, in 2003/ 2004. After the market shock, in 2004 SRL members asked that something be done at the national level to stabilize their lobster price in the years to come. In particular, a market for the lobsters larger than 2kg which were not demanded by the Chinese market—could be a product receiving better prices than in the domestic Australian market.

In light of these events, Matthew decided to take the lead in driving a change process in the marketing of the Australian lobster industry. In a strategic meeting with SRL in late 2003, he presented his challenge to the members: “We need to make a choice,” said Matthew. “Do we want to remain disorganized victims of food-industry globalization at the mercy of price setters who control the market by offer buyers a cheaper generic product?”

He was referring to the status quo, where one hundred competing small exporters were individually selling all their lobsters to China with no incentive or need to develop markets. And then he suggested his vision: “Or we can become organized and develop markets and new value-added products thereby creating upward price pressure and further growth for our industry.”

In his view, industry development was contingent upon coordinated investment at the whole of industry level to enter an alternative market channel with a currently undervalued product (lobsters >2kg).

The route identified by Matthew, although still vague, found a broad consensus among the SRL members and its Executive Director. The Executive Director said, “Over 90% of SRL product is exported live into the Asian region, with the majority sent to Hong Kong and China, however we recognize that we have the potential to secure ourselves as a super-premium fine-dining product in other countries.”

The SRL association was funded for research projects by the Fishery Research and Development Corporation (FRDC) and the Department of Agriculture, Forestry and Fisheries (DAFF), a national public R&D body and the Ministry—to explore opportunities for alternative export markets (Appendix, Exhibit 3). The goal of the project was to identify a viable strategy to diversify the portfolio of SRL markets and so to reduce the risk of dependency on the Chinese customers.

Juggling Lobsters in the Global Market

Exploring and Entering the US Super-Premium Fine Dining Sector (2004-2007)

With the support of the Market Development Program research funded by FRDC in 2004 and conducted by one university and one consulting company, SRL selected the US SPDS as its target to market southern rock lobsters >2kg. “It is hoped that the success of the trial will lead to a ‘trickle down’ effect amongst the Australian southern rock lobster industry, and increasing utilization of the system will benefit the whole chain,” said an authoritative SRL member, in 2004.

The US market was chosen because: 1) data showed evidence that high-end US consumers would highly value Australian southern rock lobsters relative to local varieties in super-premium restaurant settings. In particular, the research concluded that the high-end segment of US consumers would give value to lobsters having a brand identity based on place-of-origin, sustainability, traceability, guaranteed top quality, freshness and a perception of direct links with the fishermen. 2) the super-premium fine dining sector would probably not be affected by the possible negative trends in the US economy; 3) the US market, especially the West Coast, is relatively closer to Australia both geographically and culturally. The US market was assessed as culturally closer than China and South and South-East Asia.

The results of this market research led to the implementation of a second R&D project, which was funded by Seafood Cooperative Research Center (CRC) between 2006 and 2009. The project aimed at developing the concept of an SRL commodity brand in the US market and to test the feasibility of establishing an efficient distribution platform to serve restaurants, casinos and deli stores on the West Coast. Based on the opportunity sought and assessed by SRL, the Executive Director of the Seafood CRC funding the project claimed, “The Seafood CRC project is expected to contribute AUD\$ 45-50m per annum towards the AUD\$ 90 Million target. “Not bad for an investment of AUD\$ 1.78 Million over the next three years.”

To reach their goal, the SRL directors and Matthew first designed a product which was expected to match the demand of the US market. First, SRL coined and registered the label Clean Green Australian Southern Rock Lobster (Appendix, Exhibit 4). To strengthen US consumers’ perceptions of sustainability, SRL also applied and obtained the Marine Stewardship Council (MSC) certification. MSC is a global non-governmental organization (NGO) which has developed standards for sustainable fishing and seafood traceability. Both standards are based on independent third-party assessments by accredited certifiers. The MSC’s fishery certification program and seafood labels aim at recognizing and rewarding organizations adopting sustainable fishing practices.

Roger synthesized for the SRL members, “The MSC label provides an immediate branding solution and product awareness in numerous international markets,” said Roger. “Our organization is investigating various means to increasing demand for our lobster and spread market risk. Certification of our fishery by the MSC is a potential tool for achieving this.”

Moreover, Matthew and his SRL partners developed a traceability system. “Field trials have confirmed the practicality of the horn tag as part of the project when used in conjunction with a prototype mechanical tag applicator,” said Matthew. “The chefs have reinforced that traceability is an essential element for such a high value product,” he added. Through such a traceability system, consumers in restaurants and deli stores would be able to know exactly where their lobster was fished, and by whom. This would create a consumer perception of a fresh, authentic product which is directly transferred “from the pot to the plate” (the pot is the tool used to fish lobsters). Working jointly with such a traceability system, Matthew established a method of guaranteed quality with for their potential US customers: only the best lobsters were actually sold, while damaged ones were excluded from the deal (Appendix, Exhibit 5).

Finally, Matthew and the R&D project team organized workshops and meetings with chefs and restaurant owners in San Francisco and the Napa Valley, Los Angeles and Las Vegas. These meetings allowed them to test whether the designed product would work. In commercial jargon used among chefs and restaurants in the US, Matthew and Roger defined the >2kg lobsters that were going to the US as live, porcelain Southern Rocklobster jumbos. “SRL is committed to achieving its goals through an extensive education and development program designed to facilitate relationships with US chefs and reinforce the premium product quality message,” claimed Roger, in late 2006 (Appendix, Exhibit 6).

However, by the end of 2007, although much relationship-building with US customers was realized, only 18 restaurants started regularly procuring an average amount of 10kg of live lobsters per week. To some extent, this is not surprising as Matthew commented, “These R&D projects could only fund the pilot launch of the commercialization project, not the full scale rollout phase; and this is what we did. Now, we need to move on and reach our distribution target in this market.”

However, he also recognized that dealing with celebrity chefs and customers in the SPFD sectors was more challenging than he expected. “The market goggled,” said Mathew. “I have been requested to provide samples, samples and samples, but not often has this turned into a signed contract.”

Part of the difficulty of closing contracts depended on the fluctuating exchange rate conditions (from 0.68 in mid-2004 to 0.95 in mid-2008), which made Australian products sold in the US significantly more expensive (see historical trend of AUD/USD exchange rate in Exhibit 7).

Australian Lobsters to US: Transformations in the Supply Chain (2006-2010)

In order to sustain such a commodity brand strategy for market diversification, Matthew and the SRL leaders had to drive a number of changes in the supply chain between 2006 and 2009. These changes took place after the market research in the US was conducted starting from the negotiation process with targeted US customers (2006-2007). Based on the market trials, further changes in the US lobster distribution platform were made (2008-2009).

First, Matthew led the implementation process of the *Fisher direct program*: SRL license holders maintained product ownership and therefore commitment through to the customer. Along with SRL leaders, the Executive Director of the Seafood CRC believed that this would generate real

industry impact: “What makes this project innovative is that fishers will retain ownership of the product through to its final sale,” said, Matthew. “Consequently bringing higher wholesale returns back to Australia for the fishers and processors to share,” he claimed in late 2006.

SRL leaders were aware that this was a “high risk and high reward” game for their members. It utilized a different model than the chain into the Chinese market (taking 99% of exports), where importers become owners and bear the risks on the product. Live lobsters were distributed by SRL industry-managed distributors contracted by Matthew instead of large importer gatekeepers as in China. In such a way, Matthew could monitor the transport process and the quality of the live lobsters arriving from Australia into the West Coast ports.

Yet, in the first months after operations to the US started, it turned out to be difficult to assure that no damages would occur to live lobsters transported and distributed to the US. This generated controversies between the SRL fishermen and the distributing companies. To solve the controversy, Matthew established an SRL trade facilitation division (including tanks to conserve the live lobsters and issued the necessary insurance contracts) in California to guarantee the promised quality by facilitating transport until the product arrived at the US customers’ door. Moreover, SRL issued insurance against the risk of damages to live lobsters during transport.

A second change in the supply chain was attempting to redirect the available volume of live lobsters to the US market. Supplying lobsters >2kg in the US market was a voluntary initiative left to the license holders. In any case, fishermen were encouraged to support the strategy in the US market. Therefore, once the US SPFD channel became a marketing option for the fishermen, each SRL member had to choose whether to continue harvesting and selling only <2kg lobsters to China or to attempt harvesting and selling >2kg lobsters to US. On one hand, <2kg lobsters to China could guarantee an established high price for a smaller per unit quantity sold. On the other hand, supplying >2kg lobsters to US offered a possible (although still uncertain, since the market was under development) higher price for a larger per unit quantity sold (since the lobsters are bigger, so more kg are sold). So the US market offered an appealing alternative to the SRL license holders: with a fixed licensing quota limiting the number of harvested lobsters, they could sell more kg of lobsters in the US by simply selling larger animals. Plus, to make the US SPFD channel run and expand, the SRL marketing manager really needed a sufficient quantity of lobsters to be redirected from China to US.

“Success will depend on industry commitment to supply,” said Roger in early 2007. “Adopting such market approach represents a major and fundamental change for the industry from a catching mentality to that of a niche marketer,” he added. Another SRL member said in 2007: “I am now convinced that commercial market alternatives are available to the industry, but to develop and secure them will require long term industry commitment to guarantee supply. Indeed the international market development program success depends on industry commitment to supply new markets, in spite of large fluctuations in beach price as we have once again experienced this season.” This was indeed an issue for SRL lobsters.

Many fishermen perceived the incentive to sell lobsters to the US as too uncertain weighed against the risk of having their lobsters damaged in the transport to US. Therefore, a number of SRL members preferred to fish and continue selling their lobsters <2kg to China and direct the

lobsters >2kg to the domestic market or to keep them under water to minimize risks. This was a point of lively debate among the SRL members. In favor of keeping the US channel option open.

“If the potential is to supply, say, 10% or 500 tons of live large porcelain lobster into the USA, how do we guarantee the chefs we will meet the supply when they want it?,” Roger asked. “Is it the usual volunteers committing part of their catch (...) or is it partitioning part of the quota?” Roger concluded, “Whatever the answer, innovation is needed immediately and my challenge and request to you is to put forward ideas on how individually and as a whole industry, up to 10% of the catch can be secured for developing new markets and then maintaining them long term.”

By the end of 2007, Matthew and SRL leaders realized that the quantity of live lobsters sold was not sufficient to make per-unit costs of transport and distribution low enough. An independent review of the SRL market development program commissioned by Seafood CRC computed that - given the current per-unit costs the SRL must source at least 500 active restaurant customers in the USA to achieve the breakeven international sales volume in the following three years (from 2008 to 2011). This conclusion was based on the assumption, estimated with Matthew, that each active restaurant customer would buy an average of 500kg of Southern Rock Lobster per annum, or approximately 10kg per week (that is 250,000kg/annum = 250 tons). An average export value of approximately 72AUD/kg so far was achieved and a beach price paid to fishers of 35AUD/kg had also been achieved. Quite challenging, considering that the forecast total quantity sold by mid-2008 was around 14,000kg/annum.

According to an independent reviewer in order to reach such a scale the market development team of SRL would have been required to add an average increase of 3-4 restaurant customers per week, every week—for the next three years. The reviewers concluded that the commercialization of the market research will require a significant investment in market development over the next three years, and certainly a greater resourcing than has currently been committed to date is needed to achieve commercial success. The reviewers also commented that with the current business model and the current issues with the demand, reaching such full scale within three years was unlikely. Proposing an alternative business model was outside the scope of the review, but ultimately some radical changes were recommended to effectively enter the US market.

In light of the current challenges affecting both the demand and supply of live lobsters, Matthew, with the consensus of the SRL board, decided to undertake a swift change in the business model. Matthew’s decision was also influenced by the impact of the financial crisis on the US food service sector: he estimated that the sector would decline 30-40% within the two following years (2009-2010). At the same time, the beach price of live lobsters reached its peak due to increasing demand from the Chinese market. Considering the unfavorable market conditions for the live lobster business in the US, he felt it would be difficult to increase the number of customers consistently in the next three years.

By early 2009 Matthew was ready to change the business model again. He needed to find a way to make the market channel in the US financially sustainable, as the financial support by public R&D agencies was coming to an end. As the live lobsters were not profitable enough under the

current market conditions, he switched to exporting processed lobsters. In agreement with the SRL leaders, Matthew decided to expand the product range: along with live lobsters, SRL started exporting lobster ravioli, bisque, frozen steaks and portions. To create enough scale, he also diversified the basket of seafood products, including processed Australian kingfish, mullet and tuna and New Zealand shellfish.

Product diversification created the need for further changes in the supply chain. Matthew started exploring alternative channels to the SFPD sector, including deli stores, local retailers and the traditional Chinese food service sector in the US. He created SRL Marketing USA, a distribution company owned by himself in which SRL Australia held a purchase option of 50%.

He acted as both the SRL marketing manager and an independent distributor of Australian seafood products in the US market. According to Matthew, this allowed SRL to capture the commercial benefits and provided a mechanism to provide a self-funding model to undertake market development and promotion beyond the life of the CRC. While the other seafood products were only distributed rather than processed, SRL contracted with an Australian company to process lobsters into ravioli, bisque and portions.

However, selling processed lobsters as part of the product line was not a significant source of profits for SRL members. Only 3.2 kg of lobsters were sold in the US by mid-2009. At the same time, 3,576 kg of other seafood products were sold. One year later, the business expanded to sell 7,300 kg but lobsters represented still around 40% of the quantity sold. From Matthew's perspective, this could be considered a first success. Within three years, he was close to establishing a self-financed distribution system of Australian live and processed lobsters in the US (Exhibit 8 and 9).

At the same time, in front of a large public and private investment made since 2006 without return to the lobster industry, some SRL members and public R&D agencies started criticizing Matthew's strategy. Some SRL members commented that SRL Marketing in the USA became nothing more than another export-import private company dealing with the US. Others expressed concerns regarding Matthew's ownership of the US distribution company and the benefits gained by himself rather than by the industry. In general, given the rapid changes which had occurred along the chain within a few months, some SRL members lamented a scarce flow of information about the most recent US activities. Matthew's detractors demanded to stop any public and private investment for lobsters in brand marketing and relationship-building activities in the US and to shut down the channel. Given that the quantity of southern rock lobsters sold in the US market— both live or processed – was never substantial, public R&D agencies considered the US market development program a major failure. Matthew's detractors demanded they stop any public and private investment for lobsters in brand marketing and relationship-building activities in the US and channels be shut down.

To these pressures and complaints, Matthew responds firmly, "Opening up an alternative market channel was crucial for our lobster industry, and we did it. So far we made little money, but this is just the start. At the moment, we have secured an alternative market channel for our lobster supply and started managing our market risks." And toward the next future, "We need to keep the channel open. If we have no lobsters, we keep selling other selected products from our basket. The important thing is to maintain the relationships built with customers. Shutting the

channel down would be the real waste of money.” By the end of 2010, he was busy again discussing the options to expand the US channel with the SRL members and the R&D agencies.

Australian Lobsters to China: A Need for Change?

The US market experience that Matthew Muggleton and SRL leaders experienced between 2004 and 2010 caused members to rethink the importance of the Chinese market. China and Hong Kong not only account for almost 80% of Australia’s annual exports of rock lobster and 97% of Australian southern rock lobsters, finding alternative markets and new channels such as in the US may be an expensive, long-term, and uncertain.

Many SRL members that lamented Matthew’s strategy in the US argue whether developing new markets provide a true advantage over the current Chinese export market. Is it worth trying to develop new markets for the Australian southern rock lobster industry? A number of SRL members exporting directly to China are convinced that other markets aren’t willing to pay more for lobster than the Chinese because lobster is used as a celebration food for weddings, birthdays and the Chinese New Year. Furthermore, market trends show a booming growth in the food service sector in urban China which analysts forecast will eventually make the Chinese exchange rate for Australian products more competitive than in the US and Europe (see the historical trend of AUD/Chinese Yuan exchange rate in Exhibit 10).

These questions remain open as the status quo in China is continuously challenged. At the end of 2010, China banned the entire import of rock lobsters from Australia, including the Hong Kong ports. The import ban was intended to stop illegal trading of Australian lobsters from Hong Kong to China. According to current Chinese regulations, Australian lobsters shipped directly to mainland China are subject to an import tariff of 10% plus a value added tax (VAT) of 13%. Instead, Australian lobsters shipped to Hong Kong are subject to no tariff and no VAT. Moreover, since 2003, (when the Closer Economic Partnership Arrangement was signed) Hong Kong can sell goods produced exclusively in its territory to mainland China with no import duties. This implies that Australian lobsters sold to mainland China through Hong Kong ports could avoid the import tariff and VAT only through illegal trading. The unexpected ban could not have come at a worse time, during the start of the harvesting season (November) and close to Christmas, when Chinese demand sharply increases. Although the ban was subjected to further discussion between Chinese and Australian governments and then partially amended in mid-2011, the event re-confirmed the risks associated with the current export market through Hong Kong—although profitable in the short run.

The recent export ban of rock lobsters in China has encouraged SRL and its members to think about how to develop alternative and transparent market systems with customers in the food service industry of urban China. Is there an opportunity to brand the fish inside China? In the current export system through Hong Kong, Australian fishermen can only be price-takers as no brand is attached to the product and no relationships are built with the downstream chain. If import duties are not paid on the product, the origin of lobsters cannot be traced and certified downstream.

Perhaps the Australian abalone industry provides an example of how to brand a high-value Australian seafood product in China. The Australian abalone industry has also traditionally exported the majority of its live product through Hong Kong to avoid import duties. To diversify

risk, the Abalone Council of Australia with the support of a Chinese-based marketing company, started a 1.8 million AUD initiative funded by the Seafood CRC to develop a direct, long-term, sustainable, origin-certified abalone trade route between Australia and China meeting the Chinese import tariff of 10% plus 13% VAT. Similar to the southern rock lobster case in the US, the Australian abalone industry is in the process of building relationships with customers and market/sale partners in China. The process takes time and is the subject of controversy. Although, employing a similar strategy could also be a plausible direction for the southern rock lobster industry to follow.

Conclusions

It took Matthew more than three hours to present the entire story of how the SRL is building a collective brand in the US, transforming the chain, and looking for alternatives to the status quo both in the US and Chinese markets. In the past eight years, he played a major role in changing the Australian rock lobster industry culture and strenuously attempted to build consensus around the next actions to take.

Today, Matthew's execution plan remains the subject of controversy among SRL members and public R&D officers. On one hand, making fast action-oriented decisions and adapting to rapid change is the essence of entrepreneurship and innovation. Yet, when designing a strategy for an entire industry and building a collective brand, building consensus, timely and transparent communication is vital to achieving the goals the organizational goals. Matthew invested his energy and enthusiasm into making a difference for his association and their product. Yet, looking back, he realizes he could have done things differently. Several decisions would have had better outcomes if evaluated more carefully.

In the strategies Matthew pursued, could he have done something differently? He was accused of making swift changes putting his personality and energy in front of the doubts and critiques of a minority of SRL members and R&D officers, but isn't this the role of an entrepreneur? At what point should an entrepreneur facing a turbulent international market take the time to discuss the issues with stakeholders before making necessary changes? Which situations could have involved more experts, informed stakeholders and dialogue before taking decisions? "I am glad to discuss the details of what we have done so far," said Matthew. "The more I discuss this with people involved in this business, the more I learn from this story. It will help us do our business better tomorrow."

Looking back, some SRL members and R&D officers think that attempting to open a direct and transparent channel of southern rock lobsters with Chinese customers was the direction that should have been taken in 2004. But who could have forecasted the changing conditions in the US and the turbulent times of the last seven years back in 2004? Was the market research and the collective brand development strategy implemented in the US wrong? Where were the mistakes made in the supply chain transformation to adapt to such a changing context? Which decisions should have been taken in order to have a higher and less expensive penetration in the US market?

These are not rhetorical questions for Matthew. He is looking at his own story in order to make better decisions to design tomorrow's strategy for SRL and for his SRL Marketing Company in the US. Would it make sense, as some of his detractors suggest, to shut down the US channel now that investments are made, relationships with customers are built, and contracts with processors and clients are signed? Apart from his personal interest in it, shouldn't the US channel indeed be considered a risk management tool that diversifies from uncertain Chinese exports? With a duplicable prototype, Matthew can imagine opening other channels for SRL internationally. If a direct and transparent Chinese market alternative to the current sales through Hong Kong is the preferred option to follow, what are the next steps that Matthew should take? What should he do similarly to or differently from the US experience in terms of market research, collective branding and transformation of the supply chain?

Matthew is interested in hearing these questions discussed. The answers would be opinions and suggestions from international experts that have no vested interests in the southern rock lobster business.

Acknowledgements

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Note

The content provided in this case is based on authors' interpretation of primary and secondary data collected during interviews with the major stakeholders involved in this case. The interpretation reflects solely the opinion of the authors, who take full responsibility for the information and interpretation provided in this case.

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Appendix

Exhibit 1. Gross Value of Production (GVP), price and catch indices for the southern zone of Southern Australia Rock Lobster fishery (1990/91=100) (EconSearch 2011, 6)

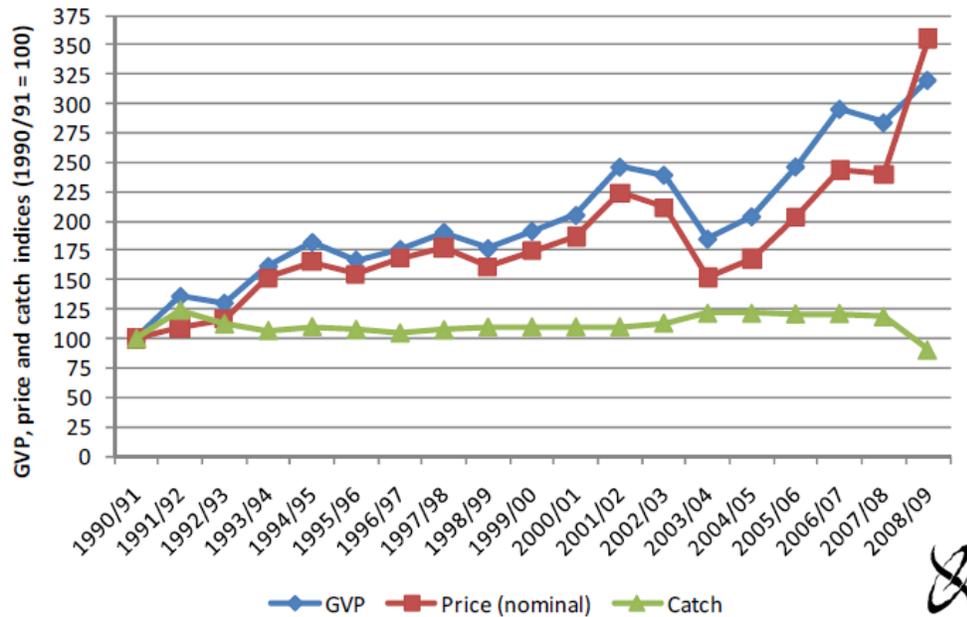


Exhibit 2. Historical trend of Total Allowable Commercial Catch (TACC) and Catch per Unit of Effort (CPUE) in Tasmania between 1970 and 2010 (Gardner et al. 2011, 9).

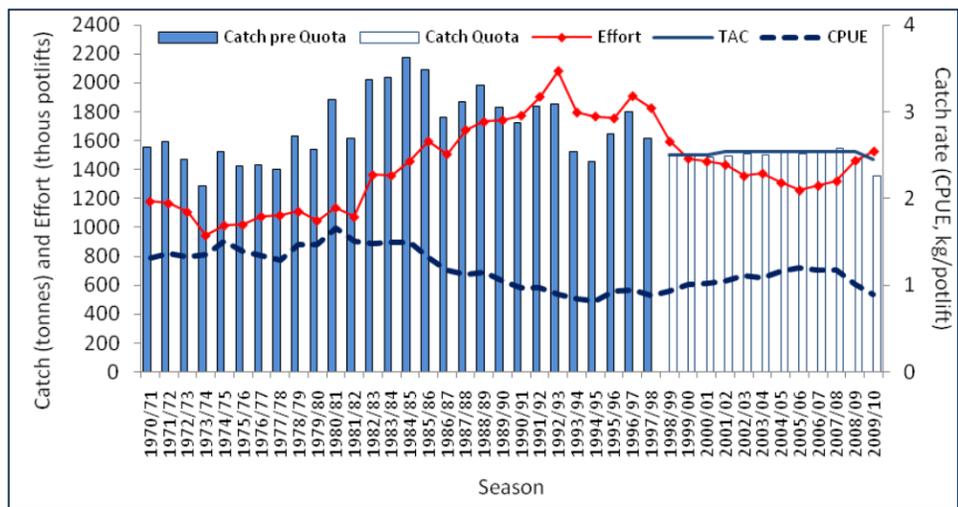


Exhibit 3. The list and outcome of projects funded by Australian public stakeholders to support SRL market diversification strategy (based on discussions with Matthew).

Date	Item	Outcome
1999	South Australia industry project: <i>Planning for Future Competitiveness</i> (Reld and Spawton, Univeristy of South Australia)	Set broad direction for development (“ <i>whole of species</i> ” and value chain analysis)
2001	Improved management of Southern Rocklobster R&D (FRDC Project 2001/072) Morgan	Recommended: National approached to industry R&D investment
2002-03	<i>Southern roc lobster R&D plan and subprogram development</i> (FRDC 2002/313) Coldhoun	Southern Rocklobster Strategic Development Plan Priority Investments: <ul style="list-style-type: none"> ▪ Establish industry R&D entity ▪ Market Development
2004	Southern Rocklobster Limited (SRL) Formed	Raised AUD\$ 240,000/annum for 5 years with 25% funded through levies from SRL license holders for new R&D investment
2005	FRDC Memorandum of Understanding (MoU)	5-year R&D planning and management agreement and extension program budget of AUD\$ 180,000/annum
2005	FRDC Project No.: 2004/251. Identification of new market opportunities for Southern Rocklobster.	
2006	Implement and establish the USA market development platform to enable trade of Certified Clear Green	Platform and Certified Clear Green delivered to industry
2007	Seafood CRC Project 2007/704: “Assessment of new market opportunities and development of effective market penetration strategies for Australian Southern Rocklobster in the USA, Middle East and Europe.”	To be determined

Exhibit 4. The Clean Green Australian Southern Rock Lobster label introduced in the US market since 2006 (from SRL Newsletter).



Exhibit 5. Specifications of the Guaranteed Quality Program in the US (from SRL Newsletter).

Product Specification - USA

Product Specifications	
Product Name	Domestic Porcelain Lobsters
Description	Larger than imported lobsters
Example of Manufacturer	Domestic
Classification	Crustaceans
Colour	Speckled (Shell) / Translucent (Meat) (See Example 1)
Branching	If any branch is broken it is to be attached to the tail base above the final joint (See Example 2)
Taste	Fresh seafood smell
Size	2.5 - 3.5 lbs. (European Long Tail Lobster - approx 1.5lb/680g)
Shell/Carapace/Tail Strength	One pronged tail and/or spreading of appendages within 5 seconds (See Example 3)
Tail Shape	No major abnormality in shape between the top (distally before the Carapace) and base of tail (See Example 4)
Shell Hardness	Shell to be firm on touch
Harvested	Between Tail Emission and 1200 Temperature from South Australia, Tasmania Or Victoria
Appendages	All appendages intact (See Example 5)
No Damage	No damage to Carapace, Legs, Terebra, Rostr & Tail (See Example 6)

Colour 1
Speckled shell, Translucent meat

Branching 2
If any branch is broken it is to be attached to the tail base above the final joint

Shell/Carapace/Tail Strength 3
One pronged tail and/or spreading of appendages within 5 seconds

Product Specification - USA

Tail Shape 4
No major abnormality in shape between the top (distally before the Carapace) and base of tail

Appendages 5
All appendages must be intact

No Damage 6
Lobsters are tagged to be in premium condition

tail damage
Bottom tail, Hole in the tail fan

shell damage
Cracked shell, Chipped product

appendage damage
Broken appendage, Broken legs

Clean Green Product Specs

Exhibit 6. An example of education and communication workshop on live porcelain jumbo lobsters taking place in California in late 2006 (from SRL Newsletter).



Exhibit 7. Historical trend of AUD/USD exchange rate between 1999 and 2011.

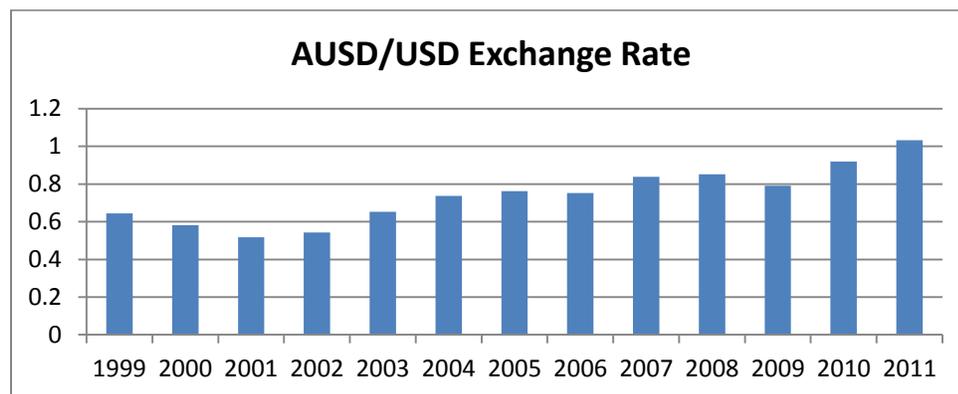


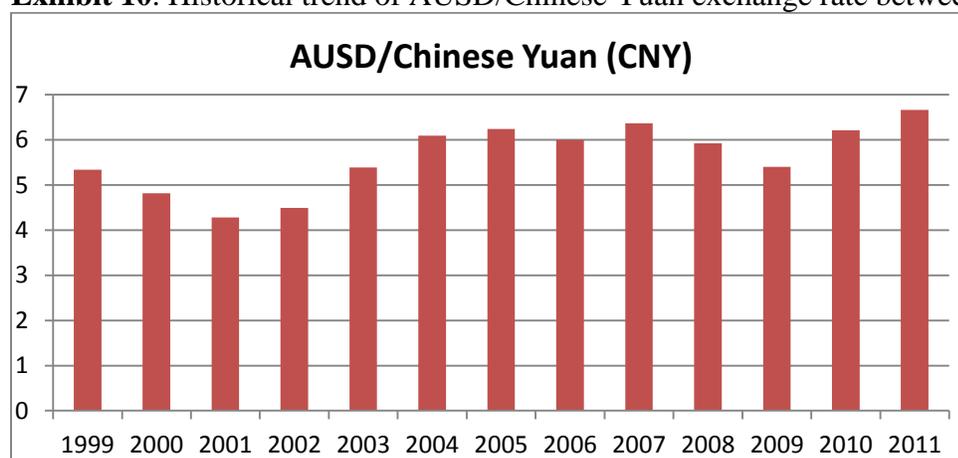
Exhibit 8. SRL processed lobster products sold in the US in 2009-2010
(Status as described by Matthew, elaboration based on discussions and reports to Seafood CRC).

Value-Added Item	Status
Southern Rock Lobster ravioli and bisque (food service package) made and packaged in the USA	Developed product received excellent customer feedback regarding taste, quality and flavor. Price point was restricting business.
Southern Rock Lobster ravioli (retail package, 7oz) and bisque (retail package, 7oz and 10 oz) made and packaged in the USA	The first commercial product was produced in February and March 2010. The next step is to seek a market feedback.
Southern Rock Lobster green raw leg and knuckle meat (500 grams) made and packaged in Australia	Market feedback from trails with customers in Australia was excellent based on taste, texture and quality. This product adds further value to the food service sector as it saves labor costs.
Southern Rock Lobster fresh (never frozen) tails (5kg package) made and packaged in Australia	Market feedback from trails with customers in Australia was excellent based on taste, texture and quality. This product is Rock Salt Frozen and produced only from live lobster. The outcome is high-end sashimi grade and optimal freshness.
Southern Rock Lobster stock package with green shells and tomalley (500 grams) made and packaged in Australia	Produced during the product yield trials, but limited market feedback to date.
Southern Rock Lobster frozen steaks (2-3, 3-4, 4-5 and 5.5oz) made and packaged in Australia	Product concept, but not commercially produced at this stage.

Exhibit 9. SRL financial and commercial results in US and Australia between 2007 and 2010 (status as described by Matthew, elaboration based on discussions and reports to Seafood CRC).

	2007/2008	2008/2009	2009/2010
SRL facilitated commercial sales	AUSD 749,475	AUSD 566,416	AUSD 1,334,942
Margin available to pay platform resources	AUSD 54,649,000	AUSD 76,836,000	AUSD 140,000
Margin percentage of total sales value	7%	14%	10%
Southern Rock Lobster volume traded (kg) inUS	4506	3191	7,300
Southern Rock Lobster volume traded (kg) in Australia	6007	1204	300
Other seafood volumes traded (kg) in USA	0	3575	37,000
Seafood CRC Project 704/2007 expenditure	AUSD 661,517	AUSD 674,772	AUSD 485,000

Exhibit 10. Historical trend of AUD/Chinese Yuan exchange rate between 1999 and 2011.





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Towards a Branded Food Economy in China

Industry Speaks

Damien McLoughlin ^a, Steve Bourne ^b, Mary Shelman ^c, Frank Bradley ^d and Aidan Connolly[ⓐ]

^a *Professor of Marketing, UCD Michael Smurfit Graduate Business School,
University College Dublin, Blackrock, Co Dublin, Ireland*

^b *Vice-President, Asia Pacific, Alltech, 3031 Catnip Hill Pike, Nicholasville,
Lexington, Kentucky, 40356, USA*

^c *Director, Agribusiness Program and President of IFAMA, Harvard Business School,
Morgan T74, Boston, Massachusetts, 02163, USA*

^d *Emeritus Professor, Michael Smurfit Graduate Business School,
University College Dublin, Blackrock, Co Dublin, Ireland*

[ⓐ] *Vice President Corporate Accounts, Alltech, Summerhill Road, Sarney,
Dunboyne, Meath, Ireland*

Abstract

The Chinese economy has achieved extraordinary levels of economic growth and prosperity over the past 30 years. This has evolved into a desire for greater quantities, quality and variety of food products both from its newly enriched citizens and political leaders. These changes have affected the rest of the world, most notably in the demand for the commodity products needed to feed an expanding agricultural industry and its citizens. This paper discusses the six forces which are currently shaping the food industry: an expanding middle class; concerns for food security, safety and quality; the integration and consolidation of industry supply chains; the simultaneous complexity and simplicity of Chinese culture. These forces will shape food production and consumption; the emergence of a Chinese consumer market, the emergence of food retailing and we conclude a branded food economy.

Keywords: branded food, china, demographics, food safety, supply chains

[ⓐ]Corresponding author: Email: aconnolly@alltech.com

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Introduction

China is currently in the throes of a breathtaking economic growth phase that is transforming China and the world. China has a population of 1.3 billion but has only 7% of the world's arable farmland. Harsh climate, rough terrain and a growing water shortage (China only has 25% of the world's average per capita water supply) each present limiting factors, although China is the world's largest agricultural producer. In 2009/10 it was the global leader in many categories such as cotton, rice, pork, apples and dairy/dry whole milk powder.

Through an export oriented economic growth strategy China has seen significant growth in its economic prosperity over the past 30 years. In 1980, per capita GDP (on a purchasing power parity basis) was US\$250, this rose to US\$7,500 in 2010 and is expected to rise to US\$17,400 by 2025.

This growth in income has already led to an increase in food consumption and a switch from grains to protein in particular. Meat consumption in China has doubled over the past 20 years, with per capita consumption of 26kg in 1990, 55kg in 2011 and estimated growth of up to 85kg per person in 2030.

Pork is the favorite meat and over half of the world's pork is produced and consumed in China. Poultry consumption is also rising, particularly as pork prices have risen by more than 50% over the past year. China produces 4.7bn broilers annually and firms are moving towards integrated production. While Chinese diets traditionally do not include dairy products, dairy consumption is also growing—especially for infant formula and other products for children. Chinese consumers are also dining on Western style fast food (KFC is opening a new restaurant every 13 hours) and buying convenience products.

Agriculture is a top priority for government as it contributes 10.9% of GDP in China and employs 39.5% of the labor force, although this is gradually leaking to other parts of the economy. There has been a consistent migration of population from rural areas to cities over the past decades, with 15-20 million people moving each year. In 2011, China had 160 cities with population in excess of 1m people, Europe had only 25. By 2025, 65 new cities will have populations of more than 1m and 24 new megacities will be home to more than 5 million people. This movement is re-shaping China's demand for food and presenting new challenges for the location of farms and the availability of farm workers with the absence of a cold chain becoming an increasing problem.

China faces serious issues as it strives to keep feeding its ever-hungrier population. Farms are small—less than 1 acre on average – which requires food processors to deal with a myriad of suppliers of varying capabilities. Meat and milk production is also fragmented: about 60% of Chinese hog operations have fewer than 50 pigs and many dairy farmers milk only four or five cows. This leads to problems with productivity, disease (especially when animals are raised in close proximity to cities), and food safety—sometimes leading to very serious consequences.

By 2020, China will be the world's largest economy. While today it is largely self-sufficient in food, China is an important and growing importer of several commodities. It buys over 50% of

all globally traded soybean and in 2010 passed Russia to become the world's largest importer of dairy products. During 2011, China surprised the global market by importing increasing quantities of corn and pork. However, even with strong government efforts to keep prices in check, food inflation is running at over 11%.

The potential for agriculture and the food industry in China is great. The Chinese governments, as well as the indigenous and global food industries, have recognized this, as have partners outside the industry such as international banks, who have begun to provide loans to farmers for investment.¹ⁱ Each of these parties sees the challenges, but above all the opportunities, in the modernization of the Chinese agricultural production. China must make important choices about the future of its food industry. These choices will shape the development of the industry. The question is how will this industry evolve?

The authors suggest the next significant development in the Chinese food industry will be the emergence of a branded food economy.

Six forces are identified that individually, but particularly when combined, help to understand why the future of food in China will be branded. Ambition for a branded future was confirmed by a number of speakers at the Alltech Presidents Club, including senior leaders of COFCO, Bright Foods and Liuhe. This end point will be important for the momentum that it will introduce into the food supply chain. This was highlighted by one speaker at the Alltech Presidents Club who noted that the emergence of a branded food economy in China would impact upon every business as its effects rippled through supply chains, improving margins at the front end and tightening them in the middle.

The remainder of this paper is divided into two parts; the first highlights the six forces, each individually important, but which, as they converge, will drive the emergence of a branded food industry. The second is a reflection on the forces of uncertainty in the Chinese food economy that might impact on the imagined future.

Forces Leading the Chinese Food Industry Towards Brands

The presentations and discussions of the Alltech Presidents Club revealed six forces driving the Chinese food industry towards a branded model:

- Expanding middle class
- Food security, safety and quality
- Integration and consolidation of industry supply chains
- Simultaneous complexity and simplicity
- Emergence of a Chinese consumer market
- Emergence of a retail economy

Each of these forces is detailed below.

¹ 'HSBC Sows Seeds in Chinese Countryside', *The Financial Times*, 5th September 2011.

Expanding Middle Class

The principle driver of a branded economy in food will be the emergence of a middle class, those with an income sufficiently large that they have discretion over what they spend their income on. The McKinsey Global Institute estimates that by 2025 up to 75% of the Chinese population will be middle class². This will include groups of lower and upper middle class consumers with incomes of up to 25,000 RMB and 100,000 RMB respectively. These new groups will be younger than other global middle class cohorts and will see their income as sufficient to save for both old age and ill-health and consume new types of higher quality food. Much of this growth will be located in 400 mid-size cities in China and other parts of the South and East of the world. By 2025, more of the world's middle class will be in the developing world than in the developed world. This will be a huge new growth market that is not currently on the radar of many organizations.

A speaker at the Alltech Presidents Club identified three groups in the Chinese population: survivors, builders and boomers. The 'survivors' are the fast growing 60+ age group who lived through hard times of famine and austerity in China's past. However, their economic power and good health make this group an important target for food companies. Their children are the 'builders', the brand conscious, tough negotiating investors in the modern Chinese economy. The next population cohorts are the 'boomers' who will be the first generation to offer a private alternative to public investment as a driver of economic growth. This group is important as they are in the midst of a love affair with brands in many other categories. For example, many of the world's luxury goods such as Burberry and Prada are thriving on the basis of Asian and particularly Chinese demand. This cohort is educated on the value of brands as a symbol of status and a guarantee of quality. It is imperative to monitor, understand and participate in the emergence of this middle class.

Food Security, Safety and Quality

China faces the challenge of balancing food security with the need for food safety. The latter has become a particular challenge following the rapid expansion of domestic food consumption. While China is able to feed itself, it relies heavily on imported food inputs; it imported, for example, 78% of its soybean requirements in 2010. An important challenge in coming years will be the need to balance its raw materials imports, particularly for animal feed, against the price for food in China. A further challenge to food security is access to suitable land in the face of rapid urbanization, the availability of water and the competition for labor with better-paid industrial work.

China's opportunity is to improve the safety and quality of the food that it produces. Attempts to develop national systems of food standards have been described as 'sluggish' due to the absence of a food safety culture. One speaker spoke of food safety being the number one issue for the Chinese government. Another explained that safe food was not a luxury for the Chinese people, but a necessity. However, there is a demonstrated willingness on the part of the Chinese government and firms to engage in meaningful learning with international partners, with the Jilin

² The Value of China's emerging middle class

https://www.mckinseyquarterly.com/The_value_of_Chinas_emerging_middle_class_1798

Food Zone an excellent example of this. A cooperation between the governments of Singapore and China, along with the city government of Jilin and Singapore's SATS, aims to share China's access to natural resources and Singapore's expertise in safe food production to improve the quality and safety of food in China.

The Integration and Consolidation of Industry Supply Chains

The integration of industry supply chains will be an important dynamic in the future as they will contribute to the safety and productivity needed to support a branded food economy. The desire to produce safe food is driving the integration of industry supply chains. For example, leading Chinese feed firm Wellhope and its European joint venture partners De Heus, have been active in creating an integrated chain with the objective of resolving the issues of safety and quality through creating a farm to fork integrated chain in which control and authority, and thus responsibility, for safety can be readily observed³.

The opportunity of integration is not just open to Chinese firms. Nestlé is one Western firm that has been making such investments in the dairy industry in China⁴. Recognizing the need to improve the efficiency and profitability of farming in China they have worked to provide advice on feed and build relationships directly with feed suppliers for those wishing to supply them with milk. They also provide banks loans, agronomic advice and advice on sourcing the right equipment.

Chinese food firms are also under pressure to invest in improving the productivity of the industry in order to maximize the country's ability to meet food security goals, reduce input price volatility and produce safer food.

In ten years, it is likely that there will be 1,000 significant food firms operating in China, down from 20,000 ten years ago and 12,000 today. This consolidation of the Chinese industry and the resulting drive for efficiencies will leave the largest of these firms looking for new ways to create and capture value, with branded goods and the lure of higher margins an easy choice. This approach was signaled by Liuhe as an important future growth strategy. The best way to get a return for these investments is to brand their products, incorporating the safety message as part of their promise to consumers, and secure a premium from consumers.

Simultaneous Simplicity and Complexity

China will continue to offer simultaneous simplicity and complexity. The apparent simplicity arises around the strength of Chinese culture and its apparent uniformity. For example, during the Alltech Presidents Club, the role of culture was highlighted in the case of Wellhope and Liuhe. In the former, the success of the firm was founded on the five Confucian principles of benevolence, justice, courtesy, wisdom and honesty. The Liuhe case highlighted the importance of their values of kindness, hard work, study and harmony in how they dealt with internal and external stakeholders. The complexity begins to arise when an attempt is made to try and under-

³ 'Wellhope – A Feed Fairytale in Northern China', Pig Progress, Vol. 27, No. 6, 2011.

⁴ 'A Market for Local Sourcing', The Financial Times, 4th April 2011.

stand in a specific, rather than an anecdotal, way the role that culture plays in decision-making and action. This is a particular challenge for companies and managers from outside China.

One of the consequences of the apparent uniformity of Chinese culture is the assumption that all Chinese people are the same. However, simple demographics such as income, geography and education lead to the presence of significant market segments. For example, large segments exist in food for children, as a gift for rural dwellers and food as a gift or conspicuous consumption. While health is a major concern for Chinese people, there is also a traditional view in China that they eat for taste first and life second.

A number of forces will drive the further splintering of the consumer market in China. One is population mobility as the move from the countryside to cities continues as improved rail, road and air infrastructure allows for easier movement between cities and regions. Second is the very strong role that TV and movies play in diffusing culture in China. A third force is the role of conspicuous consumption and gift giving amongst the Chinese population. The opportunity is to target one of these segments and participate in its development over the medium term.

Emergence of a Chinese Consumer Market

The current size of the consumer market in China is great and its economic potential greater. For example, the soft drinks market is expected to double in size to \$86bn by 2015⁵. This makes the market attractive for both Chinese and international firms. Chinese firms have made good use of their local knowledge to develop products that Chinese customers want (for example, peanut flavored milk drinks), but international firms cannot let a historic opportunity of this size pass by and are responding with their own locally adapted products.

However, the Chinese consumer has a strong commitment to domestic brands, such that no consumer goods category is led by a Western brand although there are many such competitors in the market. The innovation and competitive battle between Chinese and international firms for this market will be intense but will also yield products which are unique and valuable to Chinese and international consumers.

A key trend for Chinese consumers is the need for novelty, with the average life cycle for a consumer product in China being about three years⁶. For suppliers to these companies there will be a constant need for proactive engagement with consumer focused innovation. Such innovation may have global resonance and be in areas such as health and sustainability but will have to be tailored to the needs of the Chinese consumer. The experience of firms beyond China, and their supply chains, in meeting the needs of demanding customers in areas such as health and sustainability leave them well placed to actively participate in this growth.

⁵ 'China Sets Pace in Brand Innovation', *The Financial Times*, 2011

⁶ 'China Sets Pace in Brand Innovation', *The Financial Times*, 2011.

Influence of Retailers

Consumers face the challenge that many products sold as brands in China are not authentic. As a result, Chinese consumers often trust retailers above brands as a reliable retailer guarantees the authenticity of a brand. As a consumer brand culture develops in China this will reverse, although this will likely take a generation. Retailers can be expected to take advantage of power and leverage the emergence of brands that meet consumer needs for variety, safety and quality, but also provide the best margins for retailers. In short, an international retail model looks likely to prevail. While no national channel currently exists, one speaker did identify the likelihood of government support for one or two national, or supra regional, retail champions as a likely option in the near future. Such a development would assist in a national brand roll out and encourage food producers to engage in branding.

Many international retailers, such as Walmart, are already present and growing fast in China⁷. The presence of such retailers provides branding expertise to Chinese food producers either directly through the desire of retailers to stock local brands, or indirectly through demonstrating 'how it is done' via driving brand development in other categories and stocking international brands. The latter are likely to be partners of retailers in other countries and will take advantage of retailer presence in China to enter the market, helping further to create a branded food economy.

The Future

There were three uncertainties raised during the Alltech Presidents Club that will interact with the previous six forces to ultimately decide the future of the Chinese food industry.

How will China access and use the resources it needs to develop the next stage of its food industry?

Most brands in China are relatively small and have a regional focus. While the firms which own them can be large in sales terms, they lack expertise in technology of food safety, agricultural productivity and branding. There are a variety of ways in which this expertise could be secured such as international partnerships, internal development or acquisition. The latter appears to be gaining currency in the Chinese food industry. One good example of this is provided by Bright Foods, who recently acquired 75% of the Australian company Manassen Foods in one of the largest ever acquisitions by a Chinese food company. The company had previously attempted to acquire the French yogurt maker Yoplait, US vitamin retailer GNC, and the UK snack manufacturer, United Biscuits. The common theme across the successful and unsuccessful acquisition targets is the access they would provide for Bright to international distribution channels, production technology and strong brands in developed markets. While there is no problem in securing capital for such acquisitions, there is a challenge in integrating knowledge acquired, a challenge faced by every firm post acquisition.

⁷ 'Walmart in US Sales Struggle', The Financial Times, 18th May 2011.

Will China allow its food industry to develop to international models or will it seek another way?

With industry integration and consolidation under way, the Chinese food industry looks to be heading in the same direction as the international food industry with larger farms and concentrated processing. However, the commitment of the government to social harmony and the existing desire of the Chinese people to eat fresh rather than processed food may mean that another path is chosen.

How will western influence shape food consumption in China?

As the Chinese food industry develops, it will not do so with a blank slate, rather it will progress in interaction with international participants operating in the industry. It is a source of uncertainty to consider how these Western influences will be allowed to shape and direct the development of the industry in China and whether the mistakes made elsewhere will be repeated or repaired in China.

Conclusion

This paper reviewed discussions which occurred during the 4th Annual Alltech Presidents Club conference. Six prevailing forces were identified which we conclude will accelerate the development of strong local branded food products. While three scenarios also emerged which may make the path less certain, the end point is clear. The implications for the food and feed industries are that the provision of technologies, products and processes that facilitate the ability of Chinese national and international companies to develop these brands, must be the goal of any supplier to these businesses. In addition to offering cutting edge technology, traceability, cost-effectiveness and consistency, such companies should also consider offering softer, knowledge based, services such as the transfer of branding building skills. Our conclusion is that while the Chinese industry might be ten years behind Western companies in building a branded food industry, it is unlikely to take ten years to catch up.

About the Alltech President's Club

The Alltech Presidents Club is an annual meeting of food and agribusiness industry leaders hosted by the founder and President of Alltech, Dr. Pearse Lyons. This invitation only event is intended to be a club of presidents and a forum for open exchange and debate on leadership issues. It expressly focuses on identifying opportunities for business growth. The 4th Alltech Presidents Club in 2011 took place in Beijing and Shanghai, China, and was attended by 105 Presidents.



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The Agenda of Sustainable Development¹

Industry Speaks

Gustavo Grobocopatel

*President, Grupo Los Grobo, Ruta No. 5 Km 308 C.C. 188
Figuerola Alcorta 3535 . 12th Floor, Carlos Casares, BA 6530, Argentina*

Abstract

A new generation of industries will gradually replace those inherited from the Industrial Revolution; that process will be a sort of “rural industrialization”, with new, copious and cheaper products of higher quality and less impact on the environment.

Within this new paradigm, sustainable development challenges will not only include the impacts on the environment or social issues, construed as those included within the “goals of the millennium”, but governing such transformations. How will decisions be made in a more integrated and interdependent world so that this process is inclusive? Who will have the ability or responsibility to make these processes possible?

Keywords: sustainable development, environmental impact, consumption habits

Corresponding author: Email: losgrobo@losgrobo.com

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Introduction

Sustainable development (SD) may be understood as a way of inclusive progress of society. “Progress for Everybody” was the motto of the recent Summit of the Americas. Thus, I take for granted that SD includes a better quality of life, higher happiness indexes, a greater ability to meet needs, improved education and health levels, and more opportunities for those willing to have them - an aspect that requires a greater ability to understand the world, its dynamics, opportunities, and challenges.

It is sustainable because I believe that time does not degrade this process; on the contrary, it enhances and envisages it to a higher extent. On the one hand, I could presume that SD means a growing and extensive well-being with no limits for each and all human beings. On the other hand, I believe that SD may have various meanings depending on cultures, the phase of society or its prevailing paradigm.

Within this framework, I think we have developed a notion of well-being and, therefore, of SD, with standards derived from industrial society, with a pattern of consumption and particular habits, with ownership of property as the core of satisfaction. Each human being requires a house, a refrigerator, a car that uses fossil fuel, prefers to eat proteins or use oil instead of cereals or vegetables. At this pace, if a significant portion of the world population continues to adopt these consumption habits, many planets will be required to satisfy our needs. All lands available would not be enough to produce more food; minerals, oil and other sources of energy will also be insufficient. Just to mention an example: an average American consumer use twice as much energy as a typical European consumer and four times more than an average Latin American consumer. The discussion on SD should include deep thought about these issues since there is no solution to the problem that such an increase in the consumption of goods would cause.

Sustainable Development (SD) may be understood as a way of inclusive progress of society.

However, moving from an industrial society to a society of knowledge brings about good news to some of these issues. We are walking towards a society where the tendency is to share goods, where satisfaction is less frequently based on using material objects and focuses more on experiences as well as on the consumption of services instead of products. That is to say, a society that focuses on flow control more than on the ownership of stocks.

Owning a PC with Internet access already seems to be more important than having a car in certain geographies and segments of society. Should this tendency – seen in more advanced societies – increase, we will probably face a change in consumption habits.

With regard to agribusiness-related issues, we will witness a fascinating change given the fact that plants are used more and more as bioreactors, and they not only produce food (proteins, carbohydrates, or fibers) but also varied ways of energy, industrial enzymes, plastics, or medicines. Consequently, we are looking at small “industrial plants” or a “green industry” that uses clean and renewable energies, such as solar energy, where leaves are some kind of efficient “panels”. These “factories” have original designs that come in a chip, which is the seed, and

which determines their features; instead of having smokestacks and issuing gases, they consume the atmosphere's carbon dioxide.

We are walking towards a society where the tendency is to share goods.

I believe a new generation of industries will gradually replace those inherited from the Industrial Revolution; that process will be a sort of "rural industrialization", with new, copious and cheaper products of higher quality and less impact on the environment.

Within this new paradigm, SD's challenges will not only include the impacts on the environment or social issues, construed as those included within the "goals of the millennium", but governing such transformations. How will decisions be taken in a more integrated and interdepending world so that this process is inclusive? Who will have the ability or responsibility to make these processes possible?

Undoubtedly, these trends place the State and its ability to adapt to this new paradigm in the center of the scene. The extent to which this process will produce an extensive well-being with no frontiers will depend on such State's quality and intelligence.

During the recent Summit, several Heads of State of the Americas clearly introduced this issue into the agenda; governance is required based on consensus, institutional character, predictability, and a safe framework. They also discussed about pragmatism in the Government's actions and a State that adapts to changes; they stated that they consider a "good government" one that is efficient (I personally think there are various ways of efficiency), effective, transparent, and accountable to society.

The responsibility of such State transformation goes beyond governments or political groups and includes civil society as a whole and, of course, businesspeople, who will be responsible for undertaking risks, investment capacity, and creativity in view of this new age's challenges. The process must create public goods and build social capital. Public-private associations may be a good platform to drive these actions.

Meanwhile, the social agenda knocks at our doors every day: structural poverty, economic unreliability with consequences on the pension plan, inequality, and violence together with organized crime, income differences between the rich and the poor, the youngsters that do not study or work, the problem of access to housing, the need of high-quality education, how to create employment and, especially, employability. The environmental agenda requires joint actions at a local and global level so as to find solutions to climate change, deforestation, the problem of access to water, and sea control.

The discussion of these issues should speed up and intensify. There are solutions available, and this is why sustainable development should go beyond an ethical discussion and should be included within the authorities' agenda.

The agenda of sustainable development must include the pressing problems of the social and environmental agenda, reviewing consumption habits, the State's quality, the development of

new ways of global government, and the productive paradigm's transformation with the emergence of "green industries".



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Mapping and Quantification of the Cotton Chain in Brazil

Industry Speaks

Marcos Fava Neves[ⓐ], Mairun Junqueira Alves Pinto[ⓑ], José Carlos de Lima Júnior[ⓒ]

^a *Professor, School of Economics and Business (FEARP) University of São Paulo,
Av dos Bandeirantes 3900, Ribeirão Preto (SP), 14.040-900, Brazil*

^b *Researcher, Markestrat Project and Research Center, Rua Maestro Ignácio Stabile, 520, 14025-640,
Ribeirão Preto, SP, Brazil*

^c *PhD Candidate, University of São Paulo, FEA - School of Economics, Business and Accounting,
Markestrat Project and Research Center, Rua Maestro Ignácio Stabile, 520, 14025-640
Ribeirão Preto, SP, Brazil*

Abstract

The CHAINPlan method developed by Neves (2007) is a practical tool which can be used to construct strategic plans for production chains. A preliminary step in this process includes mapping and quantifying the production chain. We present the results of applying the method to one of the most important agribusiness chains in Brazil—the cotton sector. The Gross Domestic Product for the cotton sector in the 2010-2011 crop year was estimated at nearly \$19.2 billion. We show the interconnections between the links in the chain and its ability to generate revenues, taxes and jobs.

Keywords: cotton, economic impact, value chain.

ⓐCorresponding author: Tel: +55 16 3602-3903
Email: mfaneves@usp.br
M. J. Alves Pinto: mairun@markestrat.org
J.C. de Lima Júnior: jclima@usp.br

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The Cotton Chain

The mapping and quantification of agribusiness chains in Brazil has been the subject of several studies. Readers will better understand the magnitude of economic and social development of the production chain through addressing the following questions:

- How significant is the sum of sales of the various links in the supply chain and its GDP?
- How much tax revenue is generated by the production chain?
- How many jobs are generated in Brazil?
- How significant is the sum of wages paid to workers during a season?

The Gross Domestic Product (GDP) of the cotton sector for the 2010-2011 crop year reached an estimated value of US\$ 19.19 billion (Table 1). Overall financial transactions, which consist of the sum of the revenues of each link in the productive chain sum to US \$37.94 billion.

Table 1. GDP estimate for Brazilian cotton production chain based on final goods

Product	Internal Market	External Market	GDP (IM + EM)
	US\$ (millions)	US\$ (millions)	US\$ (millions)
Cotton lint	Not applicable	745.938	745.938
Cotton linters	113.712	14.004	127.716
Cotton motes	26.512	Not applicable	26.512
Cotton yarns	Not applicable	10.981	10.981
Cotton textiles	11,785.909	164.333	11,950.242
Cotton knits	5,519.544	11.768	5,531.312
Cotton seeds	244.339a	Not applicable	244.339
Cottonseed cake and meal	271.003	Not applicable	271.003
Crude cottonseed oil	228.844b	Not applicable	228.844
Cottonseed-based biodiesel	56.076	Not applicable	56.076
Total	17,772.756	947.024	19,192.963

Source. Elaborated by the authors

a - Sales made by cotton gins considering the total production of cotton seed minus the amount allocated to crushers for the manufacture of cottonseed oil, cake and meal.

b - Sales by crushers, considering the total production of crude cottonseed oil minus the amount destined for the manufacture of biodiesel.

The cotton value chain is divided into three stages: (1) before farm, (2) on the farm, and (3) after the farm.

Before Farms

The link of supplies and inputs includes the resources necessary for agricultural production. Agricultural supply industries accounted for US\$1.93 billion in sales to cotton farmers. Pesticides, fertilizers and fuel and lubricants account for 82% of the sector's expenditure on farm inputs. The high use of pesticides is due to the high incidence of hard-to-control pests and diseases that, if left untreated, can cause major economic losses to growers. The high use of fertilizers is justified mainly by the fact that production is concentrated in the areas of the cerrado

(savannah-like vegetation zones) where the soil conditions require fertilization. The expenditure on fuel and lubricants accounts for the strong use of machinery in all stages of production: planting, treatment, harvest and internal transportation—and by the large number of field applications per harvest year.

On the Farms

In the cotton chain it is common to find an integrated model where growers gin their own cotton. The ginning process therefore is included in on-farm activities. Often, there is a rendering of services among the producers themselves, and in most reported cases, payment is made through the “barter” system, in agricultural enterprises where no ginning occurs on farm. Producers trade a portion of the processed product, mainly cotton seed and lint, for ginning services. Only in the state of Minas Gerais did the interviewees indicate that producers paid cash per kilo ginned. Bartering comprised \$636.41 million of the \$7,059.15 million in revenue earned by cotton farmers. The other \$ 6,423.15 came from the sale of cotton lint.

Beyond the Farm

The next stage in the chain includes the textile industry (spinning and weaving/knitting), which purchases lint from producers. Textiles in 2010 accounted for \$26.38 billion in sales of cotton products (IEMI, 2011; Secex, 2011). Another source of revenue is generated from crushers who process the farm-produced cotton seeds into vegetable oil, meal, and linters. Vegetable oil is marketed primarily to the food and biodiesel industries, while the meal is used for animal feed. The linters, which are short cotton fibers that cover the seeds are also sold by the crushers. The combined sale of oil; cake and meal; linters; and biodiesel resulted in \$737.46 million in revenue.

Value Chain Services

The cotton service sector had sales totaling \$412.12 million. Services include cotton fiber classification laboratories (\$11.10 million); brokerage firms (\$80.96 million); maintenance of gin plants (\$ 21.48); and credit lines for cotton cultivation (\$298.58). Other important service providers such as agricultural consultants and crop application are not accounted for due to the lack of data.

Taxes, Employment and Wages

The cotton sector pays nearly \$8 billion in sales taxes and employs over 150,000 people: 79,477 people working exclusively with cotton and cotton fibers; 14,241 in the cultivation of cotton; 27,481 in the preparation and spinning of cotton fibers; and 37,755 in the weaving of cotton yarn/thread. The total wage bill for the cotton sector in 2010 was \$ 786.79 million.

Product sales estimated in US dollars for the 2010-2011 harvest year can be seen in Figure 1.

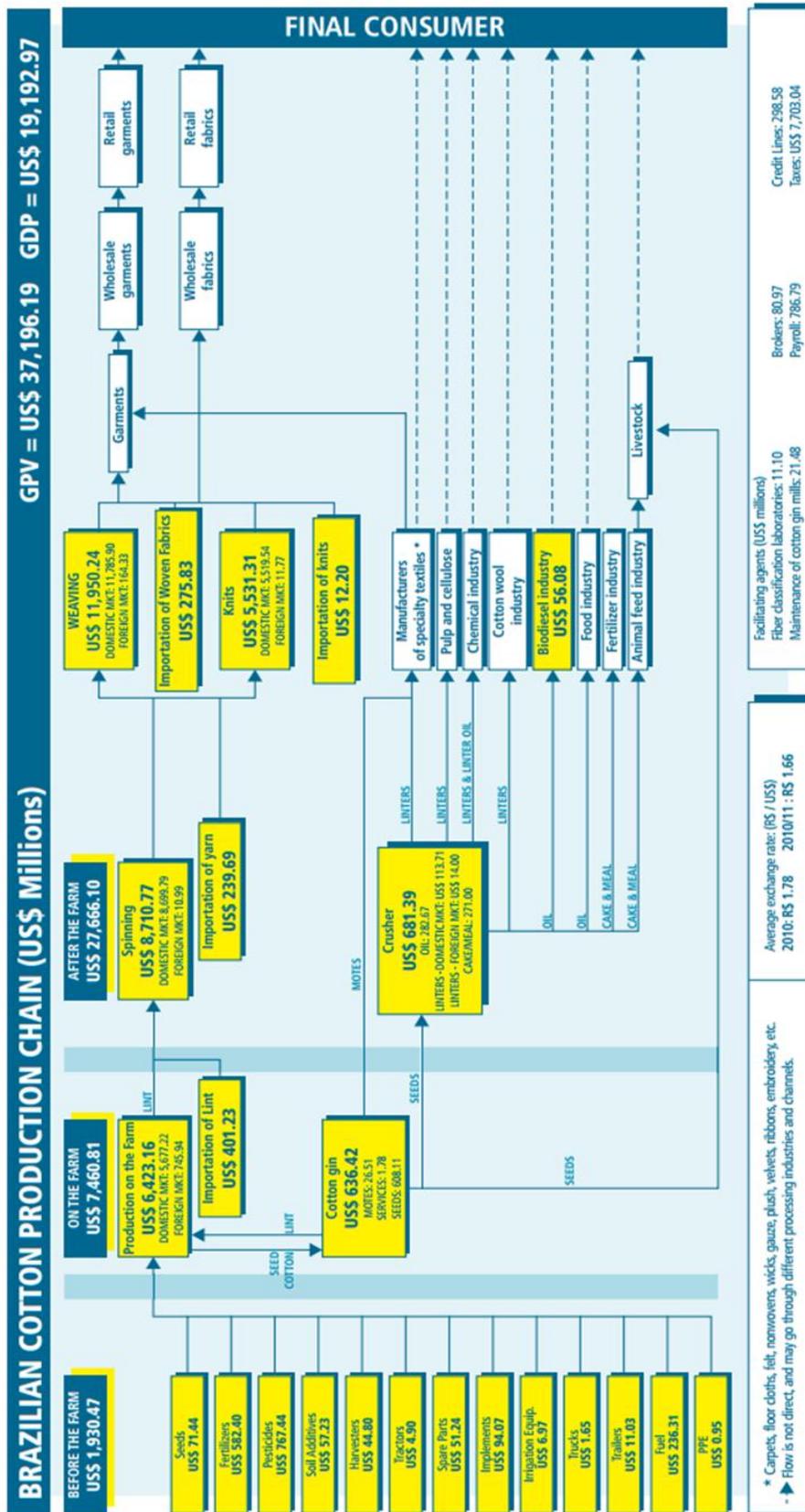


Figure 1. The mapping and quantification of the Brazilian Cotton Chain
Source. Elaborated by the authors.

Conclusion

The cotton chain is very specific, due to the fact that the most important part of the chain doesn't go to the food consumer, but to the textile industry. Consequently, the cotton chain faces competition from the industrial and alternative fiber sectors. The cotton chain is not experiencing the same consumption growth as seen in grains like soybean, corn, wheat, peanuts and others.

The implications of this study provide measurements detailing all aspects of the chain and profit sectors, and the major difficulties the chain currently faces. The findings show the Brazilian cotton sector offers growth opportunities not only in the primary production of lint, but mainly in other production systems, such as food products, pharmaceuticals and textiles, especially when one takes a closer look at the various byproducts generated from raw cotton. Among these products, a recent increase in the value of vegetable oil in the biofuels sector should be highlighted, concomitantly being a natural source of clean energy for the biodiesel industry as well as an important protein concentrate for animal feed, providing 32% crude protein, which directly impacts the development of other production chains, such as cattle breeding.

After examining the numbers and impacts, these type of projects can gain acceptance within Government, private companies and organizations within the cotton chain, and move forward into an implementation phase.

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Tel: 1-979-845-2118 • Fax: 1-979-862-1487 • E-mail: ifamr@ifama.org • Web: <http://www.ifama.org>

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