International Food and Agribusiness Management Review

Official Journal of the International Food and Agribusiness Management Association

Volume 13: Issue 3
2010

International Food and Agribusiness Management Review

Editorial Staff

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

International Food and Agribusiness Management Review
Volume 13, Issue 3, 2010

Table of Contents

RESEARCH

CASE STUDY

INDUSTRY SPEAKS

International Food and Agribusiness Management Review
Volume 13, Issue 3, 2010

Skills, Qualities and Experiences Needed for Future Leaders in Food and Agribusiness Industries of Armenia

Vardan E. Urutyan[Φa] and Kerry Litzenberg[b]

[a]*Director, International Center for Agribusiness Research and Education (ICARE), Agribusiness Department, Armenian State Agrarian University (ASAU), 74 Teryan St,. Yerevan, 0009, Armenia*

[b]*Professor, Department of Agricultural Economics, 340 Blocker Building, 2124 TAMU, College Station, Texas, 77845-2124, U.S.A.*

Abstract

It is widely recognized that academia should prepare students for the job market as well as provide general education. An important aspect of agribusiness education is that industry leaders expect graduates to have several skills that improve the management capacity of the firm. This responsibility means that curriculum development and implementation must not be conducted by academicians in isolation. Industry must participate and play an active role in curriculum design and curricular reforms. The study quantifies agribusiness industry preferences for agribusiness education and identifies the skills, capabilities and experiences the food and agribusiness companies in Armenia look for in their new employees with the potential to become future leaders in their firms.

Keywords: Armenian agribusiness industry, curriculum, skills, employer, education

[Φ]Corresponding author: Tel: + 37410.52.28.39 Ext. 21
Email: vardan@icare.am

Other contact information: K. Litzenberg: litz@tamu.edu

Problem Statement

After the achievement of independence in 1991, Armenia's higher educational system faced several important challenges. As the country's economical and social infrastructure was changing, privatization of land and other production means was undertaken. There was an urgent demand to revise higher education curricula by including new specialties required for the needs of a market economy and excluding old, non-marketable specializations. In early transition years, many agricultural universities of post-socialist countries started reorganization. Armenia also followed the other former Soviet republics and started to implement reforms in the agricultural higher educational system. Initially these reforms were based on the best considerations of higher education faculty and administration and in consultation with international specialists in curriculum development. Several U.S and European agribusiness curriculum were examined and served as the model for these evolving educational programs for managers of agribusiness firms. The newly created Armenian Agricultural Academy (AAA) now Armenian State Agrarian University (ASAU), designed a new curriculum, preparing agricultural specialists with a three-step education system: baccalaureate, graduate and post graduate programs. New specializations were introduced to adjust to the new environment. Additional new specialties are being considered in order to further adapt education to the current needs of the agri-food system of Armenia.

However, overall, the changes in agricultural higher education in Armenia are occurring very slowly. Curriculum changes are always difficult and painstakingly slow. In fact, in the US, agricultural economists spent nearly three decades integrating agribusiness into their curricula (Erven 1987). In addition to this general slowness for curriculum change, Armenia has also undergone dramatic change in their economic structure since 1991. In general, designing and changing of the curriculum in Armenia is being accomplished in isolation by academics only and there is a wide curricular bias caused by existing faculty expertise and interests. US agribusiness Industry representatives have had occasional direct input into the development of agribusiness curriculum (Coffey 1987), but agribusiness curriculum specialists have regularly sought their opinion through several surveys and analysis (Litzenberg and Schneider 1987; Boland and Akridge 2004). Most current academics in Armenia were trained during the period of centrally controlled and planned educational systems. The programs are mostly collections of courses and the existing teaching methods and materials do not foster critical thinking or communication skills. One problem appears to be that curriculum is being developed and revised by academics with no industry input. It is quite possible the agribusiness firms are changing more quickly in Armenia than academic administration has even considered.

It is widely recognized that academia should prepare students for the job market as well as provide general education (Wachenheim and Lesch 2002). An important aspect of agribusiness education is that industry leaders expect graduates to have several skills that improve the management capacity of the firm. This responsibility means that curriculum development and implementation must not be conducted by academicians in isolation. Industry must participate and play an active role in curriculum design and curricular reforms if graduates are to have the capabilities to manage the agribusiness firms in the changed environment. Academics must have unique qualities to understand on-the-job tasks, behaviors, skills and competencies that should describe a new graduate who would be well suited for employment in an agribusiness firm.

These skills and competencies necessary to be successful in their chosen career must be translated to the academic curricula in agribusiness.

Background Information on Armenian Agribusiness Industry

The agribusiness industry is the driving force in the overall development of agriculture in Armenia. During the Soviet period, food processing companies with huge capacities were operating in the system, with the Armenian-produced brandies, wines, canned fruits and vegetables and fruit juices enjoying a very high demand.

Following 1991, during the first phase of the agrarian reform, when Armenia was in the state of economic blockade, processing enterprises almost ceased their activities. In those years, family-size processing operations started to grow since the volumes and prices of raw product supplies had decreased, and the farmers had no other choice but processing their product on their own in homestead conditions just to avoid spoilage of the product. Starting from 1998, through investments from the private sector and supported by international agencies, the situation in the agri-processing industry was remarkably improved. Activation of operations in the food processing system and comparative increase in the volume of export have definitely contributed to the mitigation of the agricultural product marketing problem and enhancement of the level of commercialization of farms. In 2007, the processing companies purchased about 144,000 tonnes of grape and 72,000 tonnes of vegetables; these volumes exceeded those of 1998 for 3.5 and 5.5 times respectively. As a consequence of the 2008-2009 worldwide financial and economic crisis, the volumes of agricultural product purchase have been noticeably reduced (Avetisyan 2010).

In the Soviet period, the produce of the processing industry in Armenia - brandy, wine, tomato paste, canned fruits and vegetables - was mainly marketed in the Soviet Union. Today, the geography of the consumer market has been considerably expanded. To develop this tendency, pronounced efforts are being made to improve the quality and marketability of the products as well as standardization and certification. However, food-processing capacities are not sufficient to process the total potential of farm production in Armenia. Hence, making further investments in this profitable industry, along with development of small and medium size entrepreneurship are the most critical priorities.

From the standpoint of agrarian reform intensification and efficient management, as well as the sustainable development of the agribusiness industry, it is critical to supply the sector with relevant high quality specialists. The Armenian State Agrarian University (ASAU) is the only higher educational institution providing the agri-food sector with university-degree specialists. The ASAU (formerly Armenian Agricultural Academy) was founded in 1994, as a result of merging the Armenian Agricultural Institute and the Yerevan Zoo-Veterinary Institute. ASAU prepares specialists in 36 areas. The University has 7 departments of daytime studies with 46 chairs, master and PhD degree studies and over 10,000 students. Today's food and agriculture sector job market demands new specialties that are now included in the curriculum of ASAU: Agricultural Ecology; Children's and Functional Food Technologies; Expert Examination of Agricultural Raw Product and Foodstuff; Standardization and Certification; Insurance Business, Consultancy and Information in Agri-Food System; and others.

The Ministry of Education and Science of Armenia establishes the framework for higher education (degrees awarded, requirements for admission, fees, etc.) and the universities more or less have freedom for designing curricula and developing courses for each specialization. This allows a particular university to dynamically respond to arising needs if they have the necessary potential and resources. However, many barriers to improvement exist in Armenian universities in particular in the ASAU. Some teachers do not accept the need for improvement in their own teaching. They think that they are already doing a good job in the classroom. This perception reduces their interest in teaching improvement programs. Other barriers include the lack of creativity and drive for improvement, lack of faculty with innovative approaches and new ideas.

Most teachers are unaware of the professional literature in teaching and learning, fresh pedagogical techniques and technological advances; they do not tend to update the resources they use. The current student-centered classroom experience used in other educational systems is virtually unknown in Armenia. The teachers themselves are the main speakers during their classes. Students' input in class discussions and development is absent.

Problems also exist in course and curriculum development. Courses usually lack clear objectives and are not output-oriented. Teachers do not create the best course syllabi, evermore they do not clearly understand the essence of syllabi, they misinterpret it as a mere thematic plan for their lecturing. It is difficult for teachers to move to the new grading system. Students lack knowledge about their progress, and how to improve it. Teachers are also unable to motivate students.

There is a poor feedback from the industry to improve the curricula and maintain it with current needs of the market. No or poor mechanisms of curriculum evaluation exists. Either curricula remain the same or the revisions are done without the involvement of the industry.

This background on the historical and current status of agribusiness education in Armenia makes a clear case for the motivation for the study reported in this research effort.

Objectives

The overall goal of the current study is to establish priorities for Armenian agribusiness education curriculum through a solid partnership with the growing food and agribusiness sector of Armenia using formal surveys. These queries and explicit directives reveal the major revisions and changes needed in the ASAU's current phase of curricular reforms related to agribusiness programs. Baker G.A., Wysocki A.F., and House L.O; Baker G.A., Wysocki A.F, Wachenheim and Lesch, House L.O and Batista J.C; and Litzenberg and Dunne have all described the need and opportunities of academics partnering with industry representatives to develop curriculum. While there may be a synergistic effect between research and teaching in agribusiness (Dooley and Fulton 1999) this study is focused on curriculum. Agribusiness education must be current and meeting the needs of industry. The main objective of this study is to quantify industry preferences for agricultural higher education of Armenia, in particular agribusiness industry preferences for agribusiness education. The study identifies the skills, capabilities and experiences the food and agribusiness companies look for in their new employees with the potential to become future leaders in their firms.

Methodology

Data for this study were gathered using a structured face-to-face interviewing technique with senior executives, business owners and top/middle level managers, representing food and agribusiness industries of Armenia. One or two executives from each company involved in decision making for recruitment and hiring of new employees were interviewed. These companies included agricultural processing companies like wineries and brandy factories, meat, dairy, fruit and vegetable processing companies, companies involved in horticulture, aquaculture, arboculture, firms dealing with trade of agricultural inputs and machinery as well as agricultural banks and credit organizations. International and regional agribusiness companies operating in Armenia also were targeted.

The survey instrument was the same as used in the AGRIMASS survey conducted by Litzenberg and Schneider in the mid 80s with modifications to the Armenian situation and adaptations to modern agribusiness management techniques. The Agribusiness Management Aptitude and Skill Survey (AGRIMASS) was designed to solicit comparative rankings of alternative skills and characteristics of agricultural economics graduates required by a wide array of agribusiness firms (Litzenberg and Schneider, 1987). The AGRIMASS survey methodology was also used by Boland and Akridge in 2004 to identify the progress made by agribusiness education programs in the two decades since the original work by Litzenberg and Schneider and was the basis of the USDA national commission on food and agribusiness management report (see Akridge 2004). The survey instrument focused on total of 78 parameters/variables thought to be important to agribusiness firms in Armenia and based on the historical success by the authors above. The parameters were grouped in the following seven categories:

1. Business and economics
2. Computer, quantitative and management information
3. Technical skills
4. Communication skills
5. Interpersonal qualities
6. Employment and work experience
7. General higher education experience

Most of the skills identified in AGRIMASS are considered of some importance for higher education curricula and certainly make contribution to the skills of the agribusiness manager. The purpose of this study is to rank order these skills so agribusiness curriculum development can prioritize these skills as they are added to existing or new courses. The technical skills listed under section C of the survey instrument were designed to be highly specific so that different types of firms could respond to the technical needs for their specific industry.

A 5-point Likert scale was used to show relative importance of each characteristic as well as the ranking of each category. The survey form also contained questions about the firm size, type, number of employees and sales volume.

Profile of Respondents

A total of 100 executives from 80 quite diverse companies were interviewed and the survey instrument completed. The respondents were grouped into seven categories by firm type with the number of responding firms for each category following the category in brackets:

(1) Wineries and Brandy Factories [10]
(2) Meat and Dairy Processing [19]
(3) Fruit and Vegetable processing [15]
(4) Other agricultural processing [16]
(9) Food Wholesaler/Retailer [9]
(10) Agricultural Banks and Credit Organizations [10]
(13) "Other" category [20]

The other category included seven firms that categorized themselves as "Other" plus the following original firm types identified by their category number and name as per the original survey instrument followed by the number of firms responding in each category: (5) Horticulture and Arboculture [2]; (7) Aquaculture and Fisheries [2]; (8) Firms Dealing with trade of Agricultural Inputs and Machinery [3]; (11) Agricultural Cooperatives [3]; (12) Ministries, International Organizations and NGOs [3]. These thirteen firms (categories 5, 7, 8, 11, 12) were not considered to be representative of the overall firm type due to the low number of responses and were therefore included in the "other" category. Table 2 (See the Annex) presents the data for the seven firm types[1] for each of the seventy-eight variables in the survey (in seven general skill categories). The rank within the category for each skill is also presented. The average rating for all firms for each question is also included for comparison. All results are included in the table since low ratings are as important as high ratings when evaluating curriculum change. The category and skill order are maintained to provide the reader the ability to match to the corresponding survey instrument.

Some respondents were reluctant to provide information about the number of employees of the company and the sales volume. From the data provided it can be summarized that the average firm represented had 165 employees, although the number ranged from 3 to 1,200. About 40% of firms had more than 100 employees. The mean of annual reported sales among firms that provided the data was 9,427,000 AMD (approx. $31,423); the number ranged from 20,000 to 233,333,300 AMD (approx. $778,000).

The average respondent had about 8.8 years of working experience with the firm. Overall, the respondents represented a wide array of years of experience in the firm. Respondents with less than 5 years of employment in the company represented about 32% of the sample; 5-10 years represented 40%, 11-20 years represented 21% and more than 20 years of employment with the company represented about 7% of the respondents. About 94% of the respondents had higher education (included 20% having MS or PhD), only 5 respondents had vocational education which is considered uncompleted (semi-complete) higher education. The majority of the respondents were between 31 and 50 years old (60%) and about 23% were more than 51 years old. There were also young executives in the sample: about 17% of the respondents were between 16 and 30 years old. About 58% of the respondents were male and 42% female.

[1] Note that the number in parentheses is the category number entered in the database from the original survey instrument. These category numbers are preserved in the manuscript to enable the reader to easily match the responses with those used in the actual survey instrument. Categories 5, 7, 8, and 11 were added to the seven firms originally classified as other and entered in the 13 (Other) category. There were no firms surveyed that represented the Grain processing and marketing category. The number following the category description in brackets [ ] is the number of firms in the category that responded to the survey. Note that one firm did not categorize their business activity.

Results

Table 1 shows the numerical results for the 100 respondents of managers of agribusiness firms to the survey for 78 characteristics, skills and experiences in seven general categories. The average response for the Likert scaled responses and overall rank (out of 78) is given for each skill or characteristic. For each category the p-values are calculated at the .01 level of significance using a comparison of the response for each skill relative to the mean for the category. This shows which characteristics within a category are significantly different from the mean response. This identifies which variables within a category are significant. The agribusiness industry representatives ranked the seven general categories in the following order, where the average rating on the five point scale (where 1 = lowest requirement and 5 = highest requirement) for the category is given in brackets:

Personal Qualities [4.19]
Communication Skills [4.12]
General Higher Education Experience [3.38]
Business and Economic Skills [3.31]
Employment and Work Experiences [2.57]
Computer Quantitative and Management Information Skills [2.54]
Technical skills [2.29].

The agribusiness respondents valued personal qualities and communication skills considerably higher than the other skills and experiences included in the survey. See Table 1 in the Appendix.

The four overall highest rated skills were in the personal qualities category and included: loyalty to the organization, positive work attitude/personality/ability to work hard, work with others and be a team player in problem solving situations, high moral/ethical standards. The personal qualities category also contained the sixth, seventh and eighth overall highest rating and included: self motivation, work without supervision, self confidence and ability to "take a chance" and handle stress/failure/rejection. The fifth highest overall rated skill was "to listen to and carry out instructions" from the communication skills category.

The results are surprisingly comparable to those reported by Litzenberg and Schneider in 1978 and to the results presented by Akridge (2004) and by Boland and Akridge (2004). Of special importance is the top ranking of communication and personal skills categories and the relatively low rating of technical skills. These results have remained mostly consistent over the thirty year period. US agribusiness education programs have responded to the results presented by Akridge and Bolan in the national commission of food and agribusiness management education report. For example, Texas A&M's agribusiness program dropped the requirement for technical agriculture courses during their 2004 curriculum redesign.

Analysis by Firm Type

Survey information for each type of skill was reported in Table 2 found in the Appendix. While educational administration focused professionals might only be interested in the statistical *differences* between firms that might be in the target market for the educational program, industry-oriented readers want to see the skill profile for *their* industry type. Therefore all information is reported in Table 2.

In general there was relatively good agreement within each category for all seven firm types. For example, Table 2 (See the Annex) shows that all firm types ranked loyalty to the organization as the highest ranked skill in the personal qualities category which was ranked the highest of all general categories. General business computer software was also ranked as the highest skill required in the computer quantitative and management information skills category. In the communication skills category, the skill listen to and carry out instructions was ranked number one by all but one firm type. There was also general agreement on the least important skill in most categories by most firm types. So in general, the skill rating is consistent across firm types. Therefore, the skills identified as the highest ranked in the categories should be used for general curriculum development.

Some differences were observed by firm types. For example, the skill of marketing administration was ranked first in the business and economic skills category by four firm types (wineries and brandy, meat and dairy, food wholesaler/retailer and our other category) and second by other agricultural processing firms and third by fruit and vegetable firms. It is interesting however, that agricultural banks/credit firms ranked this skill eleventh out of the twenty-one skills in this category. Professional selling techniques were ranked the highest in the business and economic skills category by both fruit and vegetable and other agricultural processing firms and second by food wholesalers/retailers and the other category. However, agricultural banks/credit institutions ranked this skill number ten out of the twenty-one skills in the category. Another unusual ranking was for the objectives and goals skill for the agribusiness firm. Meat and dairy firms ranked this skill as number 2, while other firm types ranked it as low as 10 or even 12 for the other agricultural processors. While general curriculum should be developed considering the highly ranked skills in each category, some care should be taken for specific agribusiness programs focused on a particular firm type.

The authors were surprised with the rankings of the technical skills. Although this general category was ranked the lowest on average (7th out of 7) there was surprising agreement on the individual skills. For example, food transportation and distribution was ranked as the number one skill by all but one of the firm types, agricultural banks/credit. Even the food science and processing technology was ranked second or third by five of the firm types.

Conclusions

The survey results for the AGRIMASS-Armenia will be used to develop curriculum for agribusiness programs in Armenia. Using the results of this study should cause some realignment of the current curriculum with emphasis on areas being changed. For example the survey suggests the de-emphasis of technical skills and the added emphasis for communication and personal skills. Another change that should be made is to dramatically increase the focus on consumer behavior and professional selling skills. This may seem evident as the educational system moves from meeting the needs of a centrally planned to a market driven economy. However, the identification of these two skills as the most important business skills calls for dramatic changes from the historical perspective still taught in most educational programs. Some of the skills required by the agribusiness professionals can be taught in the classroom as subject matter. However, other skills and qualities are more difficult to teach in the context of a course. The authors suggest that administration of agribusiness education programs should develop a list of these characteristics desired by agribusiness professionals and then make it clear that the student must develop these skills to meet the needs of agribusiness industry. For example, the

number one overall ranked quality is for loyalty to the organization. While this might be difficult to teach in a course, other teaching-related activities should be developed to be sure the students know how important the skill is and create learning environments where these skills can be learned or at least practiced. Loyalty to the organization is a topic that could be emphasized through cases and business principles examples. The highly rated communication skill of being able to listen to and carry out instructions is another skill that could be emphasized in the classroom, not necessarily with theory or principles, but with practical applications. For example, instructions in the classroom could be made verbally while the students gain practice and understanding of the importance of this skill. Personal qualities of high moral and ethical behavior should be signaled as important in the educational curriculum and cases where the opportunity presents itself for comment should be used in the programs.

Meeting the needs of Agribusiness Curriculum Reform

Some of the skills highly rated in the top category (Personal Qualities) which are "high moral/ethical standard", "positive work attitude/personality/ability to work hard", etc. can be incorporated in the subjects like Business Ethics, Leadership or Management and the instructors should use such teaching methods that encourage group work, delegating responsibility, motivating students and involve them in various decision making practical cases.

The Communication Skills category was ranked second and under this category skills should be developed within several subjects. In this category top three skills were: listen to and carry out instructions, express creative ideas verbally and professional telephone skills and etiquette. These skills can be taught within the subjects like Negotiations or a new subject Business Etiquette can be developed.

The third category was "General Higher Education Experience". Although the highest rated two skills of this category were ranked very low in the overall skill ranking, it is obvious that industry highly values foreign internship and foreign study experiences. Students with foreign study or internship experiences have more chances to get employed sooner than those without such experiences. The agribusiness program directors should develop / provide international study or internship opportunities for their students. This can be accomplished with the help of agribusiness companies which can support some selected students to pass their internship in international agribusiness firms and upon arrival to get relevant positions in the company. The top rated experience of the category F (ranked number 5) which is "Employment in International Agribusiness Firm" also proves that international experiences are highly valued by local firms.

Category A, Business and Economic Skills, received a number four ranking. Top five skills within this category were: Marketing administration, Consumer behavior analysis, professional selling techniques, Risk management and Financial Statement Analysis. It can be concluded that agribusiness education programs must teach subjects including Consumer Oriented Marketing with an emphasis on Professional Selling. Other required skills in this category can be taught within Strategic Management subject, Monitoring and Evaluation (A6. Identify, monitor and evaluate key performance areas and progress toward the objective and goals of the firm) and Financial Analysis type of subjects.

The highest ranked two skills of the Category B, ranked number six, were General business computer software (overall rank of 21) and accounting software (overall rank of 52). Companies

may realize that other skills in this category are important but not for managers, as many of the companies have technical staff who support the management with the needed computer systems and programs.

The surprising finding was the Technical Skill Category ranking. The overall low ranking of technical skills (ranked 7th out of 7) may suggest that agribusiness firms believe that they can teach the recent graduates the technical skills required for the career in their firm. In Armenia the industry still leads universities on technological developments, innovations and production systems.

Additional Research Needs

This research has provided the basic evaluation of the skill profile needed by agribusiness industry for 78 skills in seven general categories for five different firm types. This study is prescriptive and built on the premise that agribusiness managers know what they need in terms of required skills of agribusiness graduates. Follow-up work is needed to develop an employability "road mapping" of these skills over time as they apply to successful employment after a sizeable group of Armenian students are educated with these skills.

References

Akridge, J.T. 2004. National Commission on Food and Agribusiness Management Education Report. *The Chain Letter* 3(2):3-4.

Avetisyan, S. 2010. *Agriculture and Food Processing*. Limush Publishing House, Yerevan.

Baker G.A., Wysocki A.F., and House L.O. 2008. Industry – Academic Partnership: The View from the Corner Office. *International Food and Agribusiness Management Review,* 11(3):57-80.

Baker G.A., Wysocki A.F, House L.O and Batista J.C. 2008. Industry – Academic Partnership – Benefit or Burden? *International Food and Agribusiness Management Review,* 11(1):97-117.

Boland M.A., and Akridge J.T. 2004. Undergraduate Agribusiness Programs: Focus or Falter? *Review of Agricultural Economics,* 26(4).

Coffey, J.D., 1987. Undergraduate agricultural economics curricula: Discussion. *American Journal of Agricultural Economics,* 69(5)1043-1044.

Dooley, F.J. and J.R. Fulton. 1999. The State of Agribusiness Teaching, Research, and Extension at the Turn of the Millennium. *American Journal Agricultural Economics* 81(5)1042-1049.

Erven, Bernard L. 1987. Reforming Curricula - Challenge and Change for Agricultural Economists. *American Journal of Agricultural Economics* 69 (5)1037-1042.

Litzenberg, Kerry K., and A. J. Dunne. 1996. Partnerships with Industry: the Essential Ingredient for Agribusiness Education. *Journal of Agribusiness* 14(2):197-204.

Litzenberg, K.K. and Schneider V.E. 1987. Competencies and Qualities of Agricultural Economics Graduates Sought by Agribusiness Employers. *American Journal of Agricultural Economics* 69(5):1031-1036.

Wachenheim C.J. and Lesch W.C. 2004. U.S. Executives' Views on International Agribusiness Education in the United States: An IAMA Membership Survey. *International Food and Agribusiness Management Review* 7(1):42-59.

Wachenheim C.J. and Lesch W.C. 2002. Assessing New-Graduate Applicants: Academic Perceptions and Agribusiness Realities. *Journal of Agribusiness* 20(2):163-173.

Appendix 1.

Table 1. Agribusiness skills proficiency for Armenian agribusiness middle managers

Rank Within Category	**Description of Skills**					
A	**Business and Economic Skills**	Average Response*	p-	value	Diff. from Mean	Overall Rank
1	Marketing Administration (Systems, Strategy, Organization, Structure, Subject: Management)	3.97	*	0.000	0.66	20
2	Consumer behaviour analysis (economics)	3.90	*	0.000	0.59	24
3	Professional selling techniques	3.89	*	0.000	0.58	26
4	Identify and manage risk and uncertainty	3.79	*	0.000	0.48	30
5	Financial statement analysis	3.71	*	0.000	0.40	33
6	Identify , monitor and evaluate key performance areas and progress toward the objective and goals of the firm	3.70	*	0.000	0.39	34
7	Firm/ industry (micro) economics (supply, demand, and price determination) 3.68		*	0.000	0.37	35
8	Develop business policies and programs for the firm	3.65	*	0.001	0.34	36
9	Objectives and goals for the firm	3.58	*	0.009	0.27	37
10	Business organizational structure and the effect of this structure on business activity	3.57	*	0.006	0.26	38
11	Coordinate human and physical resources	3.30		0.927	-0.01	41
12	Corporate finance (capital structure, formation, and budgeting)	3.25		0.552	-0.06	42
13	Human resources planning and control	3.24		0.476	-0.07	43
14	International macroeconomics (exchange rates etc.)	3.09		0.015	-0.22	45
15	Domestic (ARM) macro economics (interest rates, fiscal and monetary policy, unemployment)	3.05	*	0.004	-0.26	47
16	Accounting concepts and procedures	2.99	*	0.001	-0.32	48
17	Inventory Management Systems	2.99	*	0.000	-0.32	49
18	Current and historical international trade and export policies and procedures 2.95		*	0.001	-0.36	50
19	Process and product layout and design	2.62	*	0.000	-0.69	57
20	National and International Political and Economic forces on business operations	2.59	*	0.000	-0.72	60
21	Historical Armenian agricultural policy	1.98	*	0.000	-1.33	72
	Average for Category	**3.31**				**4**

B	**Computer Quantitative and Management Information Skills**					
1	General business computer software (e.g. spreadsheets, data bases, word processing)	3.95	*	0.000	1.41	21
2	Computerized accounting systems	2.88	*	0.004	0.34	52
3	Use computers in managerial decision-making 2.80			0.016	0.26	53
4	Interpret and use math and statistical methods	2.69		0.214	0.15	56
5	Communicate with computer programmers 2.60			0.598	0.06	59
6	Use Quantitative techniques for managerial decision making (eg. Linear programming, business forecasting)	2.53		0.912	-0.01	62
7	Purchase and implement business computer systems	2.47		0.529	-0.07	65
8	Design and implement management information systems	2.38		0.183	-0.16	66
9	Understand Expert Systems	2.33		0.058	-0.21	68
10	Design computer programs	1.86	*	0.000	-0.68	74
11	Write computer programs	1.48	*	0.000	-1.06	78
	Average for Category	**2.54**				**6**
C	**Technical Skills**					
1	Food transportation and distribution systems	3.11	*	0.000	0.82	44
2	Food science and processing technology 2.72		*	0.000	0.43	55
3	Engineering technology of production/processing machinery	2.48		0.121	0.19	64
4	Computer controlled mechanical processes	2.33		0.710	0.04	69
5	Specialized crop production systems	2.15		0.307	-0.14	70
6	General crop production systems	2.14		0.267	-0.15	71
7	General livestock/meat production systems	1.98		0.014	-0.31	73
8	Bio-science, bio-technology and bio-chemistry	1.85	*	0.000	-0.44	75
9	Soil chemistry and characteristics 1.81		*	0.000	-0.48	76
	Average for Category	**2.29**				**7**
D	**Communication Skills**					
1	Listen to and carry out instructions	4.43	*	0.000	0.32	5
2	Express creative ideas verbally 4.20			0.225	0.09	9
3	Professional telephone skills and etiquette	4.16		0.549	0.05	11
4	Give clear and concise instructions to others	4.13		0.835	0.02	12
5	Listen to and summarize lengthy oral presentations	4.10		0.846	-0.01	13
6	Speak clearly and concisely on technical information	4.09		0.731	-0.02	15
7	Write technical reports, memos and letters	4.05		0.366	-0.06	16
8	Foreign language skills (specify the language)	4.05		0.384	-0.06	17
9	Express creative ideas in writing	4.04		0.353	-0.07	18
10	Read and understand specific technical information	3.90	*	0.007	-0.21	25
	Average for Category	**4.12**				**2**
E	**Personal Qualities**					
1	Loyalty to the organization	4.79	*	0.000	0.60	1
2	Positive work attitude/personality/ability to work hard	4.53	*	0.000	0.34	2
3	Work with others and be a team player in problem solving situations 4.46		*	0.000	0.27	3
4	High moral/ethical standards	4.46	*	0.000	0.27	4
5	Self-motivation	4.38	*	0.005	0.19	6
6	Work without supervision	4.31		0.091	0.12	7

7	Self-confidence and ability "to take a chance" and handle stress/failure/rejection 4.27			0.235	0.08	8
8	Work under varied conditions	4.19		0.955	0.00	10
9	Recognize a business opportunity	4.10		0.201	-0.09	14
10	Take a position and defend it, sell your ideas	4.01		0.013	-0.18	19
11	Provide leadership and make decisions	3.93	*	0.000	-0.26	22
12	Manage people and delegate responsibility and authority	3.92	*	0.000	-0.27	23
13	Apply technical skills and information in problems solving situations 3.86		*	0.000	-0.33	28
14	Raise capital for new and ongoing business ventures	3.51	*	0.000	-0.68	39
	Average for Category	**4.19**				**1**
F	**Employment and Work Experiences**					
1	Employment in International Agribusiness firm	3.07	*	0.000	0.505	46
2	Employment in Financial Institution 2.89		*	0.003	0.325	51
3 Farm	Work	2.62		0.677	0.055	58
4	Employment in Non-Agricultural Retail business	2.59		0.813	0.025	61
5	Employment in Domestic Agribusiness firm	2.50		0.587	-0.065	63
6	Government/Public Affaires Positions 1.72		*	0.000	-0.845	77
	Average for Category	**2.57**				**5**
G	**General Higher Education Experiences**					
1	Foreign internship experience	3.87	*	0.000	0.491	27
2 Foreign	study experience	3.82	*	0.000	0.441	29
3	General Education in the Classics/Humanities/Arts etc.	3.78	*	0.000	0.401	31
4	Experience in developing a business plan and organizing a business 3.74		*	0.000	0.361	32
5	Local industry internships experiences	3.33		0.668	-0.049	40
6	Extra Curricular activities in university including leadership positions in student clubs and functions	2.74	*	0.000	-0.639	54
7	Work as student teaching assistant or part time in university	2.37	*	0.000	-1.009	67
	Average for Category	**3.38**				**3**

*Significant at the .01 level where the significance tests whether the average response is significantly different from the mean for the category. The p-value given is for a two-tailed test since the deviation from the mean can be both negative and positive.
The survey instrument is available from the authors.

Table 2. AgriMass-Armenia response by firm type

	Firm Type* - Number of firms in each type	**1-10**		**2-19**		**3-15**		**4-16**		**9-9**		**10-10**		**13-20**		AVG All Firms
		score	**R**	**score**	**R**	**score**	**R**	**score**	**R**	**score**	**R**	**score**	**R**	**score**	**R**	
	A. Business and Economic Skills (Category Rank 4)															**3.31**
1	Marketing Administration (Systems, Strategy, Organization, Structure, Subject: Management)	4.20	1	3.95	1	3.67	3	4.06	2	4.33	1	3.00	11	4.35	1	**3.97**
2	Consumer behaviour analysis (economics)	3.90	4	3.79	4	3.60	5	3.75	3	4.11	3	4.30	2	4.00	3	**3.90**
3	Professional selling techniques	4.10	3	3.68	6	3.73	1	4.25	1	4.22	2	3.10	10	4.10	2	**3.89**
4	Identify and manage risk and uncertainty	3.60	12	3.84	3	3.53	10	3.69	5	3.44	10	4.30	3	3.95	4	**3.79**
5	Financial statement analysis	4.10	2	3.74	5	3.53	8	3.63	6	3.89	5	4.00	5	3.55	9	**3.71**
6	Identify , monitor and evaluate key performance areas and progress toward objective and goals	3.70	9	3.47	9	3.53	9	3.56	7	3.78	7	4.40	1	3.70	7	**3.70**
7	Firm/ industry (micro) economics (supply, demand, and price determination) 3.90		5	3.68	7	3.73	2	3.50	8	4.00	4	2.90	13	3.85	5	**3.68**
8	Develop business policies and programs for the firm	3.70	8	3.63	8	3.60	7	3.44	9	3.78	6	4.10	4	3.50	12	**3.65**
9	Objectives and goals for the firm	3.70	7	3.84	2	3.67	4	3.31	12	3.56	9	3.40	6	3.55	10	**3.58**
10	Business organizational structure and the effect of this structure on business activity	3.60	11	3.32	12	3.47	11	3.69	4	3.78	8	3.40	7	3.80	6	**3.57**
11	Coordinate human and physical resources	3.00	18	3.47	10	3.20	13	3.44	10	3.33	11	3.00	12	3.50	13	**3.30**
12	Corporate finance (capital structure, formation, and budgeting)	3.70	6	3.21	13	2.93	15	3.25	13	3.00	15	3.30	8	3.40	1 4	**3.25**
13	Human resources planning and control	3.10	16	3.42	11	3.60	6	3.19	14	3.11	14	2.40	15	3.50	11	**3.24**
14	International macroeconomics (exchange rates etc.)	3.60	10	3.16	15	3.40	12	2.88	16	2.89	16	2.20	20	3.20	17	**3.09**
15	Domestic (ARM) macro economics (interest rates, fiscal and monetary policy, unemployment)	3.50	13	3.16	14	2.93	16	2.81	18	3.22	12	2.40	16	3.20	16	**3.05**
16	Accounting concepts and procedures	2.60	21	2.95	18	2.47	18	3.31	11	3.11	13	3.10	9	3.30	15	**2.99**
17	Inventory Management Systems	3.20	15	3.16	16	2.47	19	2.88	17	2.89	17	2.40	17	3.65	8	**2.99**
18	Current and historical international trade and export policies and procedures	3.50	14	3.05	17	3.07	14	2.56	19	2.78	18	2.60	14	3.15	18	**2.95**
19	Process and product layout and design	3.10	17	2.74	19	1.87	21	3.06	15	1.78	20	2.30	19	3.10	19	**2.62**
20	National and International Political and Economic forces on business operations	2.90	19	2.63	20	2.67	17	2.25	20	2.56	19	2.30	18	2.85	20	**2.59**
21	Historical Armenian agricultural policy	2.70	20	2.00	21	2.07	20	1.50	21	1.33	21	1.40	21	2.55	21	**1.98**

	B. Computer Quantitative and Management Information Skills (Category Rank 6)															**2.54**
1	General business computer software (e.g. spreadsheets, data bases, word processing)	3.80	1	4.05	1	4.00	1	3.81	1	4.11	1	4.00	1	3.90	1	**3.95**
2	Computerized accounting systems	2.20	5	3.26	2	2.27	5	3.63	2	2.56	6	2.40	5	3.15	2	**2.88**
3	Use computers in managerial decision-making	2.50	3	2.53	5	3.13	2	2.69	6	3.33	2	2.70	3	2.95	3	**2.80**
4	Interpret and use math and statistical methods	2.70	2	2.42	8	3.00	3	2.44	8	3.33	3	2.60	4	2.70	5	**2.69**
5	Communicate with computer programmers	2.20	7	2.58	4	2.47	4	2.75	5	2.78	4	3.40	2	2.40	8	**2.60**
6	Use Quantitative techniques for managerial decision making (eg. Linear prog, bussiness forecasting)	2.40	4	2.53	6	2.27	7	2.56	7	2.56	7	2.40	6	2.70	6	**2.53**
7	Purchase and implement business computer systems	2.20	6	2.84	3	2.00	9	3.00	3	1.56	9	2.30	7	2.75	4	**2.47**
8	Design and implement management information systems	2.10	9	2.32	10	2.27	6	2.81	4	2.67	5	2.20	8	2.35	9	**2.38**
9	Understand Expert Systems	2.20	8	2.53	7	2.20	8	2.38	9	2.56	8	1.80	9	2.50	7	**2.33**
10	Design computer programs	1.80	10	2.37	9	1.47	11	1.75	10	1.44	10	1.60	10	2.15	10	**1.86**
11	Write computer programs	1.40	11	1.58	11	1.53	10	1.44	11	1.11	11	1.10	11	1.80	11	**1.48**
	C. Technical Skills (Category Rank 7)															**2.29**
1	Food transportation and distribution systems	3.60	1	3.21	1	3.27	1	3.25	1	3.33	1	2.40	5	2.85	3	**3.11**
2	Food science and processing technology	3.20	2	3.05	2	2.67	2	3.06	3	2.11	2	2.40	4	2.40	9	**2.72**
3	Engineering technology of production/processing machinery	2.50	3	2.53	4	2.40	4	3.19	2	1.33	4	2.00	8	2.75	4	**2.48**
4	Computer controlled mechanical processes	2.20	5	2.32	5	2.47	3	2.44	4	1.78	3	2.20	6	2.60	6	**2.33**
5	Specialized crop production systems	2.00	7	1.84	7	2.00	5	1.94	5	1.11	7	2.70	3	2.95	2	**2.15**
6	General crop production systems	2.10	6	1.84	6	1.80	6	1.81	6	1.11	6	3.00	2	2.95	1	**2.14**
7	General livestock/meat production systems	1.40	9	2.74	3	1.07	9	1.56	8	1.11	5	3.00	1	2.40	8	**1.98**
8	Bio-science, bio-technology and bio-chemistry	2.20	4	1.84	8	1.60	8	1.75	7	1.00	9	1.70	9	2.45	7	**1.85**
9	Soil chemistry and characteristics	1.80	8	1.58	9	1.60	7	1.50	9	1.00	8	2.10	7	2.70	5	**1.81**
	D. Communication Skills (Category Rank 2)															**4.12**
1	Listen to and carry out instructions	4.40	1	4.26	1	4.73	1	4.38	1	4.67	2	4.30	1	4.35	1	**4.43**
2	Express creative ideas verbally	4.30	2	3.89	5	4.33	6	4.13	6	4.67	1	4.00	5	4.25	3	**4.20**
3	Professional telephone skills and etiquette	3.80	9	4.21	2	4.33	7	4.31	2	4.11	8	4.00	6	4.10	7	**4.16**
4	Give clear and concise instructions to others	4.10	5	3.84	6	4.53	2	4.19	4	4.44	4	4.00	4	4.05	8	**4.13**
5	Listen to and summarize lengthy oral presentations	4.00	7	4.11	3	4.40	5	4.25	3	3.67	10	4.20	2	3.90	10	**4.10**
6	Speak clearly and concisely on technical information	4.10	4	3.79	8	4.47	3	3.88	7	4.33	5	3.90	7	4.20	5	**4.09**
7	Write technical reports, memos and letters	4.00	6	3.58	10	4.40	4	4.13	5	4.22	6	3.80	9	4.20	4	**4.05**
8	Foreign language skills (specify the language)	3.90	8	4.05	4	4.27	9	3.69	10	4.11	9	3.90	8	4.35	2	**4.05**
9	Express creative ideas in writing	3.60	10	3.74	9	4.27	8	3.88	8	4.56	3	4.10	3	4.20	6	**4.04**

10	Read and understand specific technical information	4.20	3	3.84	7	3.93	10	3.81	9	4.22	7	3.30	10	4.05	9	**3.90**
	E. Personal Qualities (Category Rank 1)															**4.19**
1	Loyalty to the organization	4.70	1	4.79	1	4.87	1	4.88	1	4.78	1	4.90	1	4.70	1	**4.79**
2	Positive work attitude/personality/ability to work hard	4.60	2	4.58	2	4.60	2	4.63	3	4.56	3	4.70	2	4.25	4	**4.53**
3	Work with others and be a team player in problem solving situations	4.50	3	4.37	5	4.53	3	4.25	6	4.56	2	4.60	4	4.50	2	**4.46**
4	High moral/ethical standards	4.50	4	4.32	6	4.53	5	4.56	4	4.56	4	4.50	5	4.35	3	**4.46**
5	Self-motivation	4.30	6	4.42	4	4.53	4	4.38	5	4.44	5	4.70	3	4.05	8	**4.38**
6	Work without supervision	3.90	9	4.53	3	4.33	9	4.25	7	4.44	8	4.40	7	4.25	5	**4.31**
7	Self-confidence and ability "to take a chance" and handle stress/failure/rejection 4.30		7	4.26	7	4.33	7	4.69	2	4.44	6	4.10	10	3.95	11	**4.27**
8	Work under varied conditions	4.40	5	3.95	10	4.40	6	4.06	8	4.22	9	4.40	6	4.10	7	**4.19**
9	Recognize a business opportunity	3.90	8	4.16	8	4.27	10	3.81	12	4.11	10	4.20	9	4.15	6	**4.1**
10	Take a position and defend it, sell your ideas	3.80	11	3.79	11	4.33	8	4.00	10	4.44	7	4.00	13	3.85	14	**4.01**
11	Provide leadership and make decisions	3.60	12	3.68	13	4.07	11	4.00	9	3.89	12	4.20	8	4.00	9	**3.93**
12	Manage people and delegate responsibility and authority	3.60	13	4.00	9	4.07	12	3.88	11	4.00	11	4.00	11	3.90	13	**3.92**
13	Apply technical skills and information in problems solving situations	3.80	10	3.74	12	4.07	13	3.75	13	3.78	13	4.00	12	3.95	12	**3.86**
14	Raise capital for new and ongoing business ventures	3.00	14	3.58	14	3.73	14	3.19	14	3.56	14	3.30	14	4.00	10	**3.51**
	F. Employment and Work Experiences (Category Rank 5)															**2.57**
1	Employment in International Agribusiness firm	3.80	1	2.79	1	3.73	1	2.88	1	2.56	3	2.30	5	3.20	1	**3.07**
2	Employment in Financial Institution	3.20	4	2.53	2	3.13	4	2.50	2	2.56	2	3.30	1	3.10	3	**2.89**
3	Farm Work	3.40	2	2.16	3	2.73	5	2.25	3	1.33	6	3.10	2	3.15	2	**2.62**
4	Employment in Non-Agricultural Retail business	2.60	5	2.16	4	3.40	2	2.06	5	3.22	1	2.40	4	2.55	5	**2.59**
5	Employment in Domestic Agribusiness firm	3.20	3	2.05	5	3.33	3	2.13	4	1.44	5	2.70	3	2.55	4	**2.50**
6	Government/Public Affaires Positions	2.00	6	1.26	6	1.80	6	1.94	6	1.89	4	1.50	6	1.85	6	**1.72**
	G. General Higher Education Experiences (Category Rank 3)															**3.38**
1	Foreign internship experience	3.70	2	4.00	1	4.13	3	4.13	1	4.22	1	3.60	2	3.35	3	**3.87**
2	Foreign study experience	3.70	3	4.00	2	4.20	2	3.50	4	4.00	2	3.60	3	3.65	1	**3.82**
3	General Education in the Classics/Humanities/Arts etc.	3.40	4	3.79	4	4.60	1	4.13	2	3.33	6	3.70	1	3.35	4	**3.78**
4	Experience in developing a business plan and organizing a business	4.00	1	3.89	3	4.07	4	3.50	5	3.67	3	3.30	4	3.60	2	**3.74**
5	Local industry internships experiences	3.30	5	3.26	5	3.93	5	3.63	3	3.56	4	2.70	5	2.95	5	**3.33**
6	Extra Curricular activities in university including leadership positions in student clubs and functions	2.50	6	3.21	6	2.33	7	2.75	6	3.56	5	2.70	6	2.25	7	**2.74**
7	Work as student teaching assistant or part time in university.	2.40	7	2.79	7	2.33	6	2.13	7	2.44	7	2.00	7	2.30	6	**2.37**

International Food and Agribusiness Management Review
Volume 13, Issue 3, 2010

Product Life Cycles and Innovation in the US Seed Corn Industry

Alexandre Magnier[a], Nicholas Kalaitzandonakes[Ⓓb], and Douglas J. Miller[c]

[a]*Doctoral Fellow, Department of Agricultural and Applied Economics, University of Missouri, 131 A Mumford Hall, Columbia, Missouri, 65211, U.S.A.*

[b]*MSMC Endowed Professor, Department of Agricultural and Applied Economics, University of Missouri, 125 A Mumford Hall, Columbia, Missouri, 65211, U.S.A.*

[c]*Associate Professor, Department of Economics, University of Missouri, 320 Professional Bldg., Columbia, Missouri, 65211, U.S.A.*

Abstract

The purpose of this study is to evaluate potential changes in the length of product life cycles in the US seed corn industry. We use the observed survival time on the market for hybrids sold during 1997-2009 to conduct a survival analysis. Our empirical results show that the expected lifetimes for corn hybrids with single biotech traits are 5-15% longer than for hybrids with multiple (stacked) traits, and the expected lifetimes for conventional corn are 13-17% longer than stacked hybrids. Also, the product life cycles for all types of hybrids have decreased over the past twelve years (especially after 2004), but the rate of decline is roughly similar across hybrid types. Based on this evidence, we conclude that the shorter product life cycles are closely linked to the accelerated levels of biotech product innovation in the US seed corn industry over the period of analysis.

Keywords: accelerated failure time, biotechnology, product life cycle, survival analysis

Ⓓ Corresponding author: Tel: + 1 573.882.0143
Email: KalaitzandonakesN@missouri.edu

Other contact information: A. Magnier: amwk4@mizzou.edu
D. Miller: MillerDou@missouri.edu

Introduction

With the advent of agricultural biotechnologies, molecular genetics and recombinant DNA techniques have become essential components of US seed development programs and have accelerated the transfer of desirable traits into commercial seed germplasm. Along the way, the US seed corn industry has become more similar to other high-technology industries, which are characterized by large research and development (R&D) budgets, rapid innovation, and continuous product improvement (Malecki 1981).

Observers in technologically dynamic industries have regularly suggested that shrinking product life cycles go hand in hand with rapid product innovation. For example, Bayus (1994) argued that fast shifting consumer preferences and rapid change in technology compress the life cycle of products.[1] Yet, as we discuss in the next section, academic researchers have found limited empirical evidence to support such claims. In the US seed corn industry, Dooley and Kurtz (2001) recently proposed that the product life cycles (PLCs) have significantly declined and attributed these changes to the introduction of biotechnology, the commercialization of specialty corn varieties (e.g., waxy, white) and the use of various seed treatments. It is worth noting that empirical evidence of shrinking PLCs in the US seed corn market has not been provided by Dooley and Kurtz or by other previous studies. If true, however, this development would complicate the operations of seed companies and could have significant cost implications that extend well beyond the US seed corn industry.

Historically, the window during which seed companies are able to recover the fixed costs of breeding and biotech R&D has been fairly short for corn hybrids. The research investment and varietal release stages (when fixed costs are largely incurred) typically last about eight years, while the adoption stage tends to last less than ten years (Morris et al. 2003). Shorter PLCs would make the task of recovering past R&D expenditures (or funding future ones) more challenging. Shrinking hybrid PLCs would also complicate supply chain management and inventory control with parallel cost increases (Dooley and Kurtz 2001). If the per-unit R&D expenses and the marketing, distribution, inventory, or obsolescence costs increased in the seed industry, farmers could face higher seed corn prices.

The purpose of this study is to address two key questions related to the duration of PLCs in the US seed corn industry. First, have PLCs in this industry been, in fact, growing shorter over time? Second, if the PLCs in the US seed corn industry have been growing shorter, what factors have been driving the change? We are specifically interested in the role of biotechnology innovation and in this context we analyze the life cycles of conventional and biotech hybrids over the 1997-2009 period, which includes the year when biotech corn hybrids where first introduced in the market.

The paper is organized into six sections following this introduction. The next section reviews the existing literature on PLCs emphasizing studies of high-technology industries where the rate of innovation, product introduction, and product removal may be similar to the US seed corn industry. The next section discusses the underlying data used for the analysis. The following two sections include the modeling approach and the empirical analysis of PLCs in the US seed corn industry. Then, the next-to-last section examines the link between the evolution of PLCs and the

[1] Although the theoretical literature on this topic is relatively sparse, a prominent contribution that links innovation to the product life cycle is provided by Klepper (1996).

flow of biotechnology product innovations in the US seed corn market. The final section presents conclusions and implications.

Review of the Product Life Cycle Literature

The study of PLCs has a long history in the economics and marketing literatures on consumer demand and product innovation, adoption and diffusion. The basic ideas underlying the PLC were originally derived from the biological life cycle and were adapted to describe the observed pattern of product sales between the introduction and removal of a product from the market as described in the original contribution of Rogers (1962). Although researchers have used different characterizations for the components of the PLC, most view the life cycle as having four distinct stages: introduction, growth, maturity, and decline. Early adopters buy the product in relatively low volume during the introduction stage, but sales increase rapidly during the growth stage as the early adopters become repeated buyers and information about the product diffuses in the marketplace. As new products become available to buyers and enter their own introduction phase, the mature product experiences a slow decline in sales. When the new products enter their growth phase, sales for the existing product decline at a more rapid rate and the product enters the decline phase. At some point, the diminished sales cannot support the costs of production (i.e., there are fixed costs or economies of scale), and the product is completely removed from the market. The adoption and diffusion of various product innovations have been thoroughly investigated in the economic literature, and Mahajan, Muller, and Bass (1990) provide a review.

Despite the extensive discussion of such product dynamics in the literature, there are only a few reliable empirical studies on the length of PLCs and a review of the early studies highlights some of the inherent empirical difficulties. Early studies based on the work of Young (1964) showed evidence of shortening PLC length in different industrial goods, but these findings are not reliable because the data were not based on actual sales but on production data.[2] Qualls, Olshavsky, and Michaels (1981) conducted a test of the hypothesis that the PLCs in consumer goods were getting shorter based on actual sales data. However, the authors recognized that some of the products under study were still on the market and this could bias their measurements of changes in the PLC length. To avoid this potential bias they restricted their analysis to the length of the introduction and growth stages of the PLC because all products in the study had completed these stages. They found that these PLC stages had grown shorter, but they also found considerable variations across individual products. Despite its data limitations, the results of this study have been widely cited as support for the claim that PLCs are getting shorter over time (Bayus 1994).

Bayus (1998) analyzed the PLCs of desktop personal computer introductions and withdrawals between 1974 and 1992, and the data set included 2,800 models from 600 manufacturers. Bayus used the full lifetime for each observation and conducted an accelerated failure time (AFT) analysis that accounted for the presence of censored data. The author found evidence that the time to peak sales for these products had not been shrinking over time, but the length of the complete PLC had been declining. Further, his analysis showed that the outcome was not due to an acceleration of the introduction of product technologies. Rather, the apparent shortening of

[2] See discussion in Qualls, Olshavsky, and Michaels (1981).

life cycles was driven by firms which entered the industry late and introduced models based on relatively old technologies. As a result, the PLCs for those late entrants were shorter than the lifetimes of incumbent models. Based on these results, Bayus (1998) concluded that the PLC in the computer industry was not systematically growing shorter.

Other studies have also looked beyond innovation to other factors that could influence the duration of PLCs. Greenstein and Wade (1998) investigated the PLCs in the computer mainframe industry for models introduced between 1968 and 1982. As in Bayus (1998), Greenstein and Wade tested the hypothesis that PLCs were getting shorter over time, and examined the conditioning impacts of market structure, product vintage, and firm effects. The authors discovered weak evidence regarding the impacts of industry and firm effects and they actually found some evidence that the PLCs had grown longer in their sample period.

Khessina and Carroll (2008) examined the length of PLCs in the optical disk industry over the period 1983-1999 and considered the conditioning effect of the type of firm offering new products in the market. The authors proposed that incumbent firms could have a competitive advantage relative to new startup firms and found that startups in this industry had higher withdrawal rates and shorter PLCs than firms with previous market experience.

In the case of the seed industry, there is only one study that has explored the duration of PLCs and relevant implications. Dooley and Kurtz (2001) did not measure the length of PLCs in the US seed corn market. Instead, they used anecdotal information from industry participants and proposed that between the mid-1990s and the early 2000s the average PLC in the US seed corn industry declined from 8 to 5 years. Taking these PLCs as given, Dooley and Kurtz focused their analysis on the potential cost implications of this decline. Using stochastic simulation they determined that shorter PLCs would more than double the inventory costs – a hefty increase since inventory costs can account for up to 40% of operating costs in the US seed corn industry (Akridge and Hychka 1998).

Product Life Cycles in the US Seed Corn Industry: Underlying Data

One possible explanation for the complete scarcity of empirical evidence on the length of PLCs in the US seed corn industry is the demanding data requirements for such an assessment. Sales for all of the products offered in the market are required, typically, over a long period of time. In the case of the US seed corn industry this amounts to tracking thousands of hybrids sold every year, many of which have limited sales covering a few thousand acres.

Our study is enabled by a unique data set that has been collected by a commercial market research company – GFK Kynetec (previously Doane Marketing Research) through annual surveys of over 5,000 US corn farmers between 1997 and 2009. The data are not longitudinal or panel observations, but the sample of farmers is stratified every year in order to obtain a better representation of producers planting more than 200 acres of corn. The individual survey observations are also sample weighted to represent market-level quantities, and the complete data set is composed of more than 260,000 farmer responses about annual seed corn purchases during the sample period. For purposes of this study, we aggregate the individual observations to form hybrid-specific observations for each year. For each hybrid, the data set includes the name of the seed company marketing the hybrid, the maturity zones in which the hybrid is

marketed,[3] the type of seed technology/trait (e.g., conventional, insect resistant, or herbicide tolerant hybrid), and the annual sales of the hybrid over its lifetime.

The large, stratified sample is selected every year to be representative of the US corn industry, and the data set provides a nearly complete list of the hybrids sold in the market in any given year. The data set, however, is not without limitations. Some of the reported observations are incomplete and could not be used in our analysis. Specifically, all observations in which the hybrid name was not specified (e.g., the hybrid was characterized as "unknown" or "unspecified") or the sales information was incomplete were excluded from the final dataset used for our analysis. Due to these necessary adjustments in the data set, our analysis of PLCs covers the large majority of the hybrids marketed in the US over the 1997-2009 period, but not the whole population. In total, out of the 260,000 available responses by farmers, about 15% were removed.

The data set also included a number of hybrids that appeared in the market for only one year. After consulting with individual seed companies we confirmed that in some instances the hybrids were actually sold for just one year. However, in most cases these hybrids had been sold for more than one year but were only captured once by the survey because they were sold in relatively small quantities. In the final data set used in the analysis, these one-year hybrids were excluded in order to avoid a downward bias in the estimated length of the average PLC in the US seed corn industry. After these modifications, the final data set included 7,941 hybrids, and the total number of hybrids sold in a given years varies from 693 in 1998 to 4,038 in 2007.

With the modified data set in hand, we can examine the evolution of PLCs in the US seed corn industry over the sample period. An immediate observation that emerges from the data is that there is significant variation in the observed product cycles of individual hybrids. For many hybrids the transition from introduction to growth, maturity and decline is gradual while for others it is abrupt or non-uniform. Figure 1 plots the number of acres sold for three different hybrids that were first sold in 1999 and illustrates typical PLCs for specific hybrids introduced in the US market. Like those cases in Figure 1, most hybrids reach their maximum sales within two or three years from their introduction and then sales volume decreases slowly afterwards. Large acreage hybrids are typically sold and planted in multiple maturity zones and tend to have longer PLCs (up to 10 or more years in some cases) while smaller acreage hybrids tend to have more limited geographic scope and shorter PLCs.

[3] Maturity zones define the regional adaptation of hybrids to local weather and growing conditions. Corn hybrids require a specific accumulation of temperature to reach maturity. The required accumulation of temperature is usually expressed in terms growing degree days (GDDs). This rating is calculated using the maximum and minimum temperature of every day of the growing season so maturity zones usually spread across latitudes. Farmers would prefer to plant late corn hybrids because they usually produce higher yields, but late hybrids may not reach maturity until late in the season in cooler regions. Delaying harvest after grains reach physiological maturity exposes the corn to unnecessary risks (e.g., exposure to frost). For these reasons, growing zone considerations are important in determining the market fit of any hybrid.

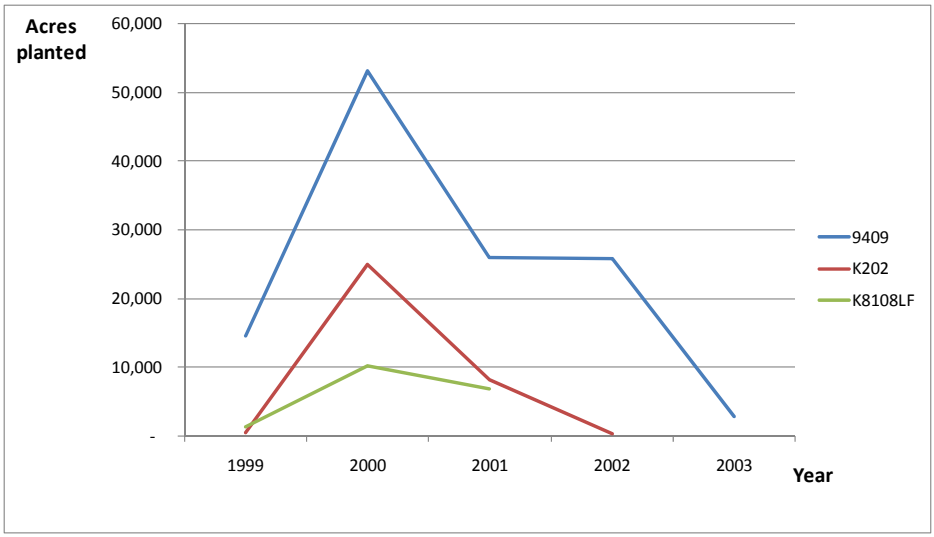


Figure 1. Typical product life cycles in the US seed corn industry.

In order to estimate the length of PLCs of the various hybrids marketed in the US corn industry, we use survival or time failure analysis that allows for right censoring of observations. To get a better measure of PLC length, we consider hybrids that have completed their cycles, like the ones in Figure 1, and others that are still actively marketed. The hybrids that have not completed their PLCs are right censored and if censoring is not taken into consideration, their life cycle would appear artificially shorter. The magnitude of this bias would be larger for more recent hybrids. For instance, the observed maximum PLC length of all hybrids introduced in 2008 would be two years while in reality a large share of the hybrids could ultimately remain on the market long after the last year in our sample period (2009).

It is important to note that all hybrids that were on the market during the first year of our sample (1997) could not be used for the calculation of PLCs because hybrids introduced in 1997 could not be distinguished from those introduced in prior years. Similarly, hybrids that were introduced in 2009 could not be used in the analysis since no survival information is yet available for this cohort. Of the 7,941 hybrids in the final data set, nearly 21% (1,509) of these observations are right censored.

In addition to measuring the duration of PLCs, we can also use the survival analysis to examine the impact of factors assumed to influence the dynamics of PLCs in the US seed corn industry. One such factor of interest to this study is biotech product innovation. The period of our analysis spans the commercial life of corn biotechnology in its entirety. The first biotech corn hybrid that conferred resistance to European Corn Borer (ECB) was introduced in 1996. Since that time the industry has been the epicenter of biotech product innovation and has introduced a large number of biotech traits, more than in any other crop or national seed market in the world (James 2009). From our data it is easy to see the transformation of the US seed corn market that has occurred through biotech innovation between 1997 and 2009. Figure 2 depicts the market share of the technology types marketed over the sample period. Here, CONV identifies conventional hybrids that do not contain any biotechnology traits, HT represents herbicide tolerant hybrids, IR identifies insect resistant hybrids and STACKED represents hybrids that include two or more of the biotechnology traits.

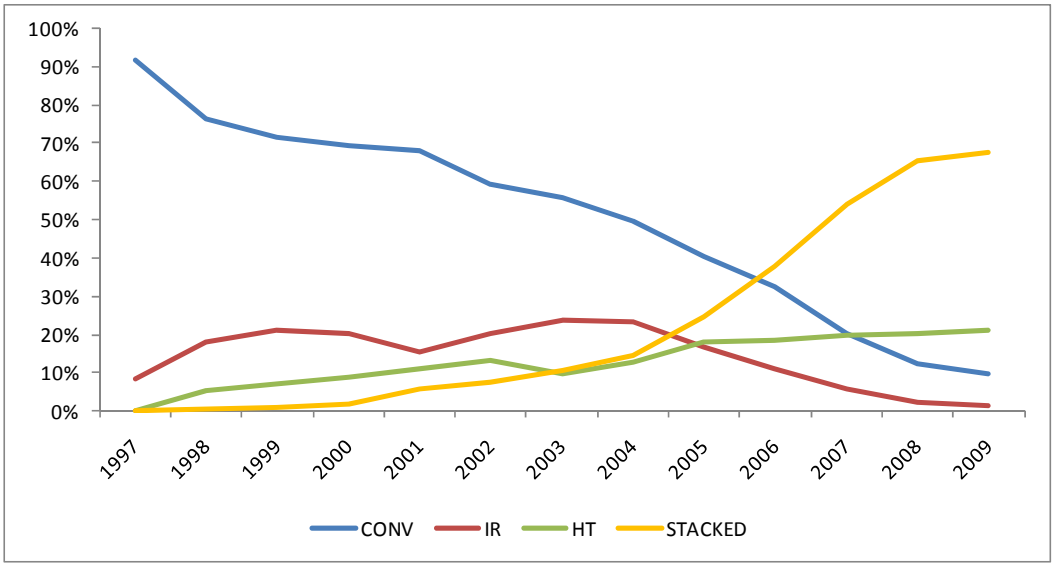


Figure 2. Market share of seed corn hybrids by type and year.

Following the introduction of biotech hybrids in 1996, the share of conventional seed corn hybrids has been gradually declining, perhaps due to the superior performance of biotech hybrids in terms of yield potential and cost savings that they permit (National Research Council 2010). Our data indicate that while the market share of conventional hybrids stood at 95% in 1997, the share decreased to 10% in 2009. Insect resistant hybrids were the only biotech hybrids on the market in 1997 and had a market share of about 5% at that time. The market share of the IR hybrids increased steadily until 2005 and then declined in the following years. Note that this decline in the insect resistant market share does not mean that this trait began to disappear from the market after 2005. Rather, the insect resistance trait has been incorporated in corn hybrids with multiple-trait combinations (stacks), and nearly 53% of all stacked corn hybrids contained at least one insect resistance trait in 2009. The market share of herbicide tolerant hybrids also increased until 2005 but it has remained relatively stable since and stood at 21% in 2009. At the same time more than 75% of all stacked hybrids contained one or more herbicide tolerance traits in 2009. Given these differential rates of biotech product innovation in the US corn seed industry, we are interested to test whether conventional, herbicide tolerant, insect resistant and stacked corn hybrids experienced different PLC dynamics over the sample period.

Econometric Models and Estimation Methods

We can use survival or failure-time analysis to model the factors that influence the observed length of time seed corn hybrids remain on the market and estimate the length of PLCs. Let T represent the stochastic survival or failure time for a hybrid on the market, and the hazard function is

$$(1) \qquad \lambda\,(t;\mathbf{x}) = \lim_{h \downarrow 0} \{[\text{Prob}\,(t \le T < t + h \mid T \ge t, \mathbf{x})] / h\},$$

which measures the marginal change in the probability that the duration ends in the near future (h time units later) conditional on the hybrid lasting to time t and on explanatory variables **x**. Under

the accelerated failure time (AFT) model, $T = \exp(\mathbf{x\beta})T_0$ where T_0 is the baseline survival time for a hybrid from the reference group with $\mathbf{x} = \mathbf{0}$. Accordingly, we have

$$(2) \qquad \ln(T) = \mathbf{x\beta} + \varepsilon,$$

where $\varepsilon \equiv \ln(T_0)$ is viewed as an error term. Under the assumption that $\varepsilon \sim N(0,\sigma^2)$, then T is a log-normal random variable, and the log-hazard function for the model is

$$(3) \qquad \ln(\lambda(t;\mathbf{x})) = \ln(\lambda_0(t\exp(-\mathbf{x\beta}))) - \mathbf{x\beta},$$

where λ_0 is the baseline hazard function. Alternatively, we may adopt other distributional assumptions for the model. For example, the Weibull distribution is a popular alternative to the log-normal specification, and it reduces to the proportional hazard model (Cox and Oakes 1984) under restrictions on the scale parameter.

In contrast to the proportional hazard model, the AFT model is based on a direct link between the observed log-survival times and the explanatory variables (Swindell 2009). From Equation 2, the slope parameters in λ may be interpreted as semi-elasticities such that $100\lambda_j$ represents the approximate percentage change in the expected survival time given a unit increase in $\mathbf{x}_j$. The explanatory variables used in this analysis are defined in Table 1 and include trait-specific dummy variables (CONV, IR, HT, STACKED). In the model, we control for the average planted acreage across the lifetime of the hybrid (AVGSIZE). The life cycle of large acreage hybrids is expected to be longer than for those planted on smaller acreage because hybrids that perform well on the market and with large market shares are likely to create a larger flow of revenue over time.

Table 1. Definition of explanatory variables

Explanatory variables	Description
AvgSize	Average quantity sold of each hybrid over its entire life time
Medium	Dummy variable that equals one if the firm is medium sized and is ranked among firms 6-55 by market share
Large	Dummy variable that equals one if the firm is large and is ranked among the top 5 firms by market share
INTRO1999 to INTRO2007	Year dummy variables that equal one for years 1999 to 2007. The reference year is 1998.
ZONE2 to ZONE11	Regional dummy variables that equal one for the crop reporting zone in which most of the hybrid sales are located.
CONV*Year dummies	Interaction term between the type of trait and the year dummies

We also use dummy variables to account for the size of the seed firm marketing the hybrid (LARGE and MEDIUM). Smaller firms license many of their hybrids from foundation seed firms and market them to smaller markets. As a result, less successful hybrids can often be replaced quickly. Therefore the life time of hybrids marketed by smaller firms is expected, on average, to be shorter. The dummy variable LARGE takes a value of 1 for companies with market share greater than 5%, and these firms are typically multinational companies that cover the entire U.S market. The dummy variable MEDIUM takes a value of 1 for firms whose average

market share is greater than 0.5%, and these firms typically operate at a regional level. The rest of the smaller firms are the base category. Finally, we include dummy variables to indicate the largest maturity zone (region) in which each hybrid is sold (ZONE2 to ZONE11) to control for different PLC lengths across locations.

Given that the hybrids were introduced in different years, we follow Wooldridge (2002) and Allison (2001) and include year-specific dummy variables to represent changes in the survival time associated with the year of introduction (INTRO1999 to INTRO2007). Accordingly, we can follow the approach taken by Bayus (1998) and use the estimated year-specific dummy coefficients to test for significant changes in the expected survival times across the different types of corn hybrids (CONV, IR, HT, STACKED) and over time.

Estimation Results

We first considered a pooled or restricted form of the AFT model for which the model parameters are the same across hybrid technology types. The maximum likelihood (ML) estimates of the model parameters were computed with the SAS LIFEREG procedure, which allows for right censoring of the survival data. For the pooled AFT model, we considered alternatives for the probability model before choosing a final specification. Although the generalized gamma model is very flexible and has a non-monotonic hazard function, the model has a large number of parameters and the computational algorithm for the ML estimator is subject to convergence problems (Allison 2001). To choose the best fitting probability model from the remaining probability model alternatives, we analyzed the Cox-Snell residual plots (see Collett 2003, and Allison 2001), which compare the model residuals to the fitted survival function. The diagnostic plot should follow a straight line if the estimated probability model provides good fit to the data, and we found that the log-normal model exhibited the best visual fit. Due to the limitation of model selection based on visual inspections, we also conducted likelihood-ratio (LR) tests for model specification under the alternative probability distributions, and the LR test results confirmed that the log-normal model has the best fit. The test results matched our prior expectations because the log-normal model has a shape that is more similar to the properties suggested by the data (e.g., see Figure 2). In particular, the lognormal specification allows the hazard rate for the hybrids (i.e., the probability that a hybrid is removed from the market at a given year) to increase initially to a maximum and then to slowly decrease. This would imply the total life time for a hybrid is characterized by an initial adoption phase, and those hybrids whose market performances do not appear promising are removed from the market at some point in time.

Then, we extended the AFT model to allow for technology-specific variation in the survival time of hybrids by including interaction terms between the technology dummy variables (CONV, IR, HT, and STACKED) and the year-specific dummy variables (INTRO1999 to INTRO2007). Due to potentially harmful collinearity among these interaction variables, we estimated a separate version of the AFT model for each technology type, and the ML estimation results are presented in Tables 2-5.

We find that the estimated AVGSIZE coefficient is significantly positive in all four cases, and the estimates have very similar values. Given a unit (thousand acres) increase in AVGSIZE, we expect the survival time for all corn hybrids to increase by roughly 0.6%. Hybrids with broader market reach would tend to have long lifecycles. For instance, the average hybrid in our sample

is planted on approximately 20,000 acres per year and a hybrid with twice that acreage would be expected to have a PLC that is roughly 12% longer than the average.

The estimated coefficients for LARGE and MEDIUM sized firms are also similar across the four models, and all estimates are significantly positive. Based on these values, we find that the expected survival time for all corn hybrids marketed by medium size firms is roughly 9% longer than those of smaller firms (which serve as baseline). Similarly, the expected survival time for all hybrids marketed by the top five firms is roughly 18% longer than that of hybrids marketed by small firms. These results indicate that firms use different management strategies for their hybrids according to the size of their overall market share.

There are also some differences in the average PLCs of hybrids marketed in different geographies. LR tests imply that that the maturity zone (region) variables are jointly significant in each model, but only the coefficient estimates for ZONE3 to ZONE8 are individually significant. Also, the magnitudes of these estimates imply that the expected survival times are roughly 7.1% to 12.6% shorter in these regions (relative to the base region, Zone 1). As these zones cover key parts of the Corn Belt, it appears that seed firms develop new products at a higher rate for these key segments of the seed corn market.

Regarding the coefficients of primary interest in our survival study, the dummy variable parameters for the non-stacked technologies (CONV, IR, and HT) represent the overall differences in the survival times for the technology groups. We find that the estimated parameters are positive, which implies that the overall expected lengths of these PLCs are longer than the base group (stacked hybrids). Although there is some variation in these values across the four models, the results show that conventional corn hybrids are expected to have PLCs that are roughly 13-17% longer than for stacked hybrids. For the IR hybrids, the expected survival time is roughly 5-11% longer than for stacked hybrids, and the PLC length is expected to be about 6-15% longer for HT hybrids relative to stacked hybrids.

The dynamics in the PLC relationships are represented by the time-specific dummy variables, and almost all of the annual dummy coefficients are negative, which indicates that the expected lifetimes for all corn hybrids have generally decreased since 1998. Further, the four estimates that are statistically significant across all four models are the dummy coefficients for 2000 and 2005-2007. The decrease in average PLCs is relatively modest for 2000, and the estimated parameters imply that the expected survival times for hybrids introduced in 2000 are roughly 6.85% to 9.22% shorter than the survival times for hybrids introduced in 1998. In contrast, the reduction in hybrid lifetime accelerated after 2004. Indeed, the annual decrease in the expected survival times for hybrids introduced in 2005-2007 ranged from 15.7% to 25.6% relative to seed corn hybrids introduced in 1998, and the estimated decline in the expected hybrid lifetime was largest for 2006. Given that these annual dummy coefficients are not technology-specific and exhibit similar patterns across the four equations, they imply that this part of the decline in PLC length is a market-wide pattern.

The estimated dummy interaction coefficients allow us to evaluate the technology-specific changes in the PLC. For the CONV model in Table 2, the estimates become negative for 2003-2007, but only the estimate for 2007 is marginally significant.

Table 2. ML estimates of the AFT model for conventional hybrids.

Parameter	DF	Estimate	Std error	Chi-square	Pr > ChiSq
Intercept	1	1.1929	0.0598	397.48	<.0001
Avgsize	1	0.0057	0.0003	456.93	<.0001
Medium	1	0.086	0.0159	29.09	<.0001
Large	1	0.18	0.0192	87.74	<.0001
CONV	1	0.1771	0.0485	13.35	0.0003
HT	1	0.1261	0.0179	49.45	<.0001
IR	1	0.0876	0.0203	18.54	<.0001
Intro1999	1	-0.1034	0.0517	4	0.0456
Intro2000	1	-0.0898	0.051	3.1	0.0781
Intro2001	1	-0.0766	0.0487	2.47	0.1157
Intro2002	1	-0.0809	0.0497	2.65	0.1036
Intro2003	1	0.0005	0.0479	0	0.9909
Intro2004	1	-0.0421	0.0471	0.8	0.3713
Intro2005	1	-0.1631	0.045	13.15	0.0003
Intro2006	1	-0.2122	0.0458	21.5	<.0001
Intro2007	1	-0.1695	0.0459	13.62	0.0002
CONV*Intro1999	1	0.0979	0.059	2.75	0.0973
CONV*Intro2000	1	0.0182	0.0601	0.09	0.7627
CONV*Intro2001	1	0.071	0.0556	1.63	0.2019
CONV*Intro2002	1	0.0717	0.0575	1.56	0.2119
CONV*Intro2003	1	-0.0594	0.0596	0.99	0.3191
CONV*Intro2004	1	-0.0852	0.0612	1.94	0.1637
CONV*Intro2005	1	-0.0401	0.0571	0.49	0.4818
CONV*Intro2006	1	-0.0809	0.0603	1.8	0.1798
CONV*Intro2007	1	-0.1084	0.065	2.78	0.0955
Zone2	1	-0.0226	0.0426	0.28	0.5969
Zone3	1	-0.085	0.0402	4.48	0.0343
Zone4	1	-0.1049	0.0389	7.29	0.007
Zone5	1	-0.12	0.0386	9.65	0.0019
Zone6	1	-0.0764	0.0376	4.13	0.042
Zone7	1	-0.1101	0.0381	8.35	0.0039
Zone8	1	-0.0859	0.0389	4.88	0.0272
Zone9	1	-0.0627	0.0404	2.41	0.1208
Zone10	1	-0.0135	0.0545	0.06	0.8042
Zone11	1	-0.0245	0.0466	0.28	0.5989
Scale	1	0.456	0.0042		
Log likelihood		-5283.1936			

Thus, the decline in the survival times for conventional corn hybrids was not significantly faster than that of other hybrids. For the IR model in Table 3, the estimates become uniformly negative for 2005-2007, and the significance pattern is similar to the CONV case.

Table 3. ML estimates of the AFT model for insect-resistant hybrids.

Parameter	DF	Estimate	Std error	Chi-square	Pr > ChiSq
Intercept	1	1.2092	0.046	691.54	<.0001
Avgsize	1	0.0057	0.0003	448.22	<.0001
Medium	1	0.085	0.016	28.33	<.0001
Large	1	0.1727	0.0192	80.98	<.0001
CONV	1	0.1673	0.0175	91.21	<.0001
HT	1	0.1127	0.0175	41.43	<.0001
IR	1	0.1139	0.0775	2.16	0.1414
Intro1999	1	-0.0294	0.0261	1.27	0.2596
Intro2000	1	-0.0922	0.0281	10.73	0.0011
Intro2001	1	-0.0343	0.0243	1.99	0.1584
Intro2002	1	-0.0363	0.0258	1.97	0.1601
Intro2003	1	-0.04	0.0283	2	0.1575
Intro2004	1	-0.0714	0.0286	6.25	0.0124
Intro2005	1	-0.157	0.0256	37.67	<.0001
Intro2006	1	-0.2254	0.0264	73.04	<.0001
Intro2007	1	-0.1797	0.0268	45	<.0001
IR*Intro1999	1	-0.0615	0.0899	0.47	0.4938
IR*Intro2000	1	0.0463	0.091	0.26	0.6107
IR*Intro2001	1	0.0134	0.0904	0.02	0.8818
IR*Intro2002	1	-0.0309	0.0922	0.11	0.7372
IR*Intro2003	1	0.0402	0.0883	0.21	0.6489
IR*Intro2004	1	-0.0201	0.0888	0.05	0.8209
IR*Intro2005	1	-0.1324	0.0855	2.4	0.1217
IR*Intro2006	1	-0.0891	0.091	0.96	0.3274
IR*Intro2007	1	-0.2137	0.1066	4.02	0.0451
Zone2	1	-0.0302	0.0426	0.5	0.4788
Zone3	1	-0.0901	0.0402	5.04	0.0248
Zone4	1	-0.1094	0.0389	7.92	0.0049
Zone5	1	-0.1265	0.0386	10.74	0.001
Zone6	1	-0.0821	0.0375	4.79	0.0286
Zone7	1	-0.1139	0.0381	8.95	0.0028
Zone8	1	-0.0894	0.0389	5.28	0.0215
Zone9	1	-0.0655	0.0404	2.62	0.1052
Zone10	1	-0.0252	0.0545	0.21	0.6437
Zone11	1	-0.0214	0.0467	0.21	0.647
Scale	1	0.4565	0.0042		
Log likelihood		-5289.3028			

However, the magnitudes of the estimates for 2005-2007 provide some evidence that the lifetimes for insect resistant hybrids decreased at a faster rate than other types of corn hybrids. The associated estimates for 2004-2007 in the HT model (Table 4) are positive but only

marginally statistically significant, which implies that the herbicide tolerant hybrids may have had expected survival times that are longer than other corn hybrids.

Table 4. ML estimates of the AFT model for herbicide-tolerant hybrids

Parameter	DF	Estimate	Std error	Chi-square	Pr > ChiSq
Intercept	1	1.2391	0.0463	716.07	<.0001
Avgsize	1	0.0056	0.0003	445.87	<.0001
Medium	1	0.0859	0.0159	29.02	<.0001
Large	1	0.1749	0.0192	83.25	<.0001
CONV	1	0.1299	0.018	51.98	<.0001
HT	1	0.0626	0.0563	1.24	0.2656
IR	1	0.0481	0.0201	5.71	0.0169
Intro1999	1	-0.0255	0.0264	0.93	0.3338
Intro2000	1	-0.0685	0.0287	5.72	0.0168
Intro2001	1	-0.0165	0.0251	0.43	0.5114
Intro2002	1	-0.0301	0.0269	1.25	0.2632
Intro2003	1	-0.0297	0.0286	1.08	0.2987
Intro2004	1	-0.106	0.0294	13.04	0.0003
Intro2005	1	-0.2254	0.0268	70.88	<.0001
Intro2006	1	-0.2556	0.0279	84.21	<.0001
Intro2007	1	-0.2376	0.0289	67.51	<.0001
HT*Intro1999	1	-0.0884	0.0751	1.39	0.2391
HT*Intro2000	1	-0.0598	0.0731	0.67	0.4128
HT*Intro2001	1	-0.1052	0.0682	2.38	0.1231
HT*Intro2002	1	-0.0381	0.0683	0.31	0.5766
HT*Intro2003	1	-0.0076	0.072	0.01	0.9157
HT*Intro2004	1	0.1154	0.07	2.72	0.0992
HT*Intro2005	1	0.1486	0.064	5.39	0.0202
HT*Intro2006	1	0.0244	0.0664	0.13	0.7133
HT*Intro2007	1	0.1237	0.0672	3.39	0.0654
Zone2	1	-0.0212	0.0427	0.25	0.6193
Zone3	1	-0.0835	0.0402	4.31	0.0378
Zone4	1	-0.1	0.0389	6.61	0.0101
Zone5	1	-0.1157	0.0387	8.95	0.0028
Zone6	1	-0.0718	0.0376	3.65	0.0562
Zone7	1	-0.1036	0.0381	7.38	0.0066
Zone8	1	-0.0795	0.039	4.16	0.0413
Zone9	1	-0.0545	0.0405	1.81	0.1785
Zone10	1	-0.0085	0.0546	0.02	0.8769
Zone11	1	-0.0192	0.0467	0.17	0.6809
Scale	1	0.4559	0.0041		
Log likelihood		-5278.2302			

However, the magnitudes of these dummy-interaction coefficients are relatively small, so there is a modest practical difference in the expected survival times of the HT hybrids. For the STACKED hybrid model (Table 5) the estimates are positive but statistically insignificant and hence no differences in the PLCs of stacked hybrids relative to all others were detected.

Table 5. ML estimates of the AFT model for multiple-trait (stacked) hybrids.

Parameter	DF	Estimate	Std error	Chi-square	Pr > ChiSq
Intercept	1	1.1779	0.1909	38.07	<.0001
Avgsize	1	0.0057	0.0003	455.72	<.0001
Medium	1	0.0848	0.0160	28.20	<.0001
Large	1	0.1763	0.0192	84.42	<.0001
CONV	1	0.1969	0.1873	1.11	0.2931
HT	1	0.1515	0.1876	0.65	0.4193
IR	1	0.1074	0.1878	0.33	0.5675
Intro1999	1	-0.0301	0.0249	1.46	0.2261
Intro2000	1	-0.0754	0.0266	8.04	0.0046
Intro2001	1	-0.0266	0.0237	1.26	0.2626
Intro2002	1	-0.0297	0.0250	1.41	0.2343
Intro2003	1	-0.0324	0.0275	1.40	0.2375
Intro2004	1	-0.0704	0.0284	6.12	0.0133
Intro2005	1	-0.1759	0.0257	46.76	<.0001
Intro2006	1	-0.2726	0.0283	92.80	<.0001
Intro2007	1	-0.2091	0.0312	44.95	<.0001
STACKED*Intro1999	1	-0.2042	0.2199	0.86	0.3531
STACKED *Intro2000	1	-0.1105	0.2168	0.26	0.6103
STACKED *Intro2001	1	-0.0321	0.1963	0.03	0.8700
STACKED *Intro2002	1	-0.1511	0.2047	0.54	0.4604
STACKED *Intro2003	1	0.0695	0.1937	0.13	0.7198
STACKED *Intro2004	1	0.0273	0.1921	0.02	0.8870
STACKED *Intro2005	1	0.0258	0.1899	0.02	0.8918
STACKED *Intro2006	1	0.1112	0.1898	0.34	0.5579
STACKED *Intro2007	1	0.0606	0.1894	0.10	0.7488
Zone2	1	-0.0286	0.0426	0.45	0.5019
Zone3	1	-0.0880	0.0401	4.80	0.0284
Zone4	1	-0.1072	0.0388	7.61	0.0058
Zone5	1	-0.1256	0.0386	10.58	0.0011
Zone6	1	-0.0810	0.0375	4.66	0.0309
Zone7	1	-0.1126	0.0381	8.74	0.0031
Zone8	1	-0.0885	0.0389	5.18	0.0228
Zone9	1	-0.0669	0.0404	2.74	0.0978
Zone10	1	-0.0219	0.0545	0.16	0.6881
Zone11	1	-0.0260	0.0467	0.31	0.5769
Scale	1	0.4564	0.0042		
Log likelihood		-5289.5025			

We may also illustrate the changes in hybrid PLCs across the trait categories by plotting their estimated expected lifetimes. The plots are presented in Figure 3 and they show that while there are variations, the expected hybrid lifetime across the different technologies is similar over the sample period. The average PLCs of conventional, IR and HT hybrids declined only slightly from 1998 to 2003. The decline was larger for stacked hybrids but by 2003 all hybrids had, more or less, the same expected lifetime.

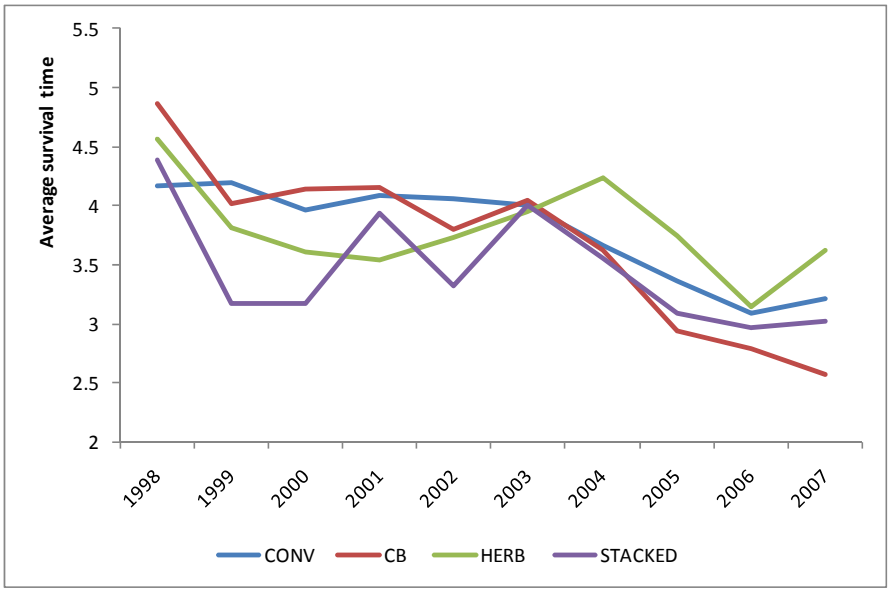


Figure 3. Estimated average survival time by hybrid type and year.

However, Figure 3 also shows that the decline in the expected life cycle started in 2004 for insect resistant, stacked and conventional hybrids and in 2005 for herbicide tolerant hybrids. Although this analysis does not permit us to identify the exact cause of such variations in the life cycle of hybrids, we examine the potential link between biotech product innovation and PLC dynamics next.

The Link between Life Cycles and Biotech Product Innovation

To understand the potential relationship between biotech innovation and PLC dynamics, we examined in more detail the temporal patterns of biotech product introduction over the sample period. Table 6 lists all of the biotechnology traits and products placed in the US seed corn market by their year of introduction. The information in Table 6 indicates that there have been two separate waves of biotech product introductions between 1997 and 2009. From 1997 to 1999, a total of nine new biotech products were introduced that provided combinations of ECB resistance and tolerance to IMI, Liberty and Roundup herbicides. However, no new biotech products and traits were introduced from 2001 until 2003 when a second wave of offerings started. From 2003 to 2007 a total of 26 new biotech products were introduced in the US seed corn market and included new traits (Rootworm resistance), competing products for traits already in the market (Agrisure CB and GT, Herculex I), second generation traits (Roundup Ready II) and various combinations.

Table 6. Timeline of biotechnology traits introduced in seed corn hybrids.

Year of introduction	Biotech Trait	Description	Trait Provider
1996	YGCB	Corn borer resistant	Monsanto
1998	IMI	Herbicide tolerant imidazoline	BASF
1998	LL	Herbicide tolerant glufosinate	Bayer
1998	RR	Herbicide tolerant glyphosate	Monsanto
1998	SR	Sethoxydim resistant	BASF
1998	YGCB-IMI	Herbicide tolerant imidazoline- Corn borer resistant	BASF/Monsanto
1998	YGCB-LL	Herbicide tolerant glufosinate - Corn borer resistant	Bayer/Monsanto
1998	YGCB-RR	Herbicide tolerant glyphosate - Corn borer resistant	Monsanto
1999	YGCB-IMI-LL	Herbicide tolerant glufosinate/imidazoline - Corn borer resistant	BASF/Bayer/Monsanto
2000	IMI-LL	Herbicide tolerant imidazoline/glufosinate	Bayer/BASF
2003	Herculex I-LL	Herbicide tolerant glufosinate - Corn borer resistant	Bayer/Dow
2003	YGRW	Rootworm resistant	Monsanto
2004	RR2	Herbicide tolerant glyphosate	Monsanto
2004	YGCB-RR2	Herbicide tolerant glyphosate - Corn borer resistant	Monsanto
2004	YGPlus	Corn borer /Rootworm resistant	Monsanto
2004	YGRW-IMI	Herbicide tolerant imidazoline - Rootworm resistant	BASF/Monsanto
2004	YGRW-RR	Herbicide tolerant glyphosate - Rootworm resistant	Monsanto
2004	YGRW-RR2	Herbicide tolerant glyphosate - Rootworm resistant	Monsanto
2005	Agrisure CB-LL-GT	Herbicide tolerant glufosinate/glyphosate - Corn borer resistant	Bayer/Syngenta
2005	Agrisure GT	Herbicide tolerant glyphosate	Syngenta
2005	Herculex I-LL-IMI	Herbicide tolerant glufosinate/imidazoline - Corn borer resistant	BASF/Bayer/Dow
2005	Herculex I-LL-RR2	Herbicide tolerant glufosinate/glyphosate - Corn borer resistant	Bayer/Dow/ Monsanto
2005	YGPlus- RR2	Herbicide tolerant glyphosate - Corn borer/Rootworm resistant	Monsanto
2006	HX RW-LL	Herbicide tolerant glufosinate - Rootworm resistant	Bayer/Dow
2006	HX RW-LL-RR2	Herbicide tolerant glufosinate/glyphosate	Bayer/Dow/Monsanto
2006	HX XTRA-LL	Herbicide tolerant glufosinate	Bayer/Dow
2006	HX XTRA-LL-RR2	Herbicide tolerant glufosinate/glyphosate	Bayer/Dow/Monsanto
2006	YGCB-GT	Herbicide tolerant glyphosate - Corn borer resistant	Syngenta /Monsanto
2007	Agrisure CB-IMI-LL	Herbicide tolerant glufosinate/imidazoline - Corn borer resistant	BASF/Bayer/Syngenta
2007	Agrisure CB-LL	Herbicide tolerant glyphosate- Corn borer resistant	Bayer/Syngenta
2007	Agrisure CB-RW-LL	Herbicide tolerant glufosinate- Corn borer / Rootworm resistant	Bayer/Syngenta
2007	Agrisure RW	Rootworm resistant	Syngenta
2007	Agrisure RW-GT	Herbicide tolerant glyphosate- Rootworm resistant	Syngenta
2007	YGPlus-IMI	Herbicide tolerant imidazoline-Corn borer / Rootworm resistant	BASF/Monsanto
2007	YGVT RW-RR2	Herbicide tolerant glyphosate- Rootworm resistant	Monsanto
2007	YGVT3	Herbicide tolerant glyphosate- Corn borer / rootworm resistant	Monsanto
2008	Agrisure 3000GT	Herbicide tolerant glufosinate / glyphosate-Corn borer / Rootworm resistant	Bayer/Syngenta
2009	YGVT3 Pro	Herbicide tolerant glyphosate -Corn borer /Rootworm resistant	Monsanto

Our results in the previous section indicate that the average PLC duration for IR, HT and STACKED hybrids declined between 1998 and 1999 and stabilized or recovered slowly in the following years until average PLC durations for all types of hybrids converged in 2003. Hence, the initial observed decline in the duration of PLCs coincides with the first wave of biotech product offerings. The duration of PLCs for all four types of hybrids declined once more between 2004 and 2007 and the decline coincides with the second wave of biotech product

innovation. Hence, there is evidence of a close link between biotech product innovation and the length of PLCs in the US seed corn industry. The timing and length of the decline in PLCs coincides with that of biotech product innovation (when new product introductions begin and end). Similarly, the rate of the decline increases with the rate of the innovation (number of new products per year placed in the market).

Faster biotech product innovation could lead to shorter hybrid PLCs through different mechanisms. First, it could accelerate improvements in new hybrid performance (e.g., yield, cost efficiency) which, in turn, could imply higher rates of obsolescence and shorter PLCs for older hybrids. This would be akin to the effects described in Dooley and Kurtz as "…technology is advancing so rapidly that new product releases are cannibalizing sales and shortening the life of other varieties in the market" (2001, 3).

Second, faster biotech product innovation could lead to higher demand uncertainty, greater product turnover and, ultimately, shorter PLCs. Demand uncertainty is a constant in the seed corn industry (Jones, Lowe, and Traub 2002) but it is much higher for newer hybrids (Dooley and Kurtz 2001). As the number of new biotech traits and technologies increase, seed companies could offer a larger number of products in order to learn faster which combinations of traits and germplasm may best fit the needs of heterogeneous corn producers under varying insect and weed pressures across time and space (Useche, Barham, and Foltz 2009). Such portfolio experimentation could lead to shorter PLCs as a larger number of unsuccessful products are culled by seed companies.

Third, an increase in the number of biotech product offerings would tend to increase the level of competition in the US seed corn industry (Alfranca and Lemarié 2003). Under increased competitive pressure, seed firms may be more inclined to remove underperforming hybrids faster thereby shortening PLCs. Based on our analysis, we cannot resolve whether it is through these or some other mechanisms that biotech product innovation has led to shorter product lifecycles in the US seed corn industry between 1997 and 2009.

Conclusions

Our analysis indicates that there were two key components to the dynamic behavior of product life cycles in the US seed corn industry over the past twelve years. First, corn hybrids with more advanced biotech features tend to have shorter product life cycles. In particular, we find that the expected lifetimes for corn hybrids with single biotech traits are 5-15% longer than for hybrids with multiple (stacked) traits, and the expected lifetimes for conventional corn are 13-17% longer than stacked hybrids. Second, the product life cycles for all types of corn hybrids have decreased over the past twelve years. The expected PLCs show a gradual decline between 1998 and 2003 and a sharper decline between 2004 and 2007, and the observed declines occur at roughly the same rate for all types of seed (conventional, single-trait, and stacked hybrids) in the US corn market. While other factors might have played a role, accelerated biotech product innovation seems to be a primary driver in the market-wide decline of PLC duration.

An important implication of our results is the potential impact that shorter PLCs could have on seed corn costs and prices. Due to the shorter PLCs, seed companies must incur additional expenses for supply chain management as the turnover of their product line increases.

Furthermore, because of the increased demand uncertainty they must carry larger safety inventories to avoid stock-outs for the successful products and larger excess inventories for the unsuccessful ones, all at significantly higher operating costs. Those costs can be significant. For example, Dooley and Kurtz (2001) estimated that a reduction of the product life cycle of hybrids from eight to five years could increases total inventory costs by 120.8%. As well, the seed firms will have less time to recover the R&D costs associated with developing new technologies. In the face of the increasing R&D expenses incurred by biotech firms in recent years (Kalaitzandonakes, Magnier, and Miller Forthcoming), shorter PLCs could further increase the effective cost pressure on seed corn firms.

These important changes could only lead to higher per-unit production costs and, ultimately, higher seed prices. Indeed, abrupt increases in seed corn prices have been observed since the mid-2000s and have been actively discussed in the farm press (e.g., Hillyer 2005). The portion of these price increases that are due to higher costs associated with shorter PLCs is not known.

The observed changes in the product lifecycles of the US seed corn industry in the last two decades suggest that understanding more fully the link between biotech product innovation and the dynamics of product life cycles in the seed industry is important. Dooley and Kurtz (2001) indicated that between the mid-1990s and 2000 product life cycles in the US seed corn industry declined from an average of eight to five years. While we cannot confirm the first figure we find that average PLC across all hybrids was a bit less than five years in 2000 and has declined significantly in recent years. It is therefore possible that PLCs in the US seed corn industry could have declined by more than half in the span of just over a decade. This would be a remarkable development for an industry that carries thousands of products in any given year and operates on multiyear R&D, planning and production cycles.

Given the observed levels of adoption of new biotech products by US corn farmers in recent years, it would appear that the value of productivity gains from biotech innovation has been sufficiently large to compensate for seed price increases. Whether such conditions continue to hold into the future remains to be seen. Regardless, we must develop a more complete understanding of the link between biotech product innovation and the dynamics of PLCs in seed production and distribution because such dynamics affect, among other things, the internal rate of return for biotech R&D, the potential pricing and adoption of biotech innovations and the cost structure (and hence industry dynamics) of the global seed industry.

References

Akridge, Jay T., and Susan R. Hychka. 1998. *Seed industry performance analysis.* West Lafayette, IN: Purdue University, ASTA and Center of Agricultural Business.

Alfranca, Oscar, and Stéphane Lemarié. 2003. Analysing competition between seed varieties: An application to hybrid corn in France. Selected paper presented at the annual meetings for the American Agricultural Economics Association, July 27-30, in Montreal, Canada.

Allison, Paul D. 2001. *Survival analysis using the SAS system: A practical guide*. Cary, NC: SAS Institute.

Bayus, Barry. 1994. Are product life cycles really getting shorter? *Journal of Product Innovation Management* 11(4): 300-308.

Bayus, Barry. 1998. An analysis of product lifetimes in a technologically dynamic industry. *Management Science* 44(6): 763-775.

Collett, David. 2003. *Modelling survival data in medical research*. Boca Raton, FL: Chapman & Hall/CRC Press.

Cox, D.R., and David Oakes. 1984. *Analysis of survival data*. Boca Raton, FL: Chapman & Hall/CRC Press.

Dooley, Frank, J., and Matthew M. Kurtz. 2001. The effect of a changing inventory mix in seed corn on inventory costs. Selected paper presented at the annual meetings of the American Agricultural Economics Association, August 5-8, in Chicago, IL.

Greenstein, Shane M., and James B. Wade. 1998. The product life cycle in the commercial mainframe computer market, 1968- 1982. *The RAND Journal of Economics* 29(4): 772-789.

James, Clive. 2009. *Global status of commercialized biotech/GM crops: 2009* (ISAAA Brief No. 41). Ithaca, NY: International Service for the Acquisition of Agri-biotech Applications.

Jones, Philip C., Timothy J. Lowe, and Rodney D. Traub. 2002. Matching supply and demand: The value of second chance in producing seed corn. *Review of Agricultural Economics* 24(1): 222-38.

Hillyer, Gregg. 2005. Seed bank. *The Progressive Farmer* Bus 1-2.

Kalaitzandonakes, Nicholas, Alexandre Magnier, and Doug Miller. Forthcoming. Concentration, market power and dynamic efficiency in the US seed industry. *Regulation*.

Khessina, Olga M., and Glenn R. Carroll. 2002. Product dynamics of de novo and de alio firms in the worldwide optical disk drive industry, 1983-1999. Paper presented at the meetings of the Academy of Management, in Denver, CO.

Klepper, Steven. 1996. Entry, exit, growth, and innovation over the product life cycle. *American Economic Review* 86: 562-583.

Mahajan, Vijay, Eitan Muller, and Frank M. Bass. 1990. New product diffusion models in marketing: A review and directions for research. *The Journal of Marketing* 54(1): 1-26.

Malecki, Edward. 1981. Product cycles, innovation cycles, and regional economic change. *Technological Forecasting and Social Change* 19(4): 291-306.

Morris, Michael, Kate Dreher, Jean-Marcel Ribaut, and Mireille Khairallah. 2003. Money matters (II): Costs of maize inbred line conversion schemes at CIMMYT using conventional and marker-assisted selection. *Molecular Breeding* 11(3): 235-247.

National Research Council. 2010. The impact of genetically engineered crops on farm sustainability in the United States. Washington DC: The National Academies Press.

Olshavsky, Richard W. 1980. Time and the rate of adoption of innovations. *The Journal of Consumer Research* 6(4): 425-428.

Qualls, William, Richard W. Olshavsky, and Ronald E. Michaels. 1981. Shortening of the PLC: An empirical test. *The Journal of Marketing* 45(4): 76-80.

Rogers, Everett. 1962. *Diffusion of innovations*. New York: Free Press.

Swindell, William R. 2009. Accelerated failure time models provide a useful statistical framework for aging research. *Experimental Gerontology* 44(3): 190-200.

Useche, Pilar, Brad L. Barham, and Jeremy D. Foltz. 2009. Integrating technology traits and producer heterogeneity: A mixed-multinomial model of genetically modified corn adoption. *American Journal of Agricultural Economics* 91(2): 444-461.

Wooldridge, Jeffrey. 2002. *Econometric analysis of cross section and panel data*. Cambridge, MA: MIT Press.

Young, Robert B. 1964. Product growth cycles—A key to growth planning. Unpublished manuscript. Menlo Park, CA: Stanford Research Institute.

International Food and Agribusiness Management Review
Volume 13, Issue 3, 2010

Measurement of Sugar Cane Chain in Brazil

Marcos Fava Neves[Φ a], Vinicius Gustavo Trombin[b] and Matheus Alberto Consoli[c]

[a] *Professor, School of Economics and Business (FEARP) University of São Paulo-Riberião Preto, Markestrat Research Coordinator (Marketing & Strategy Projects and Research Center). Av. dos Bandeirantes, 3900. FEARP. Bloco C, sl 64. São Paulo, Ribeirão Preto, 14.040-900, Brazil.*

[b] *Researcher, Markestrat (Marketing & Strategy Projects and Research Center).Rua Maestro Ignácio Stabile, 520 - Bairro Alto da Boa Vista, São Paulo, Ribeirão Preto, 14.020-640, Brazil.*

[c] *PhD, Researcher, Markestrat (Marketing & Strategy Projects and Research Center). Rua Maestro Ignácio Stabile, 520 - Bairro Alto da Boa Vista, São Paulo, Ribeirão Preto, 14.020-640, Brazil.*

Abstract

Despite the historical importance of the sugarcane business in Brazil, which is as old in the country as its colonization, it has never been "photographed in widescreen". This research on the mapping and quantification of business generated in the sugarcane chain in 2008 for the first time gives the scale of the entire sugarcane productive chain in Brazil. The sector now shows the numbers that indicate the industry's role in building the country's GDP, as well as in job creation, tax generation, and the distribution (capillary) of economic activities.

By applying the method Strategic Management of Agro-Systems (GESIS), developed by the first author, Professor Marcos Fava Neves, coordinator of the Marketing & Strategic Projects and Research Center, USP (MARKESTRAT), it was found that the sugarcane sector GDP is around $28.1 billion USD, equivalent to almost 2% of the Brazilian GDP—or almost all of the income generated in a year in a country like Uruguay. The majority of the industry's inputs are local, explaining its favorable trade balance situation.

A series of new products has become increasingly more important and a major transformation is going on in this sector that has one of the oldest and, at the same time, most modern plants with regard to clean energy on the planet.

Keywords: chain mapping, chain quantification, agro-industry system, sugar cane sector, ethanol, sugar.

[Φ]Corresponding author: Tel: + 55.16.3456.5555
Email: mfaneves@usp.br
Other contact information: V. G. Trombin: trombin@markestrat.org
M.A. Consoli: consoli@markestrat.org

Introduction

Sugar has historically been the mainstay of the Brazilian economy. It not only provides food and ingredients into the food and beverage industry, but currently, it also supports the energy sector with inputs for the bioenergy industry. Together, ethanol and sugarcane bagasse represent 15% of the Brazilian energy matrix. It also supports significant levels of employment and tax revenues throughout its supply chain.

According to The Brazilian Sugarcane Industry Association (UNICA), the largest organization representing the sugar and bioethanol sectors, Brazil is the world's leading sugarcane producer. The 2008/09 harvest year saw a record crop estimated at 569 million tonnes of sugarcane, processed at around 423 plants nationwide. Of these, 248 were combined mills and distilleries producing both sugar and ethanol, while 159 produced just ethanol. All mills are self-sufficient in producing their own electricity needs. Production grew 85% in the last ten years due to increased area and yield. As shown in Figure 1, sugarcane currently covers 8.49 million hectares in Brazil, or 2.3% of the country's total arable land.

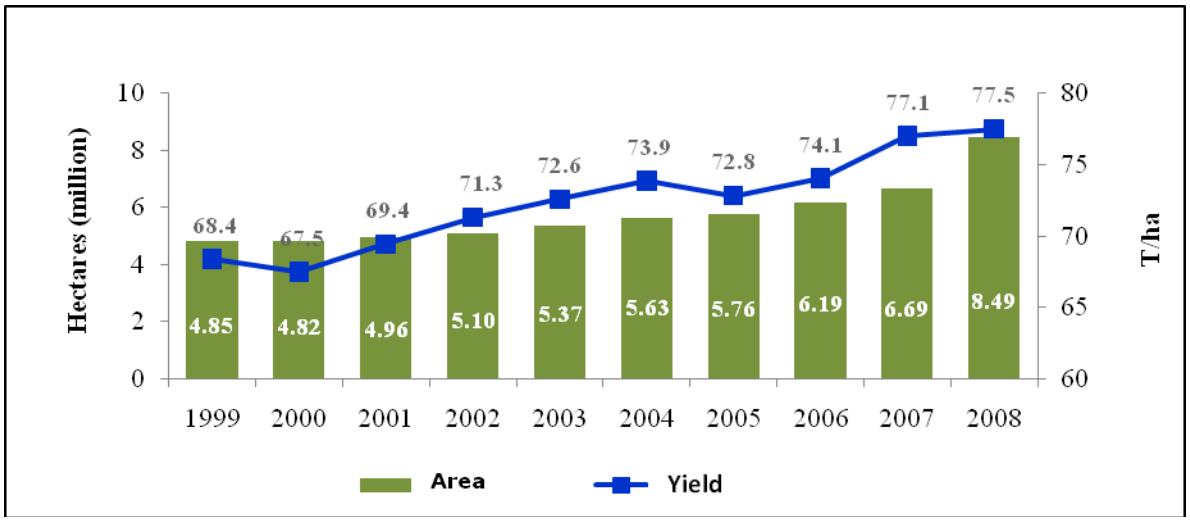


Figure 1. Area and Yield of Brazilian Sugarcane Production
Source. UNICA

Indeed, Brazilian sugar industry leaders are focusing on sustainability and social responsibility issues because of their increasingly importance. Improving the workers' quality of life, the rational use of land and water, mitigating the effects of mechanized harvesting, and the preservation of ecosystems are parts of the work agenda of the sector, which is one of the major employers in Brazil.

Although the advances are not modest, there is still much work ahead for the industry to grow even more. Externally, Brazil must convince critics that the increase in Brazilian sugarcane production does not occur in forest and food production areas, and also demonstrate the regularity of ethanol supply and the sustainability of production (social, environmental, and economic). Internally, Brazil must show that there are a number of other benefits, in addition to financial savings, by using ethanol in their vehicles. This would justify further support from the federal government, for example, through increasing the mixture of ethanol in gasoline from the

current 25% to 30%, and a greater presence of the Brazilian Development Bank (BNDES), providing long-term financing to improve the competitiveness of the sector and more investments on co-generation of electricity. One of justifying further support is to present the economic and social impact of the activity in the country.

In this sense, this paper brings data collected over four months, showing the financial outcomes generated in every link of the sugarcane productive chain, the jobs generated, taxes, and the sectoral GDP. Thus, the paper can help to enhance appreciation of the complexity of capturing value contributions for agribusiness industries. It can also be used by the sugarcane sector to get an active participation in the formulation of governmental politics for the industry and to influence the process of building the sugarcane image among the world's opinion leaders.

The objective of this article is to apply the mapping and quantification method to the sugarcane chain in Brazil. The final information of this method is a one page description of a food chain, showing all the participants and the revenue of the different links of the productive chain in a year of analysis. Besides these financial numbers, other results possible with the method are the quantification of jobs and taxes generated by the chain in a year basis[1].

Bibliographic Review

It is important to say that this article does not use a network approach, since the unit of analysis is not a network, it is a food chain. A food chain here is considered as limited by the boundaries of a particular country. Its actors are input suppliers, farmers, industry, distributors and service providers. Like the Dutch flower chain, Danish pork chain, or other country chain.

Until the early 20th century, the concept of agribusiness was not used in the agro-food system, the families made their food and the excess was sold in local market. Later, production systems have become specialists, decentralizing the stages of production, distribution and marketing. Even apart, all activities continued somehow interrelated, featuring a production chain. The understanding of this new system became the interest of researchers leading them to formulate theories that could explain the new approach (Watanabe 2005).

It is a traditional view that literature had coming from two different approaches, developed in different places and times. The first one was developed by Goldberg (1968) in the USA, which presented the term *commodity system approach* (CSA) in studying the citrus, wheat, and soy production systems. The CSA approach, beyond analyzing the traditional buyer-seller relationship, analyzes the institutional influences and concludes that the final destination of agricultural products is not the final consumer but the agro industry, which influenced the analysis of the subsystems that compose the agro industrial system.

The theoretical basis of the CSA is derived from the neoclassic theory of production and the Leontief input-output matrix. Such an approach was the basis for the introduction of inter-sector

[1] This research is part of a broader effort of the Brazilian Sugarcane Industry Association (UNICA), the largest organization in Brazil representing sugar, ethanol, and bioelectricity producers. The association is working to increase knowledge about the sugar and ethanol industry and to convey to the public, in a concise and uniform way, the benefits of production and use of clean energy from renewable and sustainable agricultural origins.

dependence and also expressed concern with the measurement intensity of inter-sector linking (Zylbersztajn, 2000). The CSA methodology emphasizes the sequence of product transformations in the system.

Goldberg's research had its merit in changing the center of the analysis from inside the firm to the system, which prevented dealing with the agricultural sector as isolated from the overall economy. The idea of *agribusiness* reinforces the existing inter-sector bonds, in that it places the agricultural production as part of the commodity system, emphasizing its relations with the world of business (Silva, 1991). Goldberg (1968) still stresses the importance of the systemic approach's use to support cooperative decisions.

The second approach, proposed by Morvan (1985), considers a chain ("*filière*") as linked operations for the transformation of a good. The chains are influenced by technology and have complementary interdependences, according to Batalha (2001). The *filière analysis* applies to the sequence of activities that transforms one commodity into a product for final consumption and represents a tool of the French industrial economy's school.

According to Morvan (1985), the *filière analysis* is an important instrument to describe systems, define technologies role in the framing of productive systems, organize integration studies, and analyze industrial polices, firms, and association strategies.

Athough not used here, there are important additional contributive theories. The *supply chain* is viewed as a system that integrates raw material suppliers, factories, distribution services and consumers (Stevens *apud* Omta et al., 2001). Furthermore, there is the network concept when organizations are directly involved in different processes that add value in the elaboration of goods and services until the final consumer (Christopher *apud* Omta et al., 2001).

Lazzarini et al. (2001) integrate chain and network concepts in a new study on *net chains*. According to these authors, the integration of these approaches allows the consideration of existing organizational interdependences in a network, as well as the different mechanisms of coordination (managerial plans, processes standardization, and adjustments) and sources of value (production and operations optimization, transaction cost reduction, diversity and "co-specialization" of knowledge).

Hardman et al. (2002) demonstrated the possibility of increasing the competitiveness of the South African apple chain exports through the cooperation among producers, packers, and exporters. From the ideas of CSA and the *filières*, it is possible to develop tools and managerial activities to improve the chains' efficiency. Thus, the concepts of *Supply Chain Management* (SCM) and the set of networks and *net chain* ideas are important theoretical concepts and empirical notions for the development of agro-industrial systems (Batalha & Silva, 2001).

After this introduction and delimitation of relevant literature, session 3 will bring details on procedures and operationalization of the empirical research that quantified the sugar cane chain, for the year of 2008.

Procedures and Operationalization

The first step in characterizing an analyzing a system is to define its boundaries, subsystems and their objectives. This will facilitate a definition for the system's environment (Malhotra, 2001). Batalha (2001) comments that for a chain analysis, the researcher must define the objectives to be reached. The most important and difficult definitions are related to the analysis of scope and the levels that should be detailed. Zylbersztajn (2000) also comments that the definition of the chains boundaries is dependent on the researcher's purposes, which are generally focused on a flow of product. In this study, the established scope was the sugarcane chain in Brazil, focusing on sugar, ethanol, and their main derived products.

As it shown in Figure 2, the sequence of this methodology can be summarized in six stages. This methodology had been applied in several studies in Brazil, by Rossi and Neves (2004), Neves and Lopes (2005), and Consoli and Neves (2006) in the PENSA (Agribusiness Intelligence Center)[2] researches of the Brazilian wheat, orange and milk agro-industry systems, respectively.

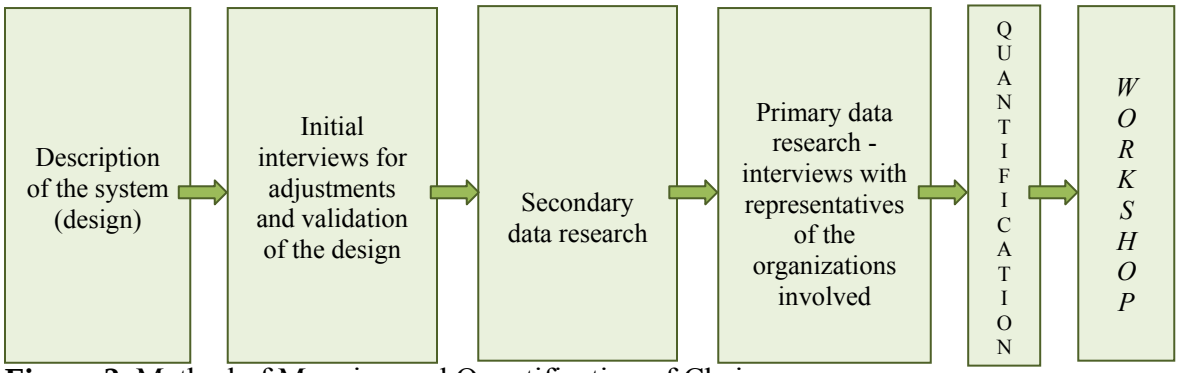


Figure 2. Method of Mapping and Quantification of Chains
Source: Neves et al. (2004)

The first step consists of elaborating a preliminary description of the chain participants, represented in small boxes, based on theory and the researchers' experience. It is also necessary to scope which segments will be studied, keeping the focus on its central axle and the research objectives. This research was focused on sugarcane chain, contemplating the Goldberg (1968) notion of the CSA, as well as emphasizing a product as the starting point for the chain analysis.

After the chain description, the second step involves submitting the analysis to chain and industry specialists and working with them to adjust the original framework to reflect the industry's reality. It is very common to forget participants, agents, and this second stage helps to map all possibilities.

The third stage consists of searching of the secondary data research, which according to Malhotra (2001) is collected for ends that differ from the problem of the research. This step

[2] A program of the School of Economics, Business and Accounting at the University of Sao Paulo (USP).

involves gathering secondary data from sources that have academic and statistical credibility, reputation, and integrity.

After the collection of the available secondary data, which in some countries and environments may be very limited, starts the collection of primary data (fourth step), which are the data originated by the researcher for the specific purpose of solving the problem in question (Mattar, 1993; Malhotra, 2001). In this empirical research, in depth interviews were performed with representatives of several organizations in the sugarcane sector. The major information needed is amount of sales of a particular segment of the chain, employment and taxes.

To select and define the interviews, it is first necessary to identify which data were not found through the secondary data sources. To be interviewed, the agent needs to match some characteristics—i.e., have access to the information and data of the sector in study, have knowledge and experience about the chain, be willing to collaborate with the research and establish a communication channel for future contacts, and indicate other possible agent to contribute with more data.

The quantification (fifth stage) involves determining the turnover of each sector in the chain, through each sector's companies' revenues, and estimating several sub-sectors of the sugarcane chain. In order to guarantee the data reliability some secondary and primary data were contrasted, attempting to find incongruous possibilities. In this process, at least two different data sources to check the results, with additional interviews with similar agents when needed.

Finally, in the sixth step is the data validation. It can be accomplished with a workshop, where information were sent to participants prior to the event, and then discuss the numbers or by sending the materials to relevant agents of all the "boxes" of the chain, for verification. After that, the research was presented to the press, National Congress and the most important Brazilian sugarcane producers' States, such as São Paulo, Goiás, and Paraná.

After definition of relevant literature and the procedures done for the empirical work, session four brings the results.

Results: Description and Analysis of the Sugarcane Sector

The sugarcane chain's GDP was $ 28.1 billion, equivalent to 2% of the Brazilian National GDP or almost the overall economic output produced in a country like Uruguay ($ 32 billion). The chain GDP calculation was estimated by adding the sales of all final goods and services offered in the economy. As shown in Table 1, subtracting sales taxes, the amount is $ 24.3 billion.

Figure 3 is the major output of this method, and represents the sugarcane chain, and the values below each link indicate its gross sales in this productive chain in 2008. Total gross revenue (financial movement of a chain in a year) of the sugarcane chain was about $ 86.8 billion. This value represents the sum of all estimated sales done by every link of the chain and the financial transactions of the facilitating agents described.

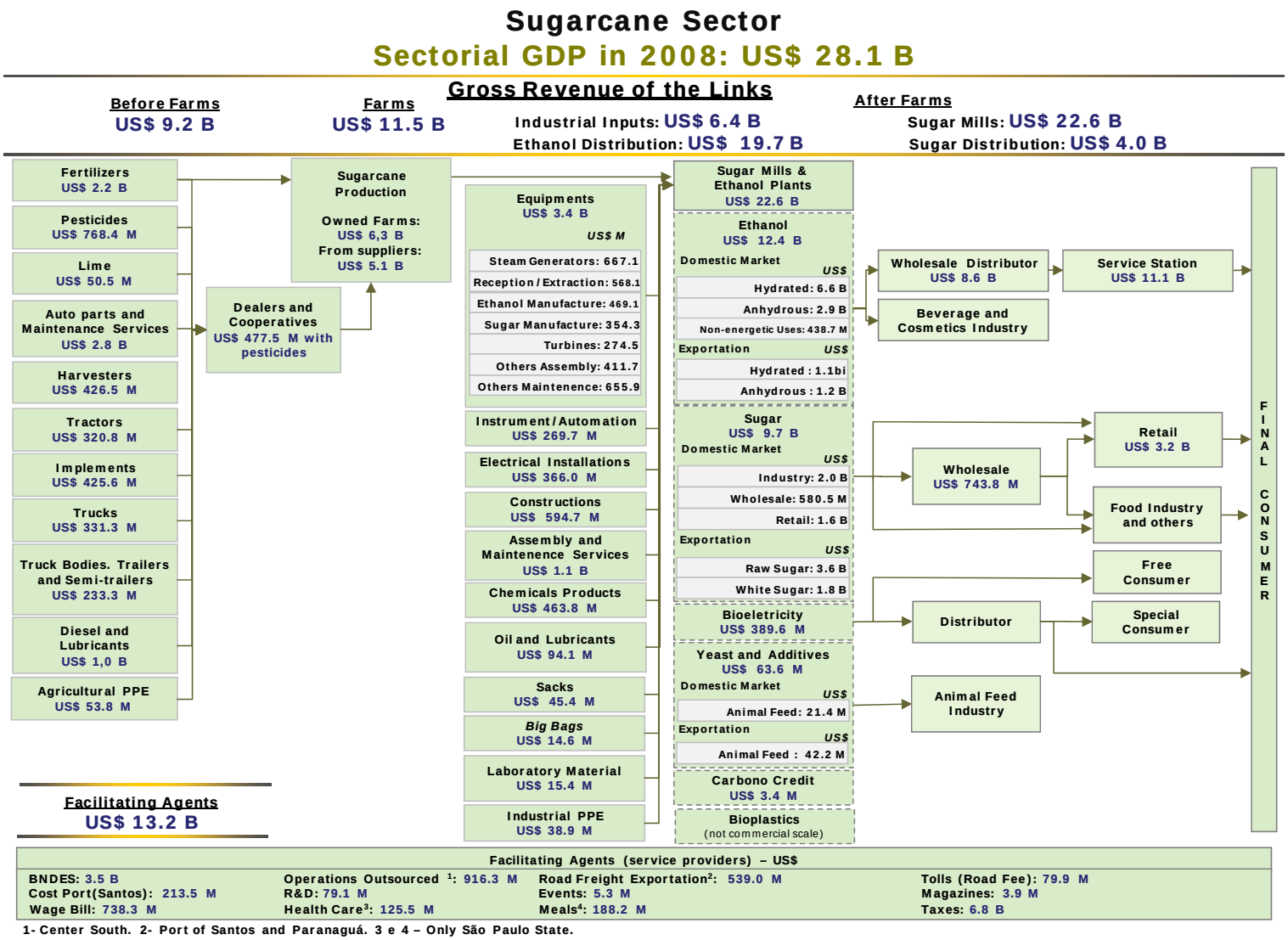


Figure 3. Sugarcane Chain (gross revenue)
Source: Neves, Trombin, and Consoli, with data generated by MARKESTRAT (2009)

Table 1. Estimates of the sector's Gross Domestic Product based on the end products

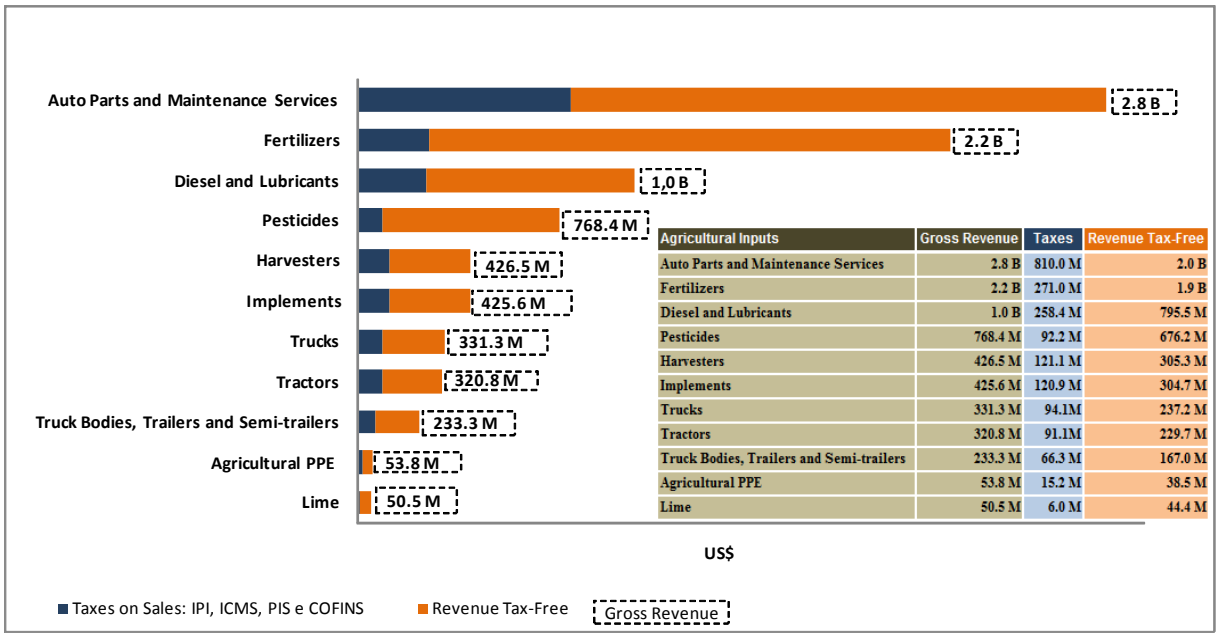
Product		Domestic Market $		Exportation $	Total $	
		With Taxes	Taxes Free	Tax Exempt	With Taxes	Taxes Free
Ethanol	Hydrated	11.1 B[a]	9.1 B	23.7 M	11.1 B	9.1 B
	Anhydrous	2.9 B[b]	2.2 B	2.3 B	5.3 B	4.6 B
	Non-energetic Uses	438.7 M[c]	351.5 M	n.d.	438.7 M	351.5 M
Sugar		5.2 B[d]	4.4 B	5.4 B	10.7 B	9.9 B
Bioeletricity		389.6 M[e]	242.8 M	n.d.	389.6 M	242.8 M
Yeast		21.4 M	19.4 M	42.2 M	63.6 M	61.6 M
Carbon Credits		n.d	n.d	3.4 M	3.4 M	3.4 M
Total		20.2 B	16.4 B	7.91 B	28.1 B	24.3 B

[a]Sales done by gas stations, considering the formal and informal markets.
[b]Sales done by the ethanol plants to ethanol wholesale distributors, considering the formal and informal markets.
[c]Sales done by ethanol plants to the beverage and cosmetics industries.
[d]Sales done by sugar mills to the food industry added with the sales done by retailers to final consumers.
[e]Sales done by the sugarcane mills and ethanol plants in energy auctions.
Source: Neves, Trombin, and Consoli, with data generated by MARKESTRAT (2009)

Before the Cane Farms Sectors

Agricultural Inputs

The agricultural inputs industry sold to the sugarcane chain about $ 9.2 billion in 2008, also considering the pesticides sales by agricultural cooperatives and dealers of $ 477.5 million. Figure 4 summarizes all the agricultural input revenues, which are detailed in the following text.



Agricultural Inputs	Gross Revenue	Taxes	Revenue Tax-Free
Auto Parts and Maintenance Services	2.8 B	810.0 M	2.0 B
Fertilizers	2.2 B	271.0 M	1.9 B
Diesel and Lubricants	1.0 B	258.4 M	795.5 M
Pesticides	768.4 M	92.2 M	676.2 M
Harvesters	426.5 M	121.1 M	305.3 M
Implements	425.6 M	120.9 M	304.7 M
Trucks	331.3 M	94.1M	237.2 M
Tractors	320.8 M	91.1M	229.7 M
Truck Bodies, Trailers and Semi-trailers	233.3 M	66.3 M	167.0 M
Agricultural PPE	53.8 M	15.2 M	38.5 M
Lime	50.5 M	6.0 M	44.4 M

Figure 4. Agricultural Inputs Sales
Source: Neves, Trombin and Consoli, with data generated by MARKESTRAT (2009).

This chain accounted for 14% ($ 2.2 billion) of the agricultural fertilizer sales in Brazil, making it the largest fertilizer market after soybeans and corn. Expansions in sugarcane production have caused an increase in the demand for fertilizer despite unfavorable cane market conditions. For example, 36.3T of sugarcane purchased a ton of fertilizer in 2008 compared to 19.8T in 2007. This happened due to rising prices of fertilizer and the reduction of sugarcane prices. Sales of lime to sugarcane plantations in 2008 were estimated at $ 50.5 million, corresponding to 2.9 billion tons or 14% of national consumption.

In 2008, the pesticides industry had revenues of $768.4 million with this chain, 9.5% of the total sales in the country (cooperatives were responsible for 61% of pesticides sales, dealers represented 2% and direct sales accounted for 37%). The sugarcane chain stands out among the 3 cultures that consume more pesticides in the country, highlighting the importance of the sector. Almost four thousand tractors were sold to the chain, generating revenues of $ 320.8 million and 9% of total tractors sales in the country. Sales coming from agriculture implements was about $425.6 million, including plows, disc harrows, subsoilers, and self-propelled irrigation systems, among other items. The auto parts sector jointly with machinery maintenance services had revenues of about $ 2.8 billion, including parts and labor force to maintain nearly 144 thousand machines in operation, which each consume approximately $ 20.000 in maintenance per year. In harvesters, the chain acquired 981 units, 22% of the total sold in 2008, accounting for a turnover of 426.5 million. All burning must cease in São Paulo by 2014 in areas where mechanized harvesting is possible.

In 2008, 1,962 heavy trucks (weight over 40 tons) were sold to the sector, 5% of this truck category's sales in the country, representing $ 331.3 million in sales. Truck bodies, trailers, and semi-trailers were estimated at $ 233.3 million. In addition to the 488 truck bodies sold, the license plates of 4,856 trailers and semitrailers were registered, which accounted for about 9% of total sales to the heavy machine in Brazil, and an 11% increase over 2007. The agricultural mechanized operations and the sugarcane transportation from farm to industry consumed about 1.0 billion liters of diesel fuel and lubricants, equivalent to $ 1.5 billion.

Results of Measurement on Farms

Sugarcane Production

The sugarcane 2008/09 harvest reached a record production of 568.9 million tons and a planted area of about 8.5 million hectares. The São Paulo State accounted for 68.6% of the sugarcane crushing in the south-central region. The sugarcane was responsible for revenues of $ 11.5 billion. The yield of raw material was 143.25 kg of total recoverable sugar (ATR) per ton of sugarcane. The ATR average value was $ 0.14/ATR, and the sugarcane average price was $ 20.23 per ton. As shown in Figure 5, the sugarcane from suppliers accounted for approximately 44.5% of the industry demand ($5.1 billion) and 55.5% were harvested on the farms owned by the mills, the called vertical integration ($6.3 billion).

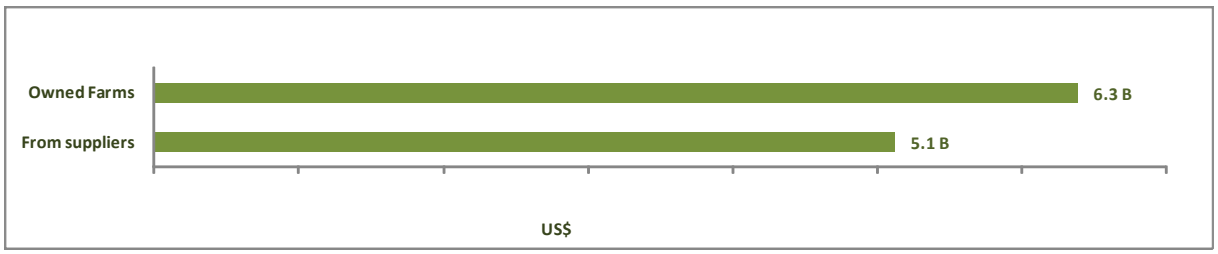


Figure 5. Sugarcane Sales
Source: Neves, Trombin, and Consoli, with data generated by MARKESTRAT (2009).

Results of Measurement After Farms

Equipment, Industrial Services and Supplies

The sugarcane chain was the responsible for the purchase of $ 6.4 billion in industrial inputs. The industrial equipment and assembly services were estimated by considering the investments done in the 29 ethanol plants and sugar mills that started operation in 2008. Of the 29 industrial units, the premise adopted was that: four are sugar mills (3 have a milling capacity of 1.5 million tons of sugarcane per year, and 1 has a capacity of 3 million tons) and 25 are ethanol plants (15 with a milling capacity of 1.5 million tons, and 10 with a capacity of 3 million tons).
The average investment to assemble the industrial part of a sugar mill was estimated at $ 85 per ton of sugarcane milling capacity and for an ethanol plant at approximately $75per ton. Table 2 shows the proportion of the investment amount needed, and Table 3 details the investment in equipment.

Table 2. Proportion of Investment to Build a New Sugar Unit.

Item	% of the Total Investment
Equipments	60%
Electromechanical Assembly	7%
Constructions	13%
Electrical Installations	8%
Instrumentation/Automation	2%
Engineering Services, Thermal Insulation, and Painting	10%
Total:	100%

Source: Prepared by MARKESTRAT from data provided by Procknor Engineering

Table 3. Proportion of the Equipment Investment per Equipment.

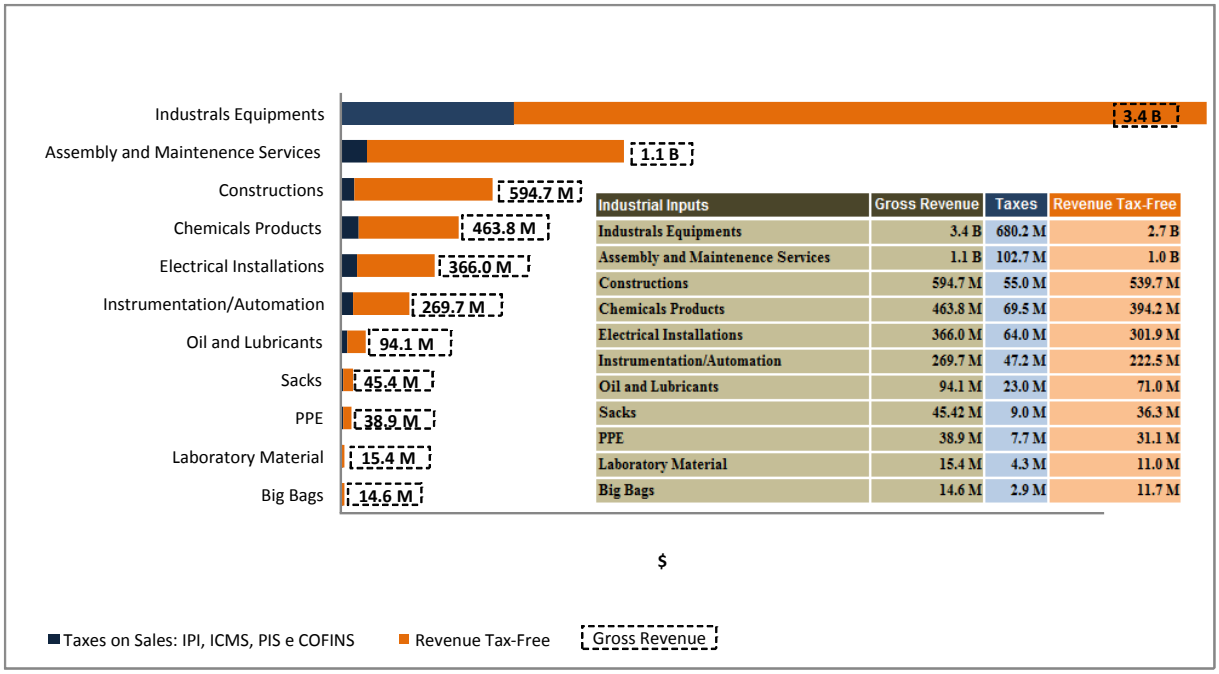
Equipments	% of the investment in equipments	
	Sugar Mill	Ethanol Plant
Steam Generators	25%	20%
Sugarcane Reception, Preparation, and Extraction System	20%	25%
Ethanol Manufacture	15%	30%
Sugar Manufacture	15%	0%
Turbines/Power Generators	10%	10%
Others	15%	15%
Total:	100%	100%

Source: Prepared by MARKESTRAT from data provided by Procknor Engineering

In addition to investments related to the new units' installation, it was also considered the sales of equipment and services for the maintenance of industrial units, which is performed between crushing sessions. Maintenance cost is $ 1.68/ton of sugarcane milled, being 62.50% spent on equipment and 37.50% spent on services. Given these assumptions, the revenue of the industrial equipment suppliers was estimated at approximately $ 3.4 billion. Sales of automation and instrumentation were $ 269.7 million, and service providers of assembly and maintenance had revenues of approximately $ 1.1 billion.

The sugarcane chain had generated revenues of $ 463.8 million purchasing the products and specialty chemicals for ethanol and sugar production, including quicklime, polymers (auxiliary in the production of sugar and ethanol), yeast, water treatment, and ion-exchange resins, among other inputs.

The fuel and oil consumption for the industrial operation was 70 million liters, generating revenues of $94.1 million. Costs of laboratory material were $15.4 million. Sacks of 50 kg for packing sugar were $ 45.4 million, and big bags of 1,200 kg also for packing sugar were $ 14.6 million in 2008. Industrial PPE (Personal Protective Equipment) was $ 38.9 million. Figure 6 summarizes the revenue generated with the industrial inputs.



Industrial Inputs	Gross Revenue	Taxes	Revenue Tax-Free
Industrals Equipments	3.4 B	680.2 M	2.7 B
Assembly and Maintenence Services	1.1 B	102.7 M	1.0 B
Constructions	594.7 M	55.0 M	539.7 M
Chemicals Products	463.8 M	69.5 M	394.2 M
Electrical Installations	366.0 M	64.0 M	301.9 M
Instrumentation/Automation	269.7 M	47.2 M	222.5 M
Oil and Lubricants	94.1 M	23.0 M	71.0 M
Sacks	45.42 M	9.0 M	36.3 M
PPE	38.9 M	7.7 M	31.1 M
Laboratory Material	15.4 M	4.3 M	11.0 M
Big Bags	14.6 M	2.9 M	11.7 M

Figure 6. Industrial Inputs Sales
Source: Neves, Trombin, and Consoli, with data generated by MARKESTRAT (2009)

Sugar Mills and Ethanol Plants

The industry sold about $22.6 billion with all of the products, being $12.4 billion with ethanol, $9.7 billion with sugar, $389.6 million with bioelectricity, and $67.0 million with yeast, additives, and carbon credits. These products represent, respectively, 55%, 43%, 1.7%, and 0.3% of their sales.

This industry had $12.4 billion in sales with ethanol in 2008, considering the domestic and international markets.

Exports generated revenues of $2.3 billion (5.1 billion liters), being $1.1 billion for hydrous ethanol and $1.2 billion for anhydrous ethanol. Exports of anhydrous ethanol were atypical in 2008. One reason for its growth was the increment of U.S. demand, due to the decrease in crop because of the flooding in the main producing region of the country, in addition to the significant increase in the cost of oil, which exceeded $ 100/barrel during the year. The main buyers were the United States (34%), Netherlands (26%), Jamaica (8%), and El Salvador (7%). However, the total exported volume is still small compared with total production, which already indicates great potential for growth, with volume multiplied 14 times since 2001.

The domestic market consumed 14.08 billion liters of hydrated ethanol in 2008, generating a turnover of $6.6 billion to the industry. The sales of hydrated ethanol have grown considerably in recent years (compared with 2006, the increase was 87%). The main reason for this growth was the introduction of the flex fueled engine cars, which in 2008 accounted for 90% of the light commercial vehicle sales in Brazil. The anhydrous ethanol in the internal market generated a turnover of $2.9 billion (6.48 billion liters). The major consumption of this product in Brazil is in blending with gasoline, currently at the rate of 25%.

Ethanol for non-energy uses has its destiny mainly to production of beverages, cosmetics, pharmaceuticals, and chemicals. According to data from the National Energy Balance, this consumption was 720 million liters ($438.7 million as turnover for the ethanol plants). Wholesale distributors earned $8.6 billion, and the fuel distribution service stations $11.1 billion.

The sugar mills earned $9.7 billion with sugar in 2008, counting sales to both the domestic and international markets. Exports generated revenues of $ 5.4 billion, being 67% with raw sugar and 33% with white sugar. Major buyers are Russia, followed by Nigeria, Egypt, Saudi Arabia, and others. The largest share of sugar production is destined for foreign markets. Production grew at rates much higher than the growth of Brazilian consumption, which remained stable over the last 6 years on average at 3% per year.

The turnover in the domestic market was $4.0 billion with sugar. Sales to the food industry were $2.0 billion; sales to retailers were $1.6 billion, and wholesale, $580.5 million. Generally wholesalers' transactions occur to sell for small factories and buyers. These wholesalers, in addition to selling to the factories, sometimes pack the sugar and sell it for retail. The main sugar-consuming industries are the producers of soft drinks (20%), candy and chocolates (10%), chemicals (10%), and milk (7%), with other industries accounting for 53%. Sugar for fresh consumption is crystal (61%), followed by refined sugar (36%). The wholesale industry had earned $743.8 million with sugar, and the retail chains (supermarkets) $3.2 billion.

The bioelectricity generated from sugarcane bagasse increasingly stands out as an important product of the industry, being sold to electricity markets. In 2008, about 30 plants had negotiated 544 MW, representing annual revenue of $389.6 million.
About 10% of the yeasts used in ethanol production, specifically in the fermentation of sugar cane, are recovered and dried to be used in the composition of animal feed. In 2008, yeast

exports reached 32 thousand tons, generating revenues of $16.8 million.
Jointly with the yeast, additives based on sugarcane yeast (such as the cell wall) are marketed. In 2008, 13,400 tons of this product were exported, generating revenues of $25.4 million. In the domestic market, 5,000 tons of additives were sold, representing a turnover of $10.33 million. Therefore, sales of yeast added to its additives reached about $21.4 million in the domestic market and around $ 42.2 million in exports, totaling $63.6 million.

For carbon credits, in terms of trading volume, Brazil ranks third among the country vendors, but it still has only 3% of the market. China is the leader with 84%. The amount traded worldwide in 2008 was 389 million tCO2e (tons of carbon dioxide equivalent), valued at $6.5 billion, 14% less than in 2007. The Brazilian participation in the carbon credit market occurs through the Clean Development Mechanism (CDM), because it is the only mechanism of the Kyoto Protocol that allows voluntary participation of the developing countries. The 68 Brazilian projects registered by the United Nations Framework Convention on Climate Change (UNFCCC) on the carbon credit market generated an estimated reduction of 3.4 million tCO2e and a turnover of approximately $25.3 million in 2008, using the average price in 2008 recorded by the voluntary market of $7.34 per tCO2e (tons of carbon dioxide equivalent). Of the 68 projects, 24 were from the sugar-energy sector, which generated an estimated decrease of 473.94 thousand tCO2e, valued at $3.4 million in 2008.

Bioplastic is one of the most promising innovations. If the planned investment really occurs, in a short time this product will be a very important item in the sugar mills' and ethanol plants' portfolios. It is estimated that the demand for this new product has already reached 600,000 tons annually worldwide, although at 15% to 30% higher price than the conventional product. According to the Europe Institute of Bioplastics, almost 331,000 tons of bioplastics are produced today, which is less than 1% of synthesized plastics produced annually.

The Brazilian participation in the carbon credit market occurs through the Clean Development Mechanism (CDM), because it is the only mechanism of the Kyoto Protocol that allows voluntary participation of the developing countries. The 68 Brazilian projects registered by the United Nations Framework Convention on Climate Change (UNFCCC) on the carbon credit market generated an estimated reduction of 3.45 million tCO2e and a turnover of approximately $25.3 million in 2008, using the average price in 2008 recorded by the voluntary market of $7.34 per tCO2e. Of the 68 projects, 24 were from the sugarcane sector, which generated an estimated decrease of 473.94 thousand tCO2e, valued at $ 3.4 million in 2008.

Bioplastic is one of the innovations for the exploitation of sugarcane bagasse. If the planned investment really occurs, in a short time this product will be a very important item in the sugar mills' and ethanol plants' portfolios. It is estimated that the demand for this new product has already reached 600 K tons annually worldwide, although at 15% to 30% higher price than the conventional product. According to the Europe Institute of Bioplastics, almost 331 K tons of bioplastics are produced today, which is less than 1% of synthesized plastics produced annually. The Brazilian bioplastics production is still at a minimum scale that is inadequate to put the product on the market.
PHB Industrial, a company controlled by one of the most important groups of sugar mills in Brazil, has in its industrial park one of the first pilot projects of the country. In laboratory scale,

the company can produce about 60 tons per year, which are currently exported to Japan, the United States, and Europe at an average price of $ 5/kg. However, very little of this material was sold effectively, and the majority was exported for developing applications with international companies. PHB Industrial is designing a plant to start operating at commercial scale in 2 to 3 years. Media reports say the plant will eventually produce 10 thousand tons/year and will begin operations in 2010.

Braskem, a Brazilian petrochemical company, currently has production capacity of about 12 tons/year in a pilot plant and has announced investments to start production in 2011 of approximately 200 K tons per year. Dow Chemical reported the creation of the first ethanol hub that is slated to produce 350 K tons/year starting in 2011. Copersucar, in partnership with the Belgian group Solvay, should produce 120,000 tons in 2010 (Source: ABDI).

If investments for 2010 materialize, press reports estimate that the alcohol chemistry industry will require 650 million liters of ethanol annually. A large potential market signals unparalleled opportunities for the sector.

Facilitating Agents of the Sugar Cane Chain

Due to further industry consolidation, new groups have been taking the sugarcane business on a professional management basis with a focus on efficient operations and better financial allocation. This created a demand for outsourcing services on the operations of cutting, loading, and transportation of the sugarcane from farms to the plants, favoring the entry of specialized companies in sugarcane logistics operations. In 2008, the outsourced CLT (operations outsourced of cutting, loading, and transportation of sugarcane) had a turnover of $916.3 million.

The resources dedicated to road freight for sugar and ethanol exportation totaled $539.0 million. Of this total, spending on road freight for sugar exportation in the center-south region was $383.6 million, and the ports of Santos, in São Paulo State, and Paranagua, in Parana State, were the main routes of exportation in 2008. Of that amount, freight export of ethanol totaled $155.4 million. The sugar export freight over the Brazilian road system costs approximately $34.16/t, and ethanol freight costs $ 34.76/m^3. The Revenues from tolls to export ethanol and sugar added an amount of $79.9 million in 2008. The revenue from the Port of Santos on customs clearances services, lifting, and supervision of loading the sugar and ethanol was estimated at $213.5 million in 2008. Almost 70% of the entire Brazilian ethanol and sugar exports were made through the Port of Santos.

In 2008, $79.1 million of resources were allocated to research on sugarcane, sugar, and ethanol production among public and private organizations on research and development, and currently, there are five important events in the sugarcane sector that together mobilized $5.3 million in 2008. The major Brazilian specialty magazines in the sugarcane chain earned $ 3.9 million, with about 61 thousand copies printed.

The Brazilian Development Bank provided an amount of $3.5 billion for all the companies operating in the sugarcane sector, thereby stimulating the development and maintenance of the industry.

According to the Union of Workers in the Sugar and Food Industry, the São Paulo State workers receive health care and food benefits, totally or partially paid by the mills. The average monthly cost paid to health plans is $ 33.00 per person, bringing sales for the health care segment of $ 125.5 million. With regard to food, it is estimated that the São Paulo sugar mills and ethanol plants have disbursed about $ 188.2 million (average monthly cost of $ 49.00 per person).

According to the Brazilian Ministry of Labor, the industry in 2008 accounted for 1.28 million formal jobs, with 481,662 allocated in the field of sugarcane cultivation; 561,292 in sugar mills for raw sugar production; 13,791 in sugar refining and milling; and 226,513 in ethanol production. This represents 2.15% of all Brazilian jobs, highlighting the importance of the sugarcane chain. The figure of 1.28 million workers is expanded if the informal employment is considered. Adding the informal employment, there are 1.43 million jobs in the chain. Considering also that every direct job generates two indirect (Balsadi, 2007), a figure of 4.29 million people placed in jobs related to sugarcane is reached.

In Brazil, 55% of the workers on sugarcane plantations are illiterate or of low education. The main responsible for the national figures is the North-East region – with more than 80% of workers grouped in that category. In the center-south area the rate did not surpass 5%. In the sugar mills and ethanol plants, the proportion of illiterate and low education is slightly lower than on the plantations, but it is still very high, highlighting illiteracy in the NE, which in 2008 accounted for almost 20% of the workers. However, increased mechanization has created a growing demand for more qualified professionals. A harvester replaces 100 workers with low skills, but it requires 10 workers trained in automation and mechanization. Brazilian institutions are assisting in the formation of this new profile of skilled workers demanded by the industry today.

The average income of the workers in the center-south region was $578 per month, and in the north-east region it was $362 per month, generating a national average of $512 per month. The national wage bill was $738.3 million in 2008.

The total tax was calculated by summing the taxes generated in each link of the sugarcane chain, from the sale of agricultural and industrial inputs to the sale of final products. To eliminate double counting and consider just the aggregate tax, the taxes generated in the first links was subtracted (agricultural and industrial inputs). The result of this estimate showed that the tax revenues in 2008 totaled about $9.8 billion, and $3.0 billion were generated by the sale of agricultural inputs and products. Thus, the aggregate tax in the sugarcane sector was estimated at $6.8 billion.

Managerial Implications and Discussion

This study sought to map and quantify the sugarcane chain in Brazil. After the application of the method, this chain now shows the numbers that indicate its economic importance to the country. The industry figures are impressive, with a turnover of over $80 billion per year and the sugarcane chain GDP is $28.1 billion, equivalent to 2% of the Brazilian GDP.

This data serves as input for public and private decision making, showing who participates, the interconnecting links among chain participants and the industry's enormous capacity to generate resources, taxes, and jobs.

Brazil has one of the cleanest energy matrixes and it is estimated that in 2015 ethanol will represent 80% of the total fuel consumed in Brazil by small vehicles. In addition, Brazil is with nearly 50% of the world sugar market and to the expectation of reaching more than 60% in 5 years. This study demonstrated also that the chain involves a tremendous amount of resources, jobs, and taxes, and that its ability to internalize Brazilian development is very large. It is a sector of fundamental importance for the Brazilian economy.

It was one more application of the Chain Mapping and Quantification method, and as suggestion of future developments and research, further applications of this method in other countries and other chains is a contribution.

References

Basaldi, O.V. 2007. Mercado de trabalho assalariado na cultura da Cana-de-açúcar no Brasil no período de 1992-2004 [Salaried Labor Market in the Sugarcane Culture in Brazil from 1992 - 2004]. http://ftp.sp.gov.br/ftpiea/publicacoes/tec4-0207.pdf (accessed July 15, 2007).

Batalha, M. O. 2001. Gestão agroindustrial. [Agribusiness Management] 2ª ed. São Paulo: Atlas.

Batalha, M. O. and A. L. Silva. 2001. Gerenciamento de Sistemas Agroindustriais: Definições e Correntes Metodológicas [Agroindustrial Systems Management: Definitions and Methodological Chains]. Gestão agroindustrial. 2ª ed. São Paulo: Atlas. 1:23–63.

Consoli, M. A. and M.F. Neves. 2006. Estratégias para o Leite no Brasil. [Strategies for Milk in Brazil]1. ed. São Paulo: Atlas, 291.

Godoy, A.S., 1995. Pesquisa Qualitativa, Tipos fundamentais.[Qualitative Research, Fundamental Research Types] *Revista Administração de Empresas, São Paulo* 35(3):20.

Goldberg, R.A., 1968. Agribusiness coordination: A system approach to wheat, soybean and florida orange economies. Division of Research. Graduate School of Business and Administration. Harvard University, 256.

Hardman, P. A., Darroch, M. A. G., & G. F. Ortmann, 2002. Improving cooperation to make the South African fresh apple export value chain more competitive. *Journal on Chain and Network Science.* 2(1):61–72.

Hill, T., & R. Westbrook (1997). SWOT analysis: It's time for a product recall. Long Range Planning 30 (1): 46–52.

IBGE, Pesquisa Trimestral do Leite. [Quarterly Survey of Milk] Disponível no site: http://www.ibge.com.br, (accessed November 20, 2005).

Lazzarini, S. G., Chaddad, F. R., & Cook, M. L. 2001. Integrating supply chain and network analyses: The study of net chains. *Journal on Chain and Network Science* 1(1):7 – 22.

Malhotra, N. K., 2001. Pesquisa de Marketing: uma orientação aplicada. [Marketing Research: an Applied Orientation] 3.ed. São Paulo: Bookman.

Mattar, F. N., 1993. Pesquisa de Marketing - Edição Compacta. [Marketing Research – Compact Edition] 1.ed. São Paulo: Atlas.

Morvan, Y. 1985. Filière de Production, in Fondaments d'economie industrielle, *Economica,[*Chain of production, Fundamentals of industry economics] 199-231.

Neves, M. F.and M. A. Conejero. 2010. Estratégias para a Cana no Brasil, [Strategies for Sugarcane sector in Brazil] São Paulo: Atlas, 288.

Neves, M. F., Rossi, R. M., Castro, L. T., Lopes.F. F., and M. K. Marino. 2004. A framework for mapping and quantifying value chains towards collective actions. European Marketing Academy, Murcia. Paper presented at an annual meeting of the International Food Agribusiness Management Association, Montroeux.

Neves, M. F. and F. F. Lopes, 2005. Estratégias para a Laranja no Brasil. 1. ed. São Paulo: Atlas, 224.

OCB – Organização das Cooperativas Brasileiras. [Organization of Brazilian Cooperatives] 2002. *Anuário do Cooperativismo Brasileiro.* Brasilia: OCB.

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

Rossi, R., and M.F. Neves. 2004. Estratégias para o Trigo no Brasil. [Strategies for Wheat in Brazil] 1. ed. São Paulo: Editora Atlas, 224.

Silva, J. G., 1991. Complexos Agroindustriais e outros Complexos. Associação Brasileira de Reforma Agrária.[Agro-industrial complexes and other complexes. The Brazilian Association for Agrarian Reform] 21:5–34.

Wright, P., M. J. Kroll, and J. Parnell. 2000.Administração estratégica: conceitos. [Strategic Management: concepts]1st ed. São Paulo: Atlas.

Zylbersztajn, D. and M. F. Neves. 2000. Economia & Gestão de Negócios Agroalimentares.[Economy & Business Management Agrifood] São Paulo: Pioneira, 428.

International Food and Agribusiness Management Review
Volume 13, Issue 3, 2010

Consumer Preferences for Olive Oil in Tirana, Albania

Catherine Chan-Halbrendt[Ⓘa], Edvin Zhllima[b], Gwendalyn Sisior[c], Drini Imami[d], and Luciano Leonetti[e]

[a]*Professor, Department of Natural Resources and Environmental Management, University of Hawaii at Manoa, 1910 East-West Road, Sherman 101, Honolulu, Hawaii, 96822, U.S.A.*

[b]*Lecturer, Department of Agrifood, Economics and Policy, Agriculture University of Tirana, Koder-kamex, Tirane, Albania*

[c]*Graduate, Department of Natural Resources and Environmental Management, University of Hawaii at Manoa, 1910 East-West Road, Sherman 101, Honolulu, Hawaii, 96822, U.S.A.*

[d]*Lecturer, Department of Agrifood, Economics and Policy, Agriculture University of Tirana, Koder-kamex, Tirane, Albania*

[e]*Researcher, Development Solutions Associates, Department of Agriculture, University of Tirana, Rr. Lek Dukagjini, Nr 11/1, Tirane, Albania*

Abstract

Increase in urban middle income consumers along with consolidation of the retail sector has created changes in olive oil consumption preferences in Albania. The objective of this study is to inform stakeholders in the olive oil industry about consumer preferences. A Conjoint Choice Experiment (CCE) was used to design the survey and latent class approach used to analyze the data. The results show a strong preference for domestic olive oil and small niche markets that cater to specific consumers. The study also shows a gap between preference and reality that needs to be addressed by the stakeholders in the olive oil industry.

Keywords: olive oil, Albania, Latent Class, Consumer preference, conjoint choice, experiment

Ⓘ Corresponding author: Tel: + 1 808 956 2626
Email: chanhalb@ctahr.hawaii.edu

Other contact information: E. Zhllima: edvinzh@yahoo.com
G. Sisior: gwendaly@hawaii.edu
D. Imami: drinimami@yahoo.com
L. Leonetti: lkns@hotmail.com

Introduction

In recent years, Albania has seen a rapid change in its citizens' consumptive behaviors and life styles due to economic growth, improvement in the standard of living, fast urbanization and trade liberalization in the country. One consequence of this has been the gradual segmentation of the food and beverage market, similar to what has been seen in other transitioning countries (Berisha and Mara 2005, World Bank 2007). The transition from a centrally planned socialist economy to a market oriented economy has also given rise to a larger urban middle-income class of consumers. The food demand from the emerging urban middle-income consumers, combined with the gradual consolidation of the retail sector and the recent establishment of the first supermarket chains, has strong implications for the agrifood industry, which in the past has been almost exclusively based on price (Leonetti et al. 2009).

The transitioning economy, the new class of consumers and the change in the food retail sector has added to the change in consumer behavior and consumption preferences. Particularly, the demand for olive oil, an important component of the Albanian diet, has also been changing in recent years. In fact, olive oil contribution to Albanian fat consumption has been increasing in the last two decades. In 2003, Albanians consumed approximately 4.21 kg of olive oil per capita per year, though this is still less than the popular olive oil consuming countries such as Greece (15.62kg), Italy (13.14kg) and Spain (11.72kg) (Grigg 2002, FAO 2003).

Accompanying the increase in olive oil consumption in Albanian, domestic production of olive and olive oil production has also increased. In the 1980s, Albania produced an average of 3,000 tons of olive oil per year. By the 1990s, the average annual production of olive oil rose to almost 4,000 tons per year. In recent years, olive tree stock has exhibited an approximately 5% increase per year, though annual olive oil production varied substantially, ranging from 3,454 to 8,979 tons of olive oil (see Table 1). The variations are due to changes in yield and importing olives from neighboring countries.

Table 1. Olive Trees, Olive Oil Production and Imports in Albania

Items	2004	2005	2006	2007	2008
Olive trees in production (000)	3,429	3,488	3,603	3,728	4,179
Olive output (tons)	58,700	30,160	40,195	28,120	56,200
Olive oil production from processing plants (tons)	4,036	3,454	4,985	8,979	5,634
Olive Oil Imports (tons)	1,110	906	842	930	1,075

Source: International Olive Oil Council 2009

Studies have shown that olive oil production is profitable in Albania but does not have a comparative advantage globally (Mane and Kapaj 2009, DSA 2008). However, even though Albanian olive trees in production have been increasing, on average, in recent years, Albania continues to import significant amounts of olive oil. These imports are mainly from neighboring countries such as Italy, which supplies about 90% of Albania's imported olive, the rest is from Greece and other European Union (EU) countries. Albania imports about 1,000 tons of olive oil per year (see Table 1). The import levels in recent years have been oscillating in response to the

domestic olive oil production as low production means more imports to meet demands with a lagged time of a year. Although domestic production has increased after the drop in levels, imported olive oil levels still show an increase. Recently the upswing in imports suggests higher consumption and/or preference for imported olive oil.

Based on the importance of the olive oil in the diet of Albanians and the historical role in supplying the domestic demand, the olive oil industry has been targeted as a top strategic sector for growth and development by the Albanian government. The rationale for prioritizing the olive oil industry for growth is as follows: (1) olive production is a traditionally produced crop, (2) there are many farmers growing olives (40,000 farms); and (3) potential for export (MAFCP 2007).

As the country continues to increase production, knowledge of consumer preferences for olive oil could greatly assist in the domestic olive oil marketing and import substitution. Recent studies on the Albanian olive oil industry have focused on the analysis of supply (DSA 2008; Skreli et al. 2009) with a paucity of studies on consumer preferences for olive oil. Understanding consumer preferences has become more important for olive and olive oil industry stakeholders as that knowledge could help in synchronizing production and marketing of these products. The olive oil industry and the Albanian government could benefit from a study on consumer preferences of olive oil attributes, as this information could assist in the development of possible strategies for market segmentation, suitable pricing, product development and standardization and adequate promotion and advertising.

Therefore, the purpose of this research is to determine consumer olive oil preferences. Specifically, the objectives are to determine the product characteristics or attributes that consumers prefer and to determine consumer types based on their preferences. To accomplish those objectives, this study will design and conduct a conjoint choice experiment survey and analyze the data using latent class analysis to determine olive oil attribute preferences and significant socio-demographics of olive oil consumers by class.

Methodology

Conjoint Choice Experiment (CCE)

The conjoint analysis derives from the theoretical basis established by Lancaster (1966) in which the utility of a product is based on the bundle of attributes it has. CCE was developed by Louviere and Woodworth (1983) and originally used in the market research and transport literature (Hensher 1994). Recently, it has been used as a method for conducting surveys for consumer preferences for environmental amenities such as woodland caribou habitat enhancement in Canada (Adamowicz et al., 1996), preferences for deer stalking trips in Scotland (Bullock et al., 1998), and remnant vegetation in Queensland (Blamey et. al. 1999).

The utility of any good is derived from the characteristics of the good rather than the good itself (Lancaster 1966). The CCE is based on the idea that a good can be described by its attributes or characteristics and by the levels of those attributes. There are several advantages to using CCE over traditional conjoint analysis. First, the design of sets of attributes can mimic a change in the product, allowing measurements of tradeoffs that respondents quantify by choosing one attribute

over another. In addition, the survey design allows for the estimation of monetary values when including price as one of the attributes. Furthermore, the method allows researchers to quantify the product attribute's utilities based on the choices the respondents made. Finally, CCE uses discrete choices for choosing among pairs of product profiles, rather than rating or ranking ten or 12 product profiles at one time, thereby reducing respondent's fatigue as is often seen with traditional conjoint analysis.

There are two disadvantages to using CCE. The first is that respondents repeat similar tasks of choosing a profile from a set of two profiles. The respondent may "catch on" and give biased answers. The recommended number of choice set is between 12 – 18 tasks or choice sets (Johnson and Orme 2003), but to minimize that possibility of bias, the number of choice sets was reduced to only 12 per respondent in this study. The second disadvantage to CCE is that there are no incentives to encourage people to participate in the study. However, olive oil is a staple part of the Albanian diet and respondents are more likely to participate if they are familiar with the product. Overall, the advantages of CCE far outweigh its disadvantages.

There are five stages for developing a conjoint choice experiment (Green and Wind 1975, Cattin and Wittink 1982, Halbrendt et al. 1991). The stages for this study are shown in Table 2.

Table 2. Stages for a Conjoint Choice Experiment and Analysis

Stage	Description
1. Selection of attributes	Attributes were selected based on a focus group input and an extensive literature review
2. Assignment of attribute levels	Attribute levels were determined by literature reviews and by focus group comprised of experts in the field
3. Construction of choice sets	The SSI Web program using the Random Method that incorporated orthogonal array was used to create the profiles in the survey.
4. Data Collection	Survey was conducted via face-to-face interviews over the course of 3 days
5. Data analysis	Data is analyzed with latent class approach using Latent Gold 4.0 software

The first and second stages of CCE are to determine the attributes and their levels, respectively. Different studies have used several techniques for determining the most relevant product attributes such as focus group interviews, in-depth interviews or means-end chain analysis (Krystallis and Ness, 2005). For this study we chose to determine the attributes through extensive literature review on choice criterion for observing consumer preferences (Siskos et al. 2001, Sandalidou et al, 2002, Goering 1985, Ga'zquez-Abadand Sa'nchez-Perez 2009) and a focus group of experts in the field. As a result, five attributes were chosen for olive oil: (1) type, (2) origin, (3) place of purchase, (4) taste, and (5) price. For each attribute, levels were chosen through a focus group comprised of experts in the field. The selected attributes and levels are shown in Table 3.

Table 3. Olive Oil Attributes and Their Levels

Attributes	Levels		
Type	Extra Virgin	Virgin	Normal
Origin	Import	Domestic	
Place of Purchase	Shop (Local)	Supermarket	
Taste	Bitter	Pungent	
Price/ ltr (Albanian Leks)	400	650	900

The third stage of designing the CCE involves construction of choice sets. Olive oil product profiles are constructed by selecting one level from each attribute and combining across all attributes. In this study, there are five attributes, of which three have two levels (origin, place of purchase and taste), while type and price have three levels each. Thus, the number of possible profiles totaled 2x2x2x3x3 or 72. A complete factorial design would use all the 72 profiles, which is impractical for respondents to evaluate at one time. The most commonly used method of constructing fractional factorial design in conjoint measurement is the orthogonal array. Orthogonal arrays build on Graeco-Latin squares by developing highly fractionated designs in which the scenario profiles are selected so that the independent contributions of all main effects are balanced, assuming negligible interactions (Green and Wind 1975). From all possible profiles, pairs of profiles were randomly developed and separated into 7 sets with 12 pairs each using software developed by Sawtooth, Inc. Having only 12 pairs to evaluate from ensures the duration of the surveying exercise does not adversely impact a respondent's responses through biased responses as mentioned above.

For each of the seven versions of the survey there are two parts. The first part consists of choosing the12 choice sets and the second part is additional questions that include the socio-demographic details of each respondent. A sample choice set is given in Table 4.

Table 4. Example of a Pair of Olive Oil Profile Scenarios

Attributes	Product A	Product B
Type	Extra Virgin	Normal
Origin	Domestic	Import
Place of Purchase	Supermarket	Shop
Taste	Bitter	Pungent
Price/ltr (Albanian Leks)	900	400

The fourth stage is the data collection stage during which the surveys are conducted and data are collected from the respondents. The survey was conducted at the Tirana Municipality in June 2009. Tirana is the capital of Albania and the biggest urban market in the country, consisting of 30% of Albania's population. (INSTAT 2001). The capital's population is extremely diverse in terms of culture, religion and income.

The interviews were mainly conducted in the food retail market at "Pazari i Ri" in the central part of Tirana, which is visited by a wide variety of consumers. The market is divided into three areas according to three different levels of quality/price product combination. Both professional sellers and local farmers sell their products there. It also attracts people from the entire inner part of the city with different consuming behaviors (systematic and sporadic-weekend purchasing) and purchasing potentials (low, medium and high-income level). The focus group organized to determine the location of the study confirmed that this location is appropriate to obtain a representative sample for the Tirana Municipality as it was the only location that fits the criteria of surveying a wide variety of people within the context of monetary and time constraints for data collection. Figure 1 shows the location of the market "Pazari i Ri", as well as the distribution of poverty levels and population, in the Tirana Municipality.

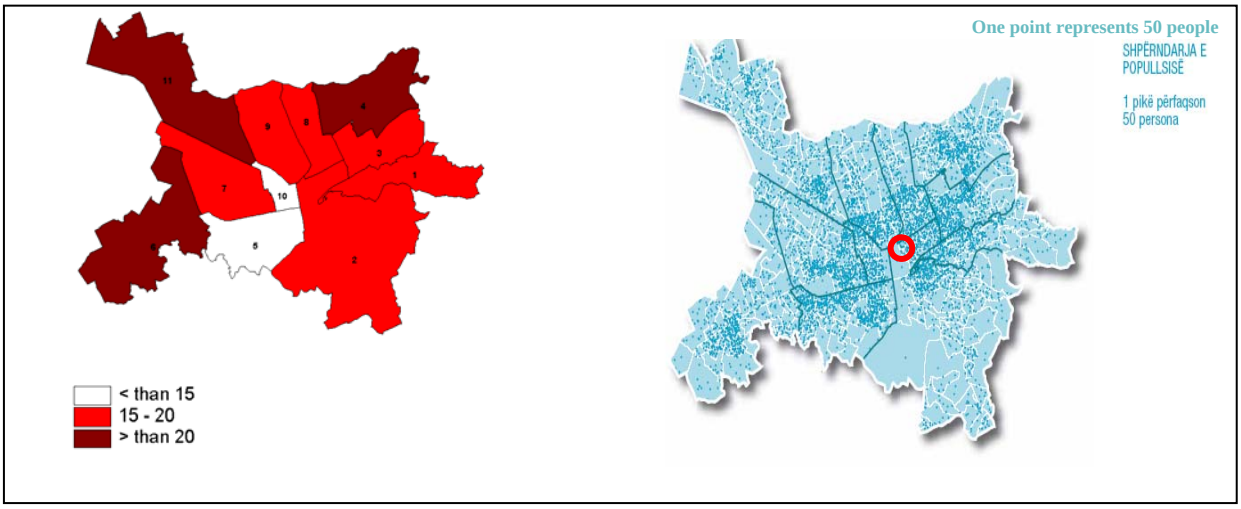


Figure 1. Distribution of population by mini-municipalities of Tirana and the poverty level
Source: 2001 Census and LSMS 2002; *Red color map represents % of people under the poverty line; *Red circle shows Pazari i Ri location

Table 5 shows the socio-demographic comparison of Tirana's population with the sample population. In terms of gender and age, the sample is comparable to that of Tirana's population although there are some differences in terms of education. Disadvantaged people, such as people with lower incomes or lower education levels, are less likely to participate in surveys (Turrell et al. 2002). Hence, the higher education levels are found for the respondents as compared to Albania's population. Income was not included in the socio-demographics table, although it was included in the analysis. There was no available comparison of respondents' income levels. According to the survey, the majority of the survey respondent's household income earned was between 30,000 leks to 80,000 leks per month ($300 to $800 USD).

Table 5. Socio-demographic Comparison of Survey Respondents with Tirana's Population

		Respondents (%)	**Tirana Population (%)**
Gender	Female	48.04	50.14
	Male	51.96	49.86
Age	18-24	9.80	12.89
	25-30	13.24	7.66
	31-35	10.78	10.74
	36-40	14.22	11.40
	41-45	13.24	11.75
	46-50	10.78	10.48
	51-55	8.82	8.59
	56-60	7.84	6.67
	61-64	1.96	6.54
	65 and up	9.31	13.34
Education	Elementary	9.31	13.92
	High School	46.08	58.97
	College	44.12	24.62
	Other	0.49	

Source: Institution of statistics, Republic of Tirana. Available at: http://www.instat.gov.al/

According to Orme (2005), the sample size is determined using the following formula (nta / c ≥ 500) for the latent class analysis (Johnson and Orme 2003) where *n* is the number of respondents, *t* is number of tasks per respondent, *a* is the profiles per task , and *c* is the maximum number of attribute levels. After factoring in the study's time and budget constraints, a total of 204 face-to-face surveys were conducted, thereby meeting the sample size requirements according to the above formula.

Latent Class Analysis (LCA)

After the data are collected, the fifth and final stage of a CCE is the latent class analysis. LCA is used to evaluate respondent choice behavior by capturing both observable attributes of choice and unobservable factors found in the heterogeneity of individuals' behavior (Greene and Hensher 2003; Milon and Scrogin 2006). In other words, respondents are placed into distinct classes (groups) based on their choices when answering the conjoint choice experiment questions. In LCA studies, the probability of making a specific choice among a pair of product profiles is based on the perceived value of product attributes, and covariates of respondents (such as respondent's age and education) (McFadden 1974). The value respondents placed on product attributes and respondents' socio-demographic factors were major factors evaluated in this study. In a conditional logit model, the probability (P_{ni}) that individual n chooses profile i can be represented by the following equation (McFadden 1974):

$$(1) \qquad P_{ni} = \frac{\exp(\eta X_{ni})}{\sum_{h=1}^{I} \exp(\eta X_{nh})}$$

Where η denotes a scale parameter, usually normalized as 1.0. X_{ni} is the deterministic component that is assumed to be a linear function of explanatory variables. Equation (1) can be represented as equation (2) for LCA:

$$(2) \qquad P_{ni} = \frac{\exp(\eta \beta Z_{ni})}{\sum_{h=1}^{I} \exp(\eta \beta Z_{nh})}$$

Where Z_{ni} are explanatory variables of X_{ni}, including a profile-specific constant, product attribute of profile *i*, and socio-demographic factors of respondent *n*. β is a vector of estimated parameter coefficients.

In a latent class analysis, respondents are sorted into *M* classes (groups) in terms of individuals' choice of observable product attributes, and the unobservable heterogeneity among the respondents. The value of estimated parameter coefficient β is different from class to class because this parameter coefficient is expected to capture the unobservable heterogeneity among individuals (Greene and Hensher 2003). Then the choice probability of individual *n* belong to class *m* (m = 1, …, M) can be expressed as equation (3):

$$(3) \qquad P_{ni \mid m} = \frac{\exp\left(\eta_m \beta_m Z_{ni}\right)}{\sum_{h=1}^{I} \exp\left(\eta_m \beta_m Z_{nk}\right)}$$

Where η_m is the class-specific scale parameter and β_m is the class-specific estimated utility parameter.

To begin the analysis, the number of classes needs to be determined using the Bayesian Information Criterion (BIC), the most commonly used criterion to assess model fit in LC analysis (Magidson and Vermunt 2003). The model with the lowest BIC value is the best in terms of number of classes when using the maximum likelihood estimation. The lowest BIC for this data was a 6-class model therefore the model with 6 classes were chosen for this study.

As mentioned above, the probability for individual *n* in class *m* choosing product profile *i*, P(*i*), is measured using two types of characteristics: (1) product attributes, including type (T), origin (O), place of purchase (P), taste (Tt), and price (C); and (2) individual socio-demographic factors, including gender (G), age (A), education (E), income (I), knowledge of different types of olive oil (K) and household size (H). The preference model is specified in equation (4).

$$(4) \qquad P(i) = f(T, O, P, Tt, C, G, A, E, I, K, H)$$

Qualitative attributes generally are presented by 'part-worth' or dummy variable specification in marketing studies (Halbrendt et al. 1995). In this case, where the attributes are qualitative, we used effects-coding specifications for the variables. These variables include: type, origin, place of purchase, taste, gender, education and knowledge of different types of olive oil. Price, age, income and household size attributes are treated as continuous variables.

Results

Results of the model's parameters estimated for each of the six classes using the Latent Gold software are reported in Table 6. LCA assumes that not all the same parameters in each class have the same signs or significance due to the heterogeneity of the respondents. Each of the six classes is described in detail below. In regards to type, extra virgin olive oil is perceived as better quality than the other olive oil types due to its processing method and perceived health benefits associated with the type. The other attributes are specifically based on consumer preference without other levels being "better" than the other.

Class 1 has significant attributes all at the 0.05 level. The significant parameters are extra virgin olive oil, not normal type, domestic (+) and price (+) olive oil. This group can be considered a domestic, high quality preference group who is willing to pay more for their preferred olive oil.

Class 2 is not significantly influenced by type of olive oil when purchasing, but by the origin, place of purchase, and its taste and price. This group significantly prefers domestic (+) and not imports (significant at 0.05 level). They prefer to purchase their products at supermarkets and prefer pungent to bitter olive oil taste, (significant at the 0.10 level). The price (+) of olive oil is also significant (0.05 level). Thus, this class strongly prefers locally produced olive oil and is willing to pay higher prices at supermarkets for olive oil that are pungently flavored.

Table 6. Parameter Estimates

Attributes	Class1	Class2	Class3	Class4	Class5	Class6	Std. Dev
TYPE							
Extra Virgin	0.130**	-0.181	0.023	0.007	0.535	9.488**	2.071
Virgin	0.012	0.065	0.358	0.161	0.017	7.174**	1.556
Normal	-0.142**	0.116	-0.380	-0.168	-0.552	-16.662**	3.620
ORIGIN							
Import	-0.12**	-2.097**	1.703**	-0.300	-0.281	-0.271	1.075
Domestic	0.12**	2.0972**	-1.703**	0.300	0.281	0.271	1.075
Place of Purchase							
Shop	0.003	-0.223*	0.015	0.357	-0.202	-0.513	0.182
Supermarket	-0.003	0.223*	-0.015	-0.357	0.202	0.513	0.182
TASTE							
Pungent	-0.011	0.278*	0.021	-2.544**	2.276**	-0.182	0.875
Bitter	0.011	-0.278*	-0.021	2.544**	-2.276**	0.182	0.875
PRICE	1.138**	2.918**	2.971**	3.428**	2.113**	-1.886	1.237

**Significant at the 0.05 level
*Significant at the 0.10 level

Class 3 has two significant olive oil attributes: origin and price, both of which are significant at the 0.05 level. This group strongly prefers imported (+) and higher priced oil (+). Taste, type and place of purchase have no impact in their oil purchases. Class 3 is a group, which is willing to pay higher prices for imported olive oil.

Class 4 is significantly affected by the attributes taste and price. This group prefers bitter olive oil (+) over pungent and higher priced olive oil (+), both significant at the 0.05 level. This group is a bitter taste-preferring group, which is willing to pay higher prices for their preferred olive oil.

Similar to the previous class, taste and price are also the significant attributes for Class 5. However, they prefer pungently flavored olive oil (+) to bitter (-). They also prefer higher priced olive oils, with both attributes significant at the 0.05 level. This is a group with a preference for pungent olive oil and is willing to pay higher prices for their preferred olive oil.

Class 6 is statistically significant only for olive oil type. They have a strong preference for extra virgin olive oil, followed by virgin olive oil, but did not like normal olive oil (all significant at the 0.05 level). This group can be considered a quality only olive oil group, as none of the other attributes was considered significantly influential in their decision.

Over all, the positive (+) sign for price from most of the classes of respondents was unexpected as it is assumed that people should prefer lower price. However, consumers often associate higher prices with better quality (Volckner and Hofmann 2007). The perceived quality associated with price may spur people to choose higher priced olive oils. This is similar to conjoint choice surveys for wine and olive oil for Italian consumers, where price had high significance on the consumer choices (Scarpa et al. 2004; Cicia et al. 2002).

Spain, Italy and Greece are well-known exporters of olive oil to Albania. It was expected that the preference would be for these imported olive oils. However, Albania also has a long history of cultivation and production of olive oil, which may account for the high preference for domestic olive oil (Classes 1 and 2), although some (Class 3) prefer imports. This is similar with surveys of Greek consumer behaviors (Krystallis and Ness 2005, Matsatsinis et al. 2007). It was also expected that people would choose extra virgin olive oil as their preferred type and this was true for Classes 1 and 6, which were the only classes that showed significance for this type. There was no sign expectation for olive oil taste as it varies depending on consumer preferences, and this was shown with classes 2 and 5 versus class 3 preferring opposite tasting oils. Place of purchase was not significant for any of the classes except Class 2 (0.10 level) and no specific sign was expected for this attribute as it is also a matter of preference and convenience for the consumer.

Relative Importance (RI)

The results of the estimated parameters above showed the significant attributes for each of the classes. However, using RI analysis, we show which attribute among all the attributes is the most important for each of the classes (Table 7). The method of estimating the RI is detailed by Halbrendt et al. (1995). The relative importance of attribute *i* (RI_i) is measured by the ratio of the range of utility change estimates of different levels of the attribute *i* (UR_i) over the sum of such ranges for all attributes of the product $\sum UR_i$:

$$RI_i = 100 \times \frac{UR_i}{\sum_{i=1}^{n} UR_i} \quad (5)$$

Table 7. Estimated Relative Importance of Attributes

Attribute	Class 1	Class 2	Class 3	Class 4	Class 5	Class 6
			(Percentages)			
Class Size	47.61	26.44	8.34	7.12	5.46	5.03
Type	16.19	3.53	10.27	3.24	12.47	**87.26**
Origin	14.32	**49.88**	**47.39**	5.90	6.45	1.81
Place of Purchase	0.34	5.29	0.42	7.02	4.64	3.43
Taste	1.26	6.60	0.59	**50.09**	**52.20**	1.21
Price	**67.88**	34.70	41.33	33.75	24.24	6.29

Classes 1 and 2 combined make up about 74% of the total number of respondents (Table 8). The rest of the 26% is split between the remaining four classes. Class 1 has the largest class size with about 48% of respondents, followed by Class 2 at 26%, Class 3 at about 8%, Class 4 at 7%, Class 5 at 6% and Class 6 at 5%.

Class 1 chose price (67%) as the most important attribute followed by type (16%) and origin (14%). The significance of high price is reflected in its relative importance for this group. Though this group prefers locally produced olive oil, they place more importance on price than on the other two significant attributes. This is contrary to Greek consumers (Matsatsinis et al, 2007) and similar to French and Italian consumers (Siskos et al. 2001, Scarpa and Del Giudice 2004, Cicia et al. 2002) who place price as the one of the most important factors in purchasing olive oil.

Class 2 is also a group that prefers higher prices for locally produced olive oil, but almost 50% of the class chose origin as the most important attribute, followed by price at about 34%. Minimal importance was given to taste (7%), where the product was purchased (5%) and the type of olive oil (4%). In other words, this group strongly prefers local olive oil, which is similar to an Albanian food preference survey in which more than 80% of consumers preferred domestic products (CRSSD 2005 on olive oil and Civici et al., 2004 on wine).

Like Class 2, the origin of the product (47%) and its price (41%) were the two most preferred attributes in Class 3, though in this class imported olive oil was preferred to instead of domestic. So this group prefers imports and willing to pay higher price for them.

In the Classes 2 and 3, origin and price were the most important attributes, but in Classes 4 and 5 taste is the most important attribute (50% and 52%, respectively), followed by price (34% and 24%, respectively). Class 4 likes bitter and Class 5 likes pungent taste.

In class 6 more than 87% of the respondents chose type of olive oil as the most important attribute. The remaining attributes constitute the remaining percent of importance (13%).

To sum up, each class showed distinctly their top importance attribute: Class one for price, class two for domestic olive oil, class three for imported olive oil, class four for bitter taste, class five for pungent taste and class six for extra virgin olive oil.

The above analysis showed the relative importance of each class' attributes, but to determine the types of consumers for each of the six classes for marketing purposes we analyzed the socio-demographics data. The socio-demographics used in most consumer studies are gender, age, education and income. For the socio-demographic analysis of this study, household size and knowledge of the different types of olive oil (Knowledge of Difference) were also included for the analysis (Table 8).

Socio-demographic analysis indicates that Class 1 comes from lower income households. Classes 2 and 5 showed no significant socio-demographics to indicate the types of people included in these groups. Class 3, which has the largest number of significant socio-demographics, is comprised of older females who are not likely high school graduates, but are from higher income households. They also do not have prior knowledge regarding the

differences between the types of olive oils. The characteristics of this class are very similar with the female consumers described in a survey conducted by Krystallis and Ness (2004). Class 4 is comprised of people who are knowledgeable about the different oil types and Class 6 is a male dominated group from small households.

Table 8. Socio-demographic Estimates by Class

Covariates	Class 1	Class 2	Class 3	Class 4	Class 5	Class 6
GENDER						
Male	0.082	0.006	-0.949**	0.263	-0.025	0.624*
Female	-0.082	-0.006	0.949**	-0.263	0.025	-0.624*
EDUCATION						
Elementary	0.394	0.789	1.349	1.940	-2.090	-2.381
High School	-0.330	-0.194	-1.330*	-0.896	1.319	1.430
University	-0.064	-0.595	-0.019	-1.043	0.771	0.951
INCOME	-0.253**	-0.125	0.342**	0.153	-0.120	0.003
AGE	-0.017	0.006	0.037*	0.006	-0.024	-0.008
KNOWLEDGE OF DIFFERENCE						
Yes	-0.191	0.041	-0.728**	0.751**	-0.003	0.130
No	0.191	-0.041	0.728**	-0.751**	0.003	-0.130
HOUSEHOLD SIZE	0.054	0.142	0.212	0.131	0.055	-0.594**

Discussion

To sum up the different results (utilities estimation, attribute importance and socio-demographic analysis), we can indicate that Class 1 respondents preferred extra virgin domestic olive oil and willing to pay higher prices, but were from lower income households, which was contrary to our expectations. Its members considered price as the most important attribute out of the five but, in general, low income people are not as willing to pay higher prices for food items. However, it may be that Albanians see olive oil as a healthier oil and as such, are willing to pay more for it. In addition, the average consumer in Tirana is not familiar with quality criterion of olive oils. Currently, Albania has weak food quality and safety assurance enforcement such that consumers have to rely on their uneducated judgments and experience to gauge quality. As a result, Albanian consumers behave just as any other consumers in the presence of asymmetric or vague information on the product, and use price as an indicator of quality (Sandalidou et al. 2002, Anania and Nistico 2004, Cicia et al. 2002).

Class 2 respondents consider origin to be the most important attribute. This class combined with Class 1 together account for almost 75% of the respondents who preferred domestic olive oil.

Even with preferences for higher priced domestic olive oil, the reality with over 1,000 tons of imports, some of the consumers of this group might still be purchasing imported olive oils. Albania's olive oil prices range from USD$ 3-5 dollars per liter, while prices from Spain, Italy and Greece are higher. Spanish olive oil has the lowest prices at $6.25 per liter, with import taxes driving the prices Albanians pay even higher. As mentioned above, without prior knowledge of or familiarity with these products, price is often used as an indicator of quality. As olive oil is a staple part of the Albanian diet, people will tend to purchase good quality items to consume. As a result Albanians might choose to purchase imported olive oil as they interpret the higher prices as indicating a good quality olive oil. Often quality can be standardized and labeled that indicates its quality. However if the label is not recognized by the consumers, they would most likely choose other olive oils that are more well-known or default to using price as a quality indicator.

In Class 3, which is comprised of older females who generally prefer imported olive oil and higher prices, the imported products were likely seen as being higher quality. Imports are perceived being produced in a more secure and controlled environment with more available information regarding safety issues (Civici et al, 2004). Since the females and retired males who usually take care of everyday food purchases tend to be more risk averse, they focus on food safety when selecting their everyday food purchases. In this survey, their orientation towards imported products appears to be a result of their perception of the affiliation between imports and safety. It is not surprising that this group exhibits no significant preferences based on type, as its members do not have knowledge of the different olive oil types. This lack of product knowledge can lead to a reliance on price as a marketing cue for product quality (Volckner and Hofmann 2007, Verdu-Jover et al. 2004, Zeithaml 1988 quoted at Veale and Quester 2009, Gabor and Granger 1966, Kupiec and Revell 2001), which results in a preference for higher priced olive oils. Other studies show that origin is also taken as a proxy for quality (Cicia et al., 2002, Scarpa and Del Giudice 2004)). High income families, such as those found in Class 3, are more likely to be able to afford and be willing to pay the higher price demanded for olive oils imported from well-known producers such as Spain, Italy and Greece.

Classes 4 and 5 showed statistically significant preference only for taste and price, with taste ranked as the most important attribute. Together these two classes make up about 13% of the total number of respondents. Although Class 5 did not show any significant socio-demographics, Class 4 showed significant knowledge in the difference between the types of olive oil, which allowed them to form a specific olive oil preference. This is useful for producers in marketing to label their products as it can be exploited to enhance product recognition. Some classes had a specific taste preference for bitter (Class 4) and pungent (Class 5) and both are willing to pay higher prices for their preference. Though this population segment is small, it creates the potential for small niche markets that cater to specific consumers. As these consumers are willing to pay higher prices for their preferred product, these niche markets can produce high quality olive oil directed towards such consumers.

Class 6 had significant preference for types of olive oil and considered this attribute to be the most important. This class was also the only class that showed a negative, though not statistically significant price preference. Type of olive oil seemed to entirely determine their purchasing decisions. It would be of interest to learn how much this class would be willing to pay more for

their desired olive oil product. To do so, willingness-to-pay could be determined for Class 6 in terms of purchasing extra virgin olive oil or virgin olive oil as opposed to normal olive oil.

Willingness to Pay (WTP)

Willingness to pay as defined in equation 6 shows the maximum amount of money that consumers are willing to pay for changes in product attributes. Willingness to pay can be determined using the ratio of the difference of the attribute coefficients to the negative of the coefficient of the monetary attribute (Colombo et al. 2008). In this study, the WTP equation is as follows:

$$WTP = -\frac{1}{\beta_m}(V^1 - V^0) \quad (6)$$

Where, β_m is the parameter estimate of price, and V^0 and V^1 are the initial utility and after change utility of an attribute, respectively. This willingness to pay for Class 6 respondents is an additional 12.2 leks to upgrade from virgin to extra virgin olive oil and 13.8 leks from normal to extra virgin.

Conclusion

Changes in the Albanian economy have led to changes in consumer behavior and preferences for the olive oil. Understanding consumer preferences is important for stakeholders and government policy makers in marketing their products as well as producing the products preferred by their consumers. These preferences can be determined through the attributes and/or characteristics of the olive oil product, and consumer types can be inferred from the choices that they make amongst those attributes.

Results of latent class show 6 different classes of people with different olive oil preferences. A majority of respondents preferred a specific type or taste of higher priced, domestic olive oil, though a small percentage preferred imported oil. Overall, a majority of the respondents chose price to be among the most important attributes.

The overall picture shows a strong demand for quality. Origin is a key choice factor for three out of six consumers' segments, altogether representing 82% of respondents. Also, there is not a direct correspondence between low income and preference for low prices, as high prices are considered one of the few reliable proxies for quality.

Most of the consumers show a preference for Albanian olive oil, even though trade statistics show that imports are growing. This can be explained by the fact that imported olive oil is generally considered higher quality. From the study, Albanian olive oil would be preferred, but consumers have little confidence in the quality and food safety standards of the domestic commercial processor since commercial fraud is common due to underfunded regulating authorities to carry out their duties (World Bank 2007). Many consumers still choose to buy olive oil directly from farmers they know, as they trust the quality of their products more than

commercial processors. All these factors create ideal conditions for branding, for promotion of quality for niche markets.
A key issue for improving customer's confidence is to set transparent standards and regulate compliance. Albanian standards on paper for olive oil are comparable to the standards provisions included in 1995 European Union regulation (i.e. EC Regulation 656/95). Since 1995, however, some changes have been introduced in the EU rules. This will require modification of the Albanian legislation to keep up with European Union system of rules (the *acquis communautaire*).

In addition, the Albanian institutions in charge of controlling and promoting the olive oil industry have to seriously begin to focus on strengthening the standards of food safety and quality certification to gain Albanian consumers' confidence on domestic labeling and standards. Only if consumers eventually gain confidence in the correlation between quality declared in the label and actual quality of product, then high price will be no more be considered the best proxy for quality.

This study showed that there is a high demand for Albanian olive oil. Furthermore, the majority of respondents indicate they are willing to pay a higher price for the product. However, in reality, there is a substantial amount of imported olive oil, which indicates there exist a demand for imports. Again, this could be due to the perceived higher quality of imported olive oil. Albania needs to have standardized regulations for quality and branding/labeling of domestic products, which will be recognized nationally and internationally in order for people to trust the quality of their products. In addition, the olive oil industry needs to educate and market to both current and potential consumers regarding the quality of domestic olive oil.

The Albanian olive oil industry's future outlook is positive. Incorporating consumer preferences into a product development and marketing strategy could benefit the industry in improving domestic sales. Knowing the olive oil attributes preferred by the consumers can help suppliers improve and define their market segments and niches, which are clearly characterized in this study. This market segmentation information can be used by olive oil producers and by food distribution operators to adapt their offerings.

As found in this study, a majority of the respondents are willing to pay higher prices for domestic olive oil but imports are still a large share of their consumption. This result is in line with different olive oil and food product studies, which showed that with vague knowledge of and information on quality differences, consumers use price as a quality indicator. Such findings have many implications for companies and institutions. Albanian companies of quality products can use a price leader strategy to set themselves apart from other companies that produce lower quality products. In addition, the institutions in charge of controlling and promoting the olive oil industry have to focus on issues such as food safety and quality certification.

There are also small niche markets for specific characteristics of olive oil such as taste and type, indicating an opportunity for a variety of olive oil products. Specifically, Albanian producers can offer different olive oils in terms of acidity, aroma, taste and color by diversifying the genotypes and regions of culture of the raw olives. A further study of the various types and tastes of olive oils is needed to better understand the specialized preferences of consumers. Table 9

(see Appendix) summarizes the results of the study by classes and the respective recommendations to the industry and government bodies.

Educating consumers about all aspects of olive oil production is much needed and could also help in promoting olive oil consumption, particularly in regions such as northern Albania which are not familiar with the product types. Promoting the substitution of domestic olive oil for fats from other oils may also encourage import substitution of olive oil and even facilitate exports.

The olive oil industry in Albania is growing and the future outlook for the industry is positive. Incorporating consumer preferences into product development and marketing will benefit the industry and help in selling the product to the consumers. With the increase in olive oil production, knowledge of consumer preferences will help satisfy consumer demand and assist local producers in competing with imported products, producing a more diversified domestic market.

Acknowledgement

The authors would like to thank the Albania-Hawaii Higher Education and Economic Development (AHEED) project for making this collaborative research possible and to Jean-Lepczyk and Quanguo Zhang for their time and assistance with preparation of this paper.

References

Adamowicz, W., Swait J., Boxall, J., Louviere, J.J. and M.Williams. 1996. Perceptions versus Objective Measurement of Environmental Valuation. *Journal of Environmental Economics and Management* 32:65-84.

Anania, G. and R. Nisticò, R. 2004. Public Regulation as a Substitute for Trust in Quality Food Markets: What if the Trust Substitute cannot be Fully Trusted? *Journal of Institutional and Theoretical Economics JITE.* 160: 681–701. ISSN 0932-4569

Berisha, A. and V. Mara. 2005. Role of diets in Balkan countries, as part of Mediterranean diets, in people's health. *Albanian Journal of Agricultural Sciences*, 1(1) Tirane, Albania.

Blamey, R., Bennett, J., Louviere, J., Morrison, M. and J. Rolfe. 1999. *The use of policy labels in environmental choice modeling studies.* Canberra: University of New South Wales.

Bullock, C.H., Elston, D.A., and N.A. Chalmers. 1998. An Application of Economic Choice Experiments to a Traditional Land Use: Deer Hunting and Landscape Change in the Scottish Highlands. *Journal of Environmental Management.* 52(4):335-351.

Cattin, P. and D.R. Wittink. 1982. Commercial Use of Conjoint Analysis. *Journal of Marketing.* 46:44-53.

Cicia, G., Giudice, T.D. and R. Scarpa. 2002. Consumers' perception of quality in organic food: A random utility model under preference heterogeneity and choice correlation from rank-orderings. *British Food Journal.* 104(3-5): 200-213.

Civici, A., F. Guri, and E. Zhllima. 2004. Wine production and consumer behavior in Albania. *Albanian Bulletin of Agricultural Sciences.* 3(3):34-41.

Colombo, S., N. Hanley, and J. Louviere. 2008. Modeling preference heterogeneity in stated choice data: an analysis for public goods generated by agriculture. *Stirling Economics Discussion Papers.*

Center for Rural Studies and Sustainable Development (CRSSD). 2005. Marketing with dignity. *Working paper for OXFAM* .

Development Solutions Associates (DSA). 2008. Value chain analysis of table olives and olive oil in Albania. *Working paper for USAID Project.*

Food and Agriculture Organization (FAO). 2003. Food Balance Sheet: Share of Total Dietary Fat Consumption. http://faostat.fao.org/site/368/default.aspx (accessed February 10, 2010).

Gabor, A. and C.W.J. Granger. 1966. Price as an indicator of quality: report on an inquiry. *Economica*, 33:43-70.

Ga´zquez-Abad, J.and M. Sa´nchez-Pe´rez. 2009. Factors Influencing Olive Oil Brand Choice in Spain: An Empirical Analysis Using Scanner Data. *Agribusiness,* 25(1):36–55.

Goering, P. A. 1985. Effects of product trial on consumer expectations, demand, and prices. *Journal of Consumer Research*, 12:74–82.

Green, P.E. and Y. Wind. 1975. New Ways to Measure Consumers' Judgments. *Harvard Business Review,* 89-108.

Greene, W. H. and D.A. Hensher. 2003. A latent class model for discrete choice analysis: contrasts with mixed logit. *Transportation Research Part B: Methodological,* 37 (8):681-698.

Grigg, D. 2002. Olive oil, the Mediterranean and the world. *GeoJournal* 53: 163–172, Kluwer Academic Publishers. Netherlands.

Halbrendt, C.K., F.F. Wirth, and G.F. Vaughn. 1991. Conjoint Analysis of the Mid-Atlantic Food-Fish Market for Farm Raised Hybrid Striped Bass. *Southern Journal of Agricultural Economics,* 23: 155-164.

Halbrendt, C.K., Q. Wang, C. Fraiz, and L. O'Dierno. 1995. Marketing Problems and Opportunities in Mid-Atlantic Seafood Retailing. *American Journal of Agricultural Economics,* 77(5): 1313-1318.

Hensher, D.A. 1994. Stated preference analysis of travel choices: the state of practice. *Transportation,* 21: 107-133.

Institute of Statistics (INSTAT). 2001, Census of population and dwellings in Albania, INSTAT post Census publication series, Tirana, Albania.

International Olive Oil Council. 2009. Olive products market report summary. *Market Commentary*. http://www.internationaloliveoil.org/COIAdmin/resources/pdf/MarketJanuary-Mach09.pdf (accessed November 2009).

Johnson, R. and B. Orme. 2003. Getting the most from CBC. Sawtooth Software Research Paper Series. http://www.sawtoothsoftware.com/education/techpap.shtml (accessed March 3, 2010).

Krystallis, A. and M. Ness. 2005. Consumer Preferences for Quality Foods from a South European Perspective: A Conjoint Analysis Implementation on Greek Olive Oil. *International Food and Agribusiness Management Review*, 8(2):68-91.

Kupiec, B. and B. Revell. 2001. Measuring consumer quality judgments. *British Food Journal,* 103(1)7-22.

Lancaster, K. 1966. A New Approach to Consumer Theory. *Journal of Political Economy*. 74(2):132-157.

Leonetti L, D. Viaggi, and D. Imami. 2009. Analysis of the dynamics of the wine market in Albania. *NEWMEDIT*, forthcoming.

Living Standards Measurement Study (LSMS). 2002. Food and alcoholic beverages expenditures. Working material for INSTAT computation of household budget. Not published.

Louviere, J.J. and G.G. Woodworth. 1983. Design and analysis of simulated consumer choice or allocation experiments: An approach based on aggregated data. *Journal of Marketing Research,* 20: 350-367

Ministry of Agriculture, Food and Consumer Protection (MAFCP). 2007. The Strategy for the Agricultural Development for the period 2007-2013. Policy Document. Tirana, Albania

Magidson, J. and J. Vermunt. 2003. Latent Class Models. http://www.statisticalinnovations.com/articles/sage11.pdf (accessed November 2009).

Mane, A. and I. Kapaj. 2009. Assessing the comparative advantage of olive oil production in Albania. http://www.ifama.org/library.asp?collection=2009_budapestandvolume=symposium/1045_paper.pdf (accessed November 2009).

Matsatsinis, N.F. , E. Grigoroudis, and A.P. Samaras. 2007. Comparing distributors' judgments to buyers' Preferences-A consumer value analysis in the Greek olive oil market. *International Journal of Retail and Distribution Management*, 35(5):342-362.

McFadden, D. S. 1974. Conditional logit analysis of qualitative choice behaviour. *Frontiers in econometrics*. New York: Academic Press.

Milon, J.W. and Scrogin, D. 2006. Latent preferences and valuation of wetland ecosystem restoration, Ecological Economics, 56(2), 162-175

Mtimet, N., Kashiwagi, A.K., Zaibet, L. and N. Masakazu. 2008. Exploring Japanese olive oil consumer behavior, Paper prepared for presentation at the 12th EAAE Congress 'People, Food and Environments: Global Trends and European Strategies', Gent (Belgium), 26-29

Orme, B. 2005. *Getting Started with Conjoint Analysis: Strategies for Product Design and Pricing Research.* Madison, Wis.: Research Publishers LLC.

Sandalidou, E., Y. Siskos, and G. Baourakis. 2002. Customers' perspectives on the quality of organic olive oil in Greece-A satisfaction evaluation approach. *British Food Journal,* 104(3-5):391-406.

Scarpa, R. and T.D. Giudice. 2004. Market segmentation via Mixed Logit: Extra-Virgin Olive Oil in Urban Italy. *Journal of Agricultural and Food Industrial Organization* 2(7).

Siskos, Y., N.F. Matsatsinis, and G. Baourakis. 2001. Multicriteria analysis in agricultural marketing: The case of French olive oil market. *European Journal of Operational Research* 130:315-331. www.elsevier.com/locate/dsw (accessed November 2009).

Skreli, E., D. Imami, L. Leonetti, and B. Feraj. 2009. Analysis of the olive and olive oil value chain in Albania through the expert choice method. 4th Annual Meeting of Alb-Shkenca Institute, Tetova, Maqedonia

Turrell, G., C. Patterson, B. Oldenburg, T. Gould, and M.A. Roy. 2002. The socio-economic patterning of survey participation and non-response error in a multilevel study of food purchasing behaviour: area- and individual-level characteristics. *Public Health Nutrition*, 6(2):181–189.

Veale, R. and P. Quester. 2009. Do consumer expectations match experience? Predicting the influence of price and country of origin on perceptions of product quality. *International Business Review,* 18:134–144. www.elsevier.com/locate/ibusrev (accessed November 2009).

Verdu-Jover, A. J., F.J.L. Montes, and M. Fuentes-Fuentes. (2004). Measuring perceptions of quality in food products: The case of red wine. *Food Quality and Preference,* 15:453–469.

Volckner, F.and J. Hofmann. 2007. The price-perceived quality relationship: A meta-analytic review and assessment of its determinants. *Marketing Letters*, 18(3):191-196.

World Bank. 2007. Strategic Policies for a More Competitive Agriculture Sector in Albania, Report No. AAA18-AL, Tirana, Albania.

Zeithaml, V. A. 1988. Consumer perceptions of price, quality, and value: A means-end model and synthesis of evidence. *Journal of Marketing* 52:2–22.

Appendix

Table 9. Result Summary and Marketing Recommendation

Class	Class Size (%)	Significant Preference Attributes	Significant Socio-Demographics	Marketing Recommendation	For Whom
1 4	7.6	Type - Extra Virgin Origin - Domestic Price - Higher	Low Income	Price Leader Strategy to set them apart from lower quality company National and international quality certification Gov Market Segment Strategy by enlarging the price gap between olive oils	Industry ernment Industry
2 2	6.4	Origin - Domestic Place of Purchase - Supermarket Taste - Pungent Cost - Higher		National and international quality certification Gov Food safety - build trust with industrial producers Research on different cultivars and climate Price Leader Strategy to set them apart from lower quality company	ernment Industry and Government Government Industry
3 8	.3	Origin - Import Cost - Higher	Female Older Unlikely to have High School Education Higher Income No Knowledge of Difference in Olive Oil type	National and international quality certification Gov Price Leader Strategy to set them apart from lower quality company National and international quality certification and education	ernment Industry Government
4 7	.1	Taste - Bitter Cost - Higher	Knowledge of Different Olive Oil types	Market segmentation for small niche markets and research on cultivars	Producers and Government
5 5	.5	Taste - Pungent Cost - Higher		Market segmentation for small niche markets and research on cultivars	Producers and Government
6 5	.1	Type - Extra Virgin, Virgin	Male, Small Household	Price Leader Strategy to set them apart from lower quality company, adopt new processing technology	Industry

International Food and Agribusiness Management Review
Volume 13, Issue 3, 2010

Reviewing, Reviewers and the Scientific Enterprise

Vincent Amanor-Boadu[®]

Associate Professor, Department of Agricultural Economics, Kansas State University, 306 Waters Hall, Manhattan, Kansas, 66506, U.S.A.

Abstract

Despite their critical importance to the scientific enterprise, reviewers receive no formal training and reviewing has become a skill that they pick up through trial and error. Additionally, because most reviewers do not receive any feedback on their performance, any bad reviewing habits become entrenched over time. This has contributed to significant and unnecessary anxiety about reviewing and to antagonistic encounters between reviewers and authors. This paper seeks to correct this situation by defining reviewers as co-creators of scholarship and the reviewing as a quality control process in the production of scientific scholarship. The paper provides three groups of activities aimed at creating the right mindset among reviewers to facilitate this co-creation and quality control perspective: relationships, commitment and honest decisions and recommendations.

Keywords: reviewers, reviewing, scientific enterprise, scholarship, co-creation

[®]Corresponding author: Tel: + 1 785 532 3520
Email: Vincent@ksu.edu

Introduction

The scientific enterprise is a collaborative endeavor involving authors, reviewers and editors. Its purpose is to advance knowledge and address society's intellectual and/or practice needs. While authors' and editors' responsibilities in this enterprise are clearly defined within the framework of the scientific process (Popper1994; Merton 1942) and the production of journals with high quality articles, reviewers' responsibilities have remained fuzzy despite their participation in the scientific enterprise since the early 1700s (Zuckerman and Merton 1971; Glen 1989). Poor understanding of reviewers and reviewing has led some to define reviewers as gatekeepers in the scientific enterprise (Crane 1967), and others to perceive reviewers as exhibiting higher propensities to exhibit superior knowledge over authors by seeking faults where there may, indeed, be none (Klahr 1985). The review process itself has been described as akin to divination (Glen 1989) and judged as being often careless in its outcomes (Bradley1981). Jauch and Wall (1989) observe that reviewers are frequently seen as people hiding behind the cloak of anonymity who "stab, like bravoes, all who come that way"(Churchill, in Peyre 1967).

The root of the foregoing perceptions about reviewing and reviewers may be attributed to the absence of any "formal training for referees, who usually pick up their review skills through learning by doing" (Tsang and Frey 2007, 129). Because of their credentials, editors expect reviewers to know what to do when reviewing, and as a result rarely provide them any guidance or feedback on the review process and their reviews. The purpose of this paper, then, is to provide some guidance to reviewers by clarifying reviewers' role in the scientific enterprise as co-creators of scholarship and reviewing as a quality control activity. Although the author draws on his experience as an associate editor of the *International Food and Agribusiness Management Review* (IFAMR) in the framing of the issues discussed in the paper, the review of the literature suggests the relevance of the topic to the academy engaged in scientific enterprise.

Reviewers and the Scientific Enterprise

Science is dynamic and the scientific enterprise is cumulative, requiring authors to situate their activities against prior evidence. Science reaches the public in the form of scholarship, packaged for this purpose as journal articles. The partners in the production of this scholarship are authors, who write the articles (inputs) for publication; the editors who publish (produce) the products of scholarship; and reviewers who help authors in improving their articles (quality control) and editors in their selection decisions. Accelerated specialization resulting from the dynamic and cumulative characteristics of the scientific enterprise has enhanced reviewer's quality control role in the scholarship production process.

Reviewer's quality control responsibilities are accomplished by, among other things, evaluating manuscripts' content against prior knowledge in the field and assessing their contribution to advancement of science or practice. This implies that reviewers occupy the interesting nexus of contributing their time, knowledge and expertise to help authors, editors and their professional communities advance scholarship and produce *useful* scientific products. Thus, contrary to the criticism that the review process is a barrier to creativity in the scientific enterprise, reviewers help impose the discipline of logic and factual accuracy on authors to the benefit professional communities while protecting authors from embarrassing mistakes (Jaeger and Toft 1998).

The scientific enterprise's business is the production of knowledge, and the relevant performance metric for any progressive journal, therefore, is not rejection or acceptance rate, but rather article quality. However, there is no independent measure of manuscript quality prior to publication (Bakanic et al. 1987). Editors have depended on reviewers' knowledge and expertise to help identify articles that have the potential to be high quality after production. A *potentially* high quality article in the *International Food and Agribusiness Review (IFAMR),* for example, will provide useful tools or insights for agribusiness researchers and/or practitioners and facilitate the advancement of the profession's scientific enterprise and/or its productivity. Post publication, an article's quality is measured by readership frequency and/or citation over time. Producing high *quality articles* consistently engenders a positive feedback effect, which enhances a journal's reputation and increases its readership and citations. Thus, like any producer bringing a new product to market, editors must focus on reducing uncertainty about the product's performance in the marketplace by minimizing potential defects ex ante using reviewers as quality controllers.

Given that the scientific enterprise is not purely altruistic—authors and publishers receive both pecuniary and non-pecuniary economic benefits—reviewers are deservedly perceived to wield the power to influence the realization of these benefits (see Mitra and Golder 2008). However, reviewers are the only ones in the production process who receive no benefits except their own contentment in their service, rooting reviewing essentially in idealism (Goldbeck-Wood 1998).

Editors select reviewers based on their expertise, but also on their willingness to serve as well as their past performance in providing quality reviews and on time. Assignment of review responsibilities have been shown to have direct effect on review outcomes (Peters and Cecci 1982). It is not uncommon for two reviewers of the same manuscript to reach diametrically opposed conclusions (Klahr 1985), leading some to argue that the review process is too careless (Glenn 1976). It is here argued that the frequent diversity of opinions about manuscripts results from reviewers' misunderstanding of their role and purpose in the scientific enterprise and the absence of standards in how to conduct and present reviews (Lepak 2009). It is argued that regardless of "real and legitimate differences of opinion among experts about what good science is or should be" (Cole et al. 1981, 885), appreciation of the role and purpose would drive reviewers to the same outcome, i.e., production of high quality scholarship products.

Reviewing as Quality Control

It has been argued that the reviewer's role in the scientific enterprise is quality control. Quality control in scholarship, as in everything else, is about "making better" through careful assessment against standards. This implies the existence of standards against which to measure quality. Given the dynamic and cumulative nature of science, a manuscript's quality is framed by a reviewer's scholarship paradigm. For example, if agribusiness scholarship is defined as research to inform management and leadership, and management and leadership practice to inform research, then reviewers are guided in the review process by the extent to which a manuscript advances scholarship in agribusiness research and/or practice. Framing responsibility in this way allows reviewers to position themselves as collaborating with authors to produce high quality articles. This increases the potential of a shared mental model emerging among multiple reviewers, even if they pursue quality from different perspectives, and eliminates any pretense that reviewers are gatekeepers (Crane 1967; Beyer 1978).

Popper's (1994) view of the scientific process is used to illustrate reviewers' role as co-creators of scholarship (Figure 1). Scholarship production process begins with authors identifying a problem situation (PS_1) and developing some tentative theories (TT_1) to explain it. They conduct experiments or build models to assess the validity of their tentative theories and produce their initial manuscript in time t = 0. Reviewers assigned to the manuscript focus on the elimination of errors using their knowledge and experience, the factual backbone of the problem situation, tentative theories revealed in the manuscript, and the authors' faithfulness to the logic of their thesis. Errors in fact or logic are quality problems to which good reviewers draw authors' attention, helping them see gaps and pointing them to facts that help them correct errors. The identified quality *defects* in the manuscript go back to authors in the form a clearly written review report that aims to encourage enhancing the manuscript's quality. The next version of the manuscript should exhibit an improvement in quality whether authors see reviewers' wisdom or not because any errors resulting from reviewers' interpretation of facts or logic can be attributed to lack of clarity in presentation, which when addressed, increases quality. Figure 1 shows manuscript quality improvement path resulting from the conversations between authors and reviewers as problem situations and tentative theories are refined and errors are eliminated.

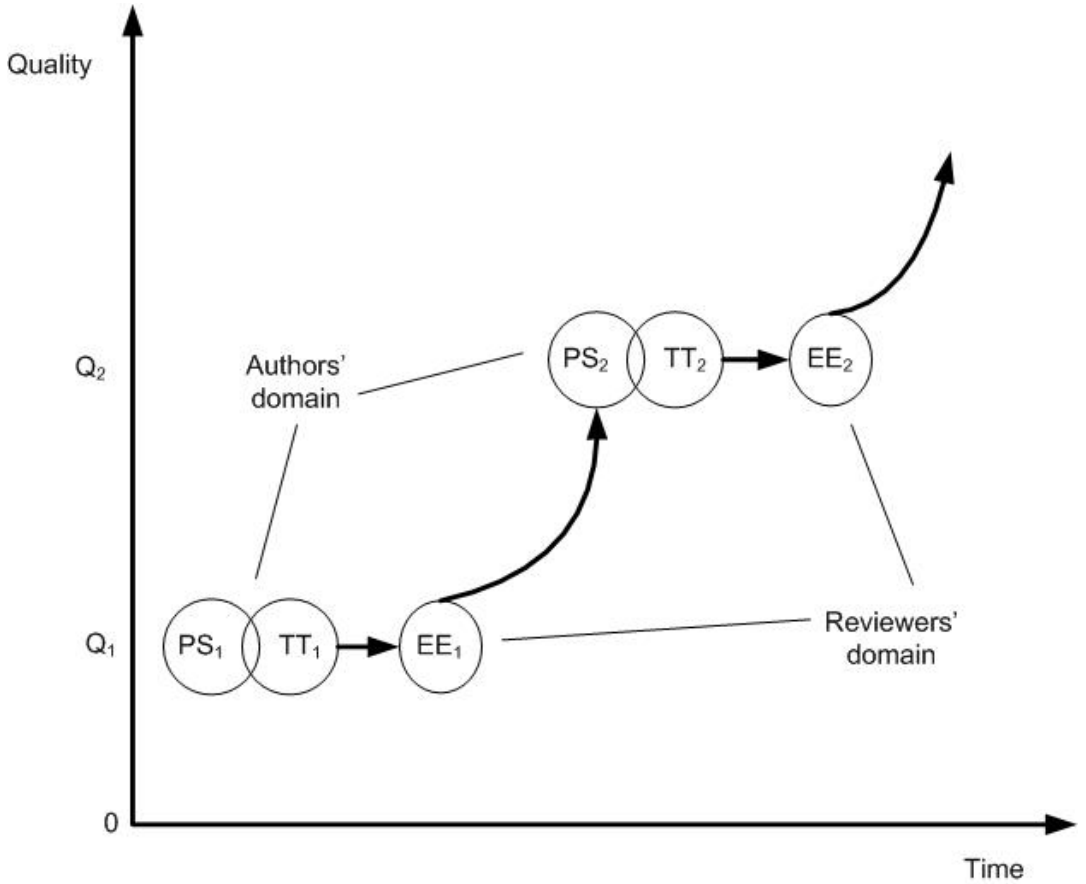


Figure 1. Popper's Problem-Solving Model Reinterpreted to Illustrate the Effect of Iterative Conversations between Authors and Reviews and Their Effects on Manuscript Quality

For interactions between authors and reviewers this to occur, authors and reviewers have to both accept that they suffer from incomplete information and awareness of the state of knowledge in their discipline. They also have to both agree that even if they have all the information, they will suffer from bounded rationality (Simon 1991), a malady that is exacerbated by the increasing specialization. The review process, thus, becomes both a learning and education process, in which both authors and reviewers expand their knowledge, discover new perspectives and improve their scholarship capability.

Guidelines to the Art of Reviewing

Tsui and Hollenbeck (2008, 19) note that an effective reviewer is one who "provides accurate, thorough, thoughtful, timely and constructive critique of a manuscript, along with instructive suggestions on how to improve it." A great review, according to Carpenter (2009, 139) is one that "identifies a path or paths to remedy those weaknesses" that the reviewer has identified. Thus, it is not enough for a reviewer to merely point out the errors. How the errors may be eliminated should also be provided to ensure co-creation of scholarship occurs.

McNutt and Fletcher (1990) note that top quality reviewers discuss the originality, importance, design and interpretation of the study in detail, with references from within and outside the manuscript, while Goldbeck-Wood (1998) observes that good reviewers make specific, useful and constructive comments on presentation. In the spirit of the quality control metaphor adopted in this paper, a great review evaluates whether the author has made meaningful theoretical contributions, adequately defined constructs and clearly described relationships (Lepak 2009). A great reviewer assesses whether a manuscript's underlying theoretical constructs and/or empirical observations have been well-explained with enough depth and completeness to provide new insights, better perspectives and/or superior performance protocols and processes. In other words, the great reviewer is focused on ensuring the consistencies of the manuscript's internal logic and facts are not violated.

The anonymity of the review process used by most scientific journals, IFAMR included, implies that reviewing, essentially, is a thankless task. Yet, as participants in the scientific enterprise, authors need reviewers to achieve their publication objectives. Therefore, reviewing is a professional responsibility that all researchers must bear, motivated by their desire to preserve their craft and sustain the relevance of their creative activities (Harrison 2002).

Outlined below are seven guidelines, organized into three categories, aimed at improving reviewers' engagement in the review process as co-creators of scholarship (Figure 2). These guidelines are by no means a complete formula for success, but a heuristic to acculturate reviewers into seeing themselves as co-creators of scholarship and quality controllers in the production of scholarship. They also seek to enhance the utility reviewers derive from performing their duty as active community contributors.

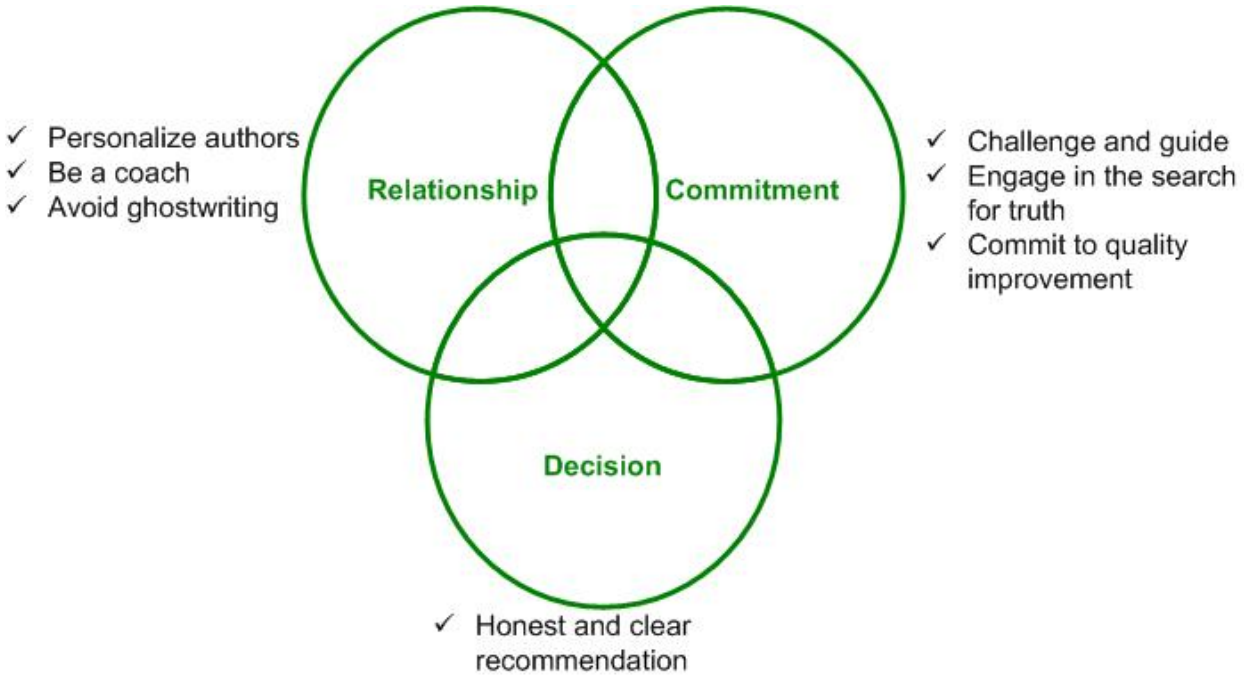


Figure 2. Schematic Overview of Reviewing Guidelines when Reviewers are Co-Creators of Scholarship

Relationship 1: Personalize the Author

Every reviewer is first and foremost an author. Therefore, it is imperative that the review process begins with the recognition of the humanness of the author, thereby facilitating reviewers' full engagement in the co-creation process. Failure to personalize authors often results in searing reviews that are crafted solely to wound and exhibit the reviewer's superiority over the author. These are destructive to the scientific enterprise, and often a waste of time for both reviewers and editors because such searing reports cannot be used to provide any useful guidance to authors on how to enhance their manuscript's quality. As noted by Goldbeck-Wood1998, 86), "Courtesy . . . is a core attribute of good reviewing." One simple way to accord courtesy in the review process is to think and refer to the author in the second person, instead of the third, and let the author *feel* the ensuing conversation in the review report by crafting it carefully with appropriate language and, daresay, humor (Harrison 2002).

Relationship 2: Think like a Coach, Not a Warrior

By thinking of the author as a colleague or a potential collaborator, good reviewers situate their mind frame as good coaches. Like good coaches, they begin with the assumption of talent and an objective to provide guidance and make better—a mental model that helps facilitate a co-creation environment during the review process. Jauch and Wall (1989) report the process that some reviewers use in achieving this: They read the manuscript as soon as it is received to determine their expertise in being able to contribute and assess any potential for bias resulting from their own work and or violation of the blind review requirement. This is instructive because good coaches will have the requisite expertise to add value to the raw talent of their

wards and the confidence to express their own inadequacies. The most important aspect of thinking like a coach involves avoiding fruitless and destructive competition resulting from perceived threats to one's own work from the manuscript (Kuhn 1970). It is important to remember that being identified as a reviewer is acknowledgment from the editors of your knowledge, competence and expertise. There no need to prove anything to the editors.

Reviewers typically take on one of two personas: the evaluator (prosecutor) (Murphy and Cleveland 1995) or the developer (advocate) (Pondy1995). The evaluator seeks the weaknesses of the manuscript and focuses only on its gaps. The developer, on the other hand, seeks to identify the gem in the manuscript and help the author polish it. Sometimes, it is merely the choice of language in a model's description or framing of results that obfuscates clarity or even logical consistency. The reviewer as a developer takes the time to discover how this may be remedied and advises the author thus. Jauch and Wall (1989, 164) again provide some insights from reviewers' comment: "I focus on serious concerns that would stop me from recommending publication and suggest concretely what the author can do to eliminate these concerns . . ."

Relationship 3: Avoid Ghostwriting

With electronic distribution of manuscripts and track changes tools in word processors, it is becoming increasingly tempting to minimize frustration with a manuscript by making the edits or re-writing components that seem to be poorly presented. This is especially true when dealing with a manuscript that exhibits significant promise. Coaches do not perform; they allow their wards to perform, and in so doing, give them the glory. Being a co-creation of scholarship with authors implies allowing them to discover their own voices in their work—their syntaxes, language, idioms, metaphors and prose. When language and the grammar are substandard, often because authors are writing in a second language, reviewers would be most helpful in counseling authors to seek technical writing services.

Commitment 1: Challenge and Guide Authors

Reviewers have a responsibility to ensure that the authors are disciplined in their presentations of arguments and results in their manuscripts. Therefore, a good review is not a laundry list of errors and gaps in the manuscript. Good reviewers, like good coaches, provide directions to authors on how they may address identified gaps to enhance quality, taking time to point them to specific useful literature or constructs and models they have overlooked that could help them improve their thinking and presentation. In the words of Rousseau (1995, 153): "It is important for the reviewer to act as a commentator and a mentor in addition to acting as a critic."

Good review reports always begin with the manuscript's potential contributions because this helps the reviewer to focus on the critical and important aspects for quality enhancement instead of the trivia, such as spelling and grammar—which will be addressed by the editorial staff. Concentrating on the important facilitates prioritization of expectations and helps authors focus on the challenges that are being presented by the reviewer. The ensuing conversation creates the milieu for the co-creation of scholarship.

To ensure efficiency in the conversation process implies respecting authors' time and helping editors keep their promise of providing quick turnarounds on manuscripts. It is recognized that reviewers have full time day jobs. Therefore, if the assigned time to submit the review report is untenable, it is imperative that the editors are informed in order to ensure that the requisite time and attention is given to the review process. After all, careless reviews do no one any good and waste the reviewer's time.

Commitment 2: Engage in the Search for Truth

It is customary for authors to believe that the easiest approach to get a manuscript published is to agree with the reviewer on every point. The flaw in this view is that the reviewer is anonymous and any errors that may emerge in the final published article become the authors' sole responsibility. Therefore, in the interest of scholarship, reviewers must encourage authors to engage them in conversation as they collaborate in search of scientific truth, and in so doing, enhance the manuscript's quality.

A way to encourage engagement is for reviewers to assume that authors might be passionate about their points of view on particular aspects of their manuscripts. Therefore, they should present their review reports in ways that are cogent about errors in logic, facts or in interpretations and/or application limitations of particular theories. At the same time, reviewers must be humble enough to recognize that they may suffer from specialization bias, bounded rationality or sense-making limitations. This humility allows them to enter into learning conversations with authors, contributing to manuscript quality enhancement.

Decision 1: Be Honest and Provide Clear Recommendations

As co-creators of scholarship, reviewers have the responsibility to be efficient and effective in helping their collaborators not waste time. As quality controller, the reviewer is responsible for rejecting manuscripts that lack the quality to make it into publication. However, because of the inherent attachment of authors to their work, it is imperative that the rejection is done politely and with sensitive language and with supporting evidence from the literature.

Reviewers should remind the authors about the journal's mandate if the manuscript does not fit the journal's mandate, and, if possible, suggest an appropriate alternative journal. Even when this is the case, it is still important, in the spirit of co-creation of scholarship, to provide suggestions for improvements that can help improve the manuscript's chances of success in the suggested alternative.

If the manuscript addresses an interesting question but the authors have clearly done a poor job in their presentation, point that out, illustrate the potential contribution they could make and challenge them to undertake the improvements with clear guidance on how they can achieve the recommended output. If the reviewer cannot see how to salvage the situation, it is best to recommend a rejection after explaining the salvaging challenges the manuscript poses. This should help guide the authors in their search for a home for their manuscript. Editors depend on the honesty and clarity of reviewers' recommendations to make their decisions. Incidentally,

authors benefit from this honesty and clarity too, even when it hurts. This honesty is an integral part of the collaborative process involved in the scientific enterprise.

Conclusion

It is almost customary across disciplines that willingness to accept review assignment is inversely related to the how well-known and distinguished a researcher is (Harrison 2002). Treviño (2008, p. 8) laments researchers' propensity to "decline most, if not all requests to review." Yet, reviewing and reviewers are essential to the scientific enterprise. Therefore, it is important that researchers assume their share of the responsibility of advancing science through participating in reviewing.

This paper attributed the foregoing situation to a poor understanding of reviewers' role in the scientific enterprise, creating unnecessary burdens for those accepting to review manuscripts and for authors submitting their work for publication considerations. This poor understanding also contributes to the antagonistic relationship that frequently emerges in the anonymous review process that supports the scientific enterprise.

This paper has presented reviewers as quality controllers and co-creators of scholarship in the scientific enterprise. As quality controllers, they defend the journal from *defective products* making their way to readers, thereby protecting the journal's reputation and assuring readers' confidence in its quality. As co-creators of scholarship, they actively collaborate with authors who have something innovative and novel to offer, helping them polish it so that they are able to move it successfully into the marketplace of knowledge and ideas. Thus, although Harrison's (2002) observation that that reviewing is more like destroying than creating tends to be accurate, this paper explicitly challenges reviewers to undertake reviewing from the perspective of co-creating with authors without losing sight of their role as quality controllers.

To enhance appreciation for reviewing and help reviewers succeed in their new co-creators' role, seven activities, grouped into three categories, were presented as guidelines: relationship with authors; commitment to the enterprise of science; and honest and clear decision about the manuscript. Developing the appropriate relationship with authors demands that reviewers see them as colleagues and potential collaborators, and not antagonists; developing a coach mentality with respect to the author and the manuscript; and helping authors excel without doing their basic work for them. Committing to the enterprise of science requires that reviewers simultaneously challenge authors about their theories, constructs, models, results and interpretations and guide them towards clarity in their assumptions, logic and presentation of their facts for the singular purpose of enhancing the manuscript's quality. Reviewers must provide honest and clear recommendations to authors about their quality expectations in order to help them make the right improvements even as they protect the journal's reputation. They should also provide honest and clear recommendations to editors about whether the manuscript is good enough to accept for publication.

Although a seemingly thankless job, reviewing offers inherent long-term rewards by helping reviewers become better scholars and fostering in them the knowledge that they are contributing to scholarship in their profession. And while many institutions do not put any weight on the

service scholars provide as reviewers (and they should if reviewers act as co-creators of scholarship and quality controllers), the scientific enterprise will be the loser if the culture of reviewing pioneered by the *Journal des Scavens* in the early 1700s (Glen 1989) is not celebrated and enhanced in the 21st century.

References

Bakanic, V., C. McPhail, and R.J. Simon. 1987. The Manuscript Review and Decision-Making Process. *American Sociological Review* 52: 631-642.

Behling, O.C. 1985. Editor's Comments. *Academy of Management Review* 10: 6-7.

Beyer, J.M. 1978. Editorial Policies and Practices among Leading Journals in Four Scientific Fields. *Sociological Quarterly* 19: 68-88.

Bradley, J.V. 1981. Pernicious Publication Practices. *Bulletin of the Psychonomic Society*, 18: 31-34.

Carpenter, M.A. 2009. Editor's Comments: Mentoring Colleagues in the Craft and Spirit of Peer Review. *Academy of Management Review* 34: 191-195.

Cole, S., J.R. Cole, and G.A. Simon. 1981. Chance and Consensus in Peer Review. *Science* 214: 881-86.

Crane, D. 1967. The Gatekeepers of Science: Some Factors Affecting the Selection of Articles for Scientific Journals. *American Sociologist* 33: 195-201.

Glen, W. 1989. Musings on the Review Process. *PALAIOS* 49: 397-399.

Glenn, N.D. 1976. The Journal Article Review Process: Some Proposals for Change. *American Sociologist* 11: 179-185.

Goldbeck-Wood, S. 1998. What Makes a Good Reviewer of Manuscripts? The BMJ Invites You to Join Its Peer Review Process. *British Medical Journal* 316(1998): 86.

Harrison, D. 2002. Obligations and Obfuscations in the Review Process. *Academy of Management Journal* 46: 1079-1084.

Jauch, L.R. and J.L. Wall. 1989. What They Do When They Get Your Manuscript: A Survey of Academy of Management Reviewer Practices. *Academy of Management Journal* 32: 157-173.

Jaeger, R.G.. and C.A. Toft. 1998. Writing for Scientific Journals II: The Review Process. *Herpetologica* 54: S54-S63.

Klahr, D. 1985. Insiders, outsiders, and efficiency in National Science Foundation Panels. *American Psychologist* 40(1985): 148-154.

Kuhn, T. 1970. *The Structure of Scientific Revolutions* 2nd ed., Chicago, IL: University of Chicago Press.

Lepak, D. 2009. Editor's Comments: What is Good Reviewing? *Academy of Management Review* 34: 375-381.

McNutt R, A. Evans, R. Fletcher, and S. Fletcher. 1990. The Effects of Blinding on the Quality of Peer Review. *Journal of the American Medical Association* 263: 1371-1377.

Merton, R. K. 1942. The Normative Structure of Science. In *Merton, Robert K. The Sociology of Science: Theoretical and Empirical Investigations.* Chicago, IL: University of Chicago Press.

Mitra, D., and P.N. Golder. 2008. Does academic Research Help or Hurt MBA Programs? *Journal of Marketing* 72: 31–49.

Murphy, K.R. and J.N. Cleveland. 1995. *Understanding Performance Appraisal*. Thousand Oaks, CA: Sage.

Peyre, H. 1967. *The Failures of Criticism*. Ithaca, NY: Cornell University Press.

Pondy, L.R. The Reviewer as Defense Attorney. 1995. In *Publishing in the Organizational Sciences* 2nd Ed., edited by L.L. Cummings and P.J. Frost, 184-195. Thousand Oaks, CA: Sage.

Popper, K. 1994. *All Life is Problem-Solving*. Munich, Germany: Piper Verlag.

Rousseau, D.M. 1995. Publishing from a Reviewer's Perspective. In *Publishing in the Organizational Sciences* 2nd ed., edited by L.L. Cummings and P.J. Frost, 151-163. Thousand Oaks, CA: Sage.

Simon, H. 1991. Bounded Rationality and Organizational Learning. *Organization Science* 2: 125-134.

Treviño, L.K. 2008. Editor's Comments: Why Review? Because Reviewing is a Professional Responsibility. *Academy of Management Review* 33: 8-10.

Tsang, E.W.K. and B.S. Frey. 2007. The As-Is Journal Review Process: Let Authors Own Their Ideas. *Academy of Management Learning and Education* 6: 128-136.

Tsui, A.S. and J.R. Hollenbeck. 2008. Successful Authors and Effective Reviewers: Balancing Supply and Demand in the Organizational Sciences. *Organizational Research Methods* 12: 1-17.

Zuckerman, H. and R.K. Merton. 1971. Patterns of Evaluation in Science: Institutionalization, Structure, and Functions of the Referee System. *Minerva*, 9: 66-100.

International Food and Agribusiness Management Review
Volume 13, Issue 3, 2010

Maintaining a Healthy Equity Structure: A Policy Change at Producers Cooperative Association

John W. Siebert[Ⓟa] and John L. Park[b]

[a]*Professor, Department of Agricultural Economics, Texas A&M University, College Station, Texas, 77845-2114, U.S.A.*

[b]*Associate Professor, Department of Agricultural Economics, Texas A&M University, College Station, Texas, 77845-2114, U.S.A.*

Abstract

Within its sales territory, Producers Cooperative Association of Bryan, Texas is a dominant feed, fertilizer, and farm supply business. This case study enables students to understand the operating philosophies of this cooperative as it faces over twenty-one different major competitors. The case is designed to give students an understanding of the equity financing of a cooperative; a greater appreciation for creating member value within a cooperative; and an illustration of a successful board decision-making process. This case is intended for use in junior or senior level cooperative management or strategic management classes. Alternatively, the case can also be used in board of director and/or manager training. A separate teaching note explains the authors' desired case learning outcomes and also answers student questions.

Keywords: board of directors, cooperative, retains

Ⓟ Corresponding author: Tel: + 1 979 845 4805
Email: j-siebert@tamu.edu

Other contact information: J. L. Park: jlpark@ag.tamu.edu

IAMA Agribusiness Case 13.3

"You participate in the profits as you participate in generating the profits"
– Bobby Kurten, Chairman of the Board

Serving an area within a one hundred mile radius of Bryan, Texas, Producers Cooperative Association (Producers) provides feed, fertilizer, fuel, and supplies to agricultural producers. As of 2003 this single-facility cooperative's membership totaled 9,591. Such a large membership exists due to the vastness of the surrounding farming and ranching area in combination with a diverse economy capable of supporting both full and part-time agricultural producers. The large membership is also a result of this cooperative's philosophy regarding quality products, excellent service, and a dedication to making a profit.

A Change Considered - 1999

When measured on the basis of return on sales (i.e., profit ÷ sales), General Manager James Deatherage understood that Producers' feed and supply departments were more profitable than either its fertilizer or fuel departments. However, each cooperative patron's allocation of year-end stock was based upon their total purchase dollars regardless of the department patronized. Therefore, in 1999, Deatherage proposed that the Board consider paying out net margins at different rates depending upon each individual department's own profitability. Deatherage thought that if Producers' stock were allocated according to a patron's purchase mix (and hence patron contribution to profits), this would always insure that patrons received the most accurate patronage dividends. As a result several benefits would occur. First, individuals doing business with the most profitable departments would be less likely to take this business to a competitor. Second, individuals doing the vast majority of their business with the less profitable departments would not be receiving profits earned in the more profitable departments. Third, the change would accurately maintain Board focus on those businesses best suited to new investment and sales growth. The seed of an important idea was thereby planted. Namely, Producers needed to be careful not to subsidize its less profitable departments by taking away from its more profitable departments. Such cross-subsidization could ultimately make Producers' profitable departments vulnerable to losing customers.

The Board of Directors was interested in this change, but a motion for the change was not made. One reason was that Producers faced numerous competitors in its twenty county (17,000 square mile) service area. Furthermore, different competitive market structures are faced by each department. For example, feed sales competition comes from Purina, Cargill, and Lone Star. Two of these companies are nationwide, and all three support numerous local feed dealers. Fertilizer competition comes from Helena, Wilbur-Ellis, and American Plant Food. Producers faces online competition in animal health products from Jeffers, Valley Vet, Walco International, Ag Med Supply Company, and Lextron Animal Health. Tractor Supply Company is a broadline farm supply competitor with eight stores in the area. McCoy's sells farm and ranch supplies and has three locations in the area. Producers face five different petroleum suppliers capable of delivering to farm and ranch locations. In addition, since Producers operates a large retail fuel location, they face countless fuel retailers (although not all of these sell farm diesel). In terms of the home and garden product category, Producers faces three major competitors. These are Lowes, Home Depot and Walmart, all of whom have tremendous buying power. Within

Producers' service area, Lowes has three locations, Home Depot has five locations, and Walmart has nine locations.

The Cooperative Business Model

Barton states that a cooperative can be

> …distinguished from other businesses by three concepts or principals: First, the user-owner principle. Persons who own and finance the cooperative are those that use it. Second the user-control principle. Control of the cooperative is by those who use the cooperative. Third, the user-benefit principle. Benefits of the cooperative are distributed to its users on the basis of their use. The user-benefits principle is often stated as business at cost. (p.1)

Barton goes on to state that user-benefits, "occur in the form of patronage refunds, more favorable prices, services that would otherwise be unavailable, and access to markets and assured sources of supplies" (p.2) He adds that, "the primary purpose [of a cooperative] is economic benefits for members." (p.8) A glossary of selected cooperative terminology is provided in Table 1.

Table 1. Glossary of selected terms pertaining to agricultural cooperatives

Term	Term Definition and Synonyms
Cooperative	A business owned by its customers (referred to as a *supply and/or service cooperative*) or owned by its suppliers (referred to as a *marketing cooperative*). Producers is a supply cooperative.
Dividends	The portion of year-end profit paid to cooperative members. In the case of Producers, dividends are paid 30% in *cash* and 70% in *stock*.
Equity	The net asset value of the cooperative, less the liabilities owed by the cooperative to non-members.
Patron	Someone who purchases from a cooperative and is an owner of the cooperative. Also called a cooperative *member*.
Patron Equity	The equity of a cooperative which is specifically identified with an individual member(s). Synonymous with stock.
Profit	Total revenue less all costs and expenses. Also called *net income* or, in a cooperative, *net savings*.
Redemption	The repayment of stock to patrons. Also called *revolving, retiring,* or *redeeming* stock.
Revolving Cycle	The number of years elapsing between when a cooperative issues stock and when that stock is redeemed. Producers is currently on a five-year revolving cycle.
Stock Al	so called *capital stock* and sometimes *preferred stock*. Stock is allocated to individual patrons.

Peterson and Anderson emphasize this when they state, "a cooperative maximizes [member] value when it produces an optimal differential return to members over what they would receive in the absence of cooperative membership." (p.372) When it comes to measuring member satisfaction, Deatherage knows that you cannot take a cooperative member's loyalty for granted. What gives members a valued experience are the things that cause such loyalty: "Run it like a business. Rotating stock [i.e., paying profits as dividends to members] is one of the things that give our members a feeling of ownership value. A managed, consistent rotation of stock will, in itself, create loyalty."

Producers History

Producers was founded in 1943 by seventeen members who purchased railcars of grain in order to bag the grain for use as livestock feed. Beginning in 1948 and spanning a period of 26 years, local rancher Woody Humphries served the cooperative. Mr. Humphries was initially a board member, holding the position of Secretary. In 1951 he was elected Chairman of the Board. In many ways his pragmatic focus set the modern direction of the cooperative: "Priorities are important. You must figure out the difference in what you want to do and what you should do. If you figure that out, you will be successful" (Clifton et al.). Over the years this mantra has manifested itself through Producers philosophy of serving members' needs and doing so at a profit.

Potential members of Producers must be in production agriculture with the intent to earn a profit. They can only join subject to board approval and must pay $10 for one share of preferred stock. As members purchase products from the cooperative, they simultaneously contribute to the cooperative's capital. This occurs because a percentage of the profit generated by each member's dollar purchases is retained in the form of capital stock. Capital stock is redeemed (i.e., paid back to each member) at the discretion of the board. Since the late 1980s, the Producers board has been able to maintain a five-year revolving cycle. Even though members must wait five years, they often refer to their stock as a dividend. Because this capital stock can only be awarded through patronage in the cooperative, a virtuous cycle exists whereby members' on-going purchases fund the cooperative's equity and secure its future growth and operation.

Recent benchmarks show that Producers leads their peers in promptly revolving patrons' capital.[1] A survey was made of ninety-six Texas marketing and/or supply cooperatives working in such areas as cotton, grain, chemicals, fuel, feed, supplies, garden, and/or other (Baros). Seventy-one of these cooperatives replied to a question concerning the "age of their oldest patronage stock outstanding." The average age of the oldest stock was 17.6 years compared to Producers' average of only five years.

The physical assets of Producers feature a modern feedmill, a dry fertilizer manufacturing plant, a self-service fueling station, a 24,000 sq. ft. farm supply store, and a home and garden center. Deatherage explains the financing of Producers growth: "We have grown out of hip pocket. It is nice to be able to say that we are debt-free. However, we cannot let this keep us from being progressive. What is important is the quality of facilities. We take on a new project every single year. You have to keep growing."

[1] The words member and patron are used interchangeably.

Producers Financial Performance

Table 2 provides recent benchmarking statistics for 2007. It presents both balance sheet and income statement information for Producers as compared to the average amongst a peer group of seventeen supply cooperatives (USDA). All of these cooperatives have annual sales between $50 to $100 million. In the balance sheet portion it can be seen that Producers has greater equity as a percentage of total assets, 83.89% versus the group average of 54.51%. Producers' equity

Table 2. Financial statement comparison of Producers Cooperative to the average of similarly-sized U.S. supply cooperatives, 2007[a]

	Producers Cooperative 2007	Supply Co-op Average 2007
Balance sheet		
Current assets	66.99%	54.53 %
Other assets	0.08%	3.02%
Investments	2.86%	17.63%
Plant, Property and Equipment (net)	30.05%	24.82%
Total assets	100.00%	100.00%
Current liabilities	16.10%	36.64%
Total liabilities	16.10%	45.49%
Allocated equity	48.12%	30.55%
Retained earnings	35.77%	23.96%
Total equity	83.89%	54.51%
Total equity and liabilities	100.00%	100.00%
Income statement		
Total sales	100.00%	100.00%
Cost of goods sold	81.30%	86.45%
Gross margin	18.69%	13.55%
Service and other income	1.06%	3.45%
Gross revenue	19.76%	17.00%
Wages 6.	05%	7.20%
Depreciation 1.	56%	1.17%
Interest 0.	00%	0.70%
Other 6.	88%	4.56%
Total expenses	14.49%	13.64%
Income-own operations	5.27%	3.37%
Patronage income	0.67%	1.48%
Non-operating income	0.99%	0.13%
Net income before taxes	6.93%	4.98%
Taxes 0.	78%	0.71%
Net income	6.14%	4.26%
Ratios[b]		
Return on sales (net income / total sales)	6.14%	4.26%
Asset turnover (total sales / total assets)	2.55	2.49
Return on assets (net income / total assets)	15.65%	10.60%
Leverage (total assets / total equity)	1.19	1.83
Return on equity (net income / total equity)	18.66%	19.44%

[a] Co-op average is for 17 U.S. farm supply cooperatives, all having between $50 to $100 million annual sales. Totals may not add due to rounding. **Source:** USDA-RBS.

[b] Dollar totals used for the ratio calculations are as follows. Column one, Producers Cooperative: total sales = $54,009,515, net income = $3,320,863, total assets = $21,208,203, and total equity = $17,792,620. Column two, the aggregate of all 17 U.S. farm supply cooperatives: total sales = $1,114,605,363, net income = $47,524,239, total assets = $448,289,903, and total equity = $244,362,826.

consists of allocated equity (i.e., members' stock) in the amount of 48.12% of total assets versus the group average of only 30.55%. Producers' equity also consists of retained earnings in the robust amount of 35.77% of total assets versus the group average of 13.65%.

In the income statement portion of Table 2 it can be seen that Producers' gross margin is higher at 18.69% of sales versus the group average of 13.55%. Other factors contributing to Producers' performance include lower wages (6.05% of sales versus the group average of 7.20%), lower interest expense (0.00% of sales versus the group average of 0.70%), and higher non-operating income (0.99% of sales versus the group average of 0.13%). As a consequence, Producers' return on sales exceeds that of the group average. Ratios presented at the bottom of Table 2 show that Producers has higher return on sales (6.14% versus 4.26%), higher asset turnover (2.55 versus 2.49), higher return on assets (15.65% versus 10.60%), lower total assets to total equity (1.19 versus 1.83), and a slightly lower return on equity (18.66% versus 19.44%).

For accounting purposes, Producers is divided into four different departments: (1) feed, (2) fuel, (3) fertilizer, and (4) farm supply/home and garden. According to Deatherage, "all four of our departments are profitable. All four pay patronage back." Referring to individual products, Deatherage states, "there are some product lines we cannot be in. Our preference is not to match price just to sell something. Loss leaders are usually just that, a loss."

To paraphrase Deatherage's philosophy of financial management, one might describe him as saying: 'We want to run this cooperative like a business where we have made a good buy, run an efficient operation, and make a return. On the other hand, when it is difficult for us to match a price we prefer not to subsidize the sale of that product. We pay our profits back to the members at year end, yet I do not want our sales people to rely on this point. But I hope members recognize this point, on their own, and factor it into purchase decisions.'

To paraphrase Deatherage's product and service philosophy, one might describe him as saying, 'we want to provide the best products, programs and services with the most knowledgeable, service-oriented staff in our area. Patrons know we can be depended upon. Non-members do business with us for these same reasons.'

Deatherage realizes that debt is a tool to both grow and to multiply earnings. He does not rule out the idea of borrowing, but it would have to be a very special project. He knows his board and members like to say that their co-op is debt-free. Although Producers does grow aggressively, Deatherage cautions against growing just to be larger."

Table 3 shows Producers' steady sales growth over the period 1999 to 2003. Despite facing numerous competitors, Producers has remained a thriving business. The cooperative returned an average of 6.3% of all of the purchase expenditures made by its members. At the end of the year, 30% of these returns were paid to members in cash. The remaining 70% was issued as preferred stock with the Board's intentions being to redeem this stock (i.e., pay back in cash) five years from the date of issue. The cash-stock percentage split, common to many cooperatives, is intended to enable members to pay personal income taxes on cooperative earnings due in the current year. Such taxes are due because these profits have been allocated to the individual members. The relatively fast five year stock rotation cycle prevents owners' investment in the cooperative from being tied up for an extended time period.

Table 3. Total qualified patronage refund distributions, 1999-2003

Year	Total Qualified Distribution[a]	Total Member Purchases	Qualified Distribution Percentage
1999 $	1,796,455	$24,747,659	7.25%
2000 $	1,853,624	$27,435,778	6.75%
2001 $	1,610,180	$28,004,075	5.74%
2002 $	1,450,521	$28,174,811	5.14%
2003 $	2,012,159	$30,443,372	6.60%
Average			6.30%

[a]The term total qualified distribution refers to the money paid back to cooperative members at year end in the form of cash and stock. Total qualified distribution *differs* from a cooperative's net savings (i.e., net income) due to factors such as: book-to-tax depreciation differences; losses on any stock the cooperative owns in federated cooperatives; cooperative earnings on non-member business; any retained earnings, and also the income taxes paid by the cooperative on such non-member business.

Board of Directors Meeting – 2003

After a successful 2003, the matter of allocation of year-end profits received board attention once more. The board had Deatherage research and prepare extensive exhibits about the topic. In the preparation of these exhibits, every effort was made to allocate General and Administrative (G&A) expenses to each department based upon direct use. However, some G&A proved to be un-allocable. Such categories included advertising, annual meeting expense, employee costs for the main office, postage, equipment, security, property taxes, telephone, credit card fees and a few more items, all of which are allocated equally against all sales dollars. Fixed costs, in so far as these can be measured by depreciation, are allocated to each respective department.

Table 4 is a Board exhibit that detailed individual departmental performance for the years 1999-2003. On a percentage of sales basis, earnings averaged 8.71% for Feed, 7.93% for Supplies, 3.33% for fertilizer an 1.55% for petroleum. Feed was the top department for the years 2000, 2002, and 2003 while Supply was the top department for the years 1999 and 2001. On the bottom end, Petroleum was the lowest performer in every single year. Because all members received dividends based on overall profitability, such numbers naturally led Deatherage to be concerned that petroleum customers might be subsidized by the customers of the other departments.

In order for the Board to understand this situation, Table 5 gives a 2003, department-by-department, profile for fourteen different patrons' purchases. Those shown purchased an average of $11,682 in supplies, $41,790 in fuel, $17,915 in feed, and $18,773 in fertilizer. In aggregate, these patrons' received a 2003 refund of $5,960. This payment was the actual 6.61% dividend (based on average profit) for 2003. In contrast, by using the proposed new dividend rates by department, the aggregate payment received by these selected patrons would drop by $2,356 to the new lower level of $3,604. Deatherage had selected the fourteen patrons in Table 5, not as a random sample, but rather so as to profile which types of members would benefit, or lose, as a consequence of their particular departmental purchasing mix.

Table 4. Profits expressed as a percentage of departmental sales, Producers Cooperative

Year	Supply	Petroleum	Feed	Fertilizer	Sales Weighted Average
1999					
Profit	9.07%	1.87%	8.79%	5.49%	7.26%
Difference[a] 1.	82%	-5.38%	1.54%	-1.76%	0.00%
2000					
Profit	7.91%	1.97%	9.41%	4.03%	6.76%
Difference[a] 1.	16%	-4.78%	2.66%	-2.72%	0.00%
2001					
Profit	8.97%	1.81%	7.65%	2.78%	5.75%
Difference[a] 3.	22%	-3.94%	1.89%	-2.97%	0.00%
2002					
Profit	5.46%	0.91%	7.87%	2.34%	5.15%
Difference[a] 0.	31%	-4.24%	2.72%	-2.81%	0.00%
2003					
Profit	8.25%	1.21%	9.83%	1.99%	6.61%
Difference[a] 1.	64%	-5.40%	3.22%	-4.62%	0.00%
5 Year Simple Average					
Profit	7.93%	1.55%	8.71%	3.33%	6.31%
Difference[a] 1.	63%	-4.74%	2.41%	-2.98%	0.00%

[a]Difference refers to the profit of an individual department minus the sales weighted average profit for the cooperative as a whole.

Once the board members looked at Table 5, a significant discussion ensued. Only five of the fourteen patrons shown in the Table would gain from the proposed policy change. The smallest gain was that of patron number twelve, in the amount of $18. The largest gain was going to be that of patron number fourteen, in the amount of $2,270. Patron fourteen's good fortune resulted from the fact that his/her purchases were mainly from the more profitable feed department. On the other hand, nine of those listed in the Table would receive less money due to the proposed change. The smallest of these would be the decrease in the dividend of patron number one, in the amount of -$42. The largest of these would be the decrease in the dividend incurred by patron number eight in the amount of -$21,537. This occurred because patron eight's purchases were all from the petroleum department.

Seeing these exhibits, a board member spoke up to say, "it simply does not seem right to make a change whereby many patrons would lose."

A second board member spoke up in response. "Wait a minute. Look at our average for all patrons shown on the bottom right corner of the Table 5. Our average patron does not win or lose from this change. If this is a more efficient way to price our products, then we need to consider making this change even though some patrons might lose."

Table 5. Impact of proposed profit allocation method based upon selected patron's 2003 purchase history[a]

Selected Patrons	Supply Purchases	Fuel Purchases	Feed Purchases	Fertilizer Purchases	Total 2003 Purchases	Profit Payment at 6.61%	Proposed New Payment[b]	Gain (Loss)
	($/Yr.)	*($/Yr.)*	*($/Yr.)*	*($/Yr.)*	*($/Yr.)*	*($/Yr.)*	*($/Yr.)*	*($/Yr.)*
#1	$4,312	$1,645	$15,340	$11,203	$32,499	$2,148	$2,107	($42)
#2	$658	$0	$11,457	$0	$12,115	$801	$1,181	$380
#3	$30	$3,021	$10	$0	$3,061	$202	$40	($162)
#4	$19,964	$90,593	$5,757	$0	$116,314	$7,688	$3,309	($4,379)
#5	$54,290	$4,889	$680	$66,743	$126,601	$8,368	$5,933	($2,435)
#6	$575	$16,866	$7	$0	$17,447	$1,153	$252	($901)
#7	$6,794	$6,943	$19,182	$40,850	$73,768	$4,876	$3,343	($1,533)
#8	$0	$398,828	$0	$0	$398,828	$26,363	$4,826	($21,537)
#9	$0	$20,698	$231	$75,123	$96,051	$6,349	$1,768	($4,581)
#10	$21,742	$19,999	$29,186	$23,980	$94,907	$6,273	$5,382	($891)
#11	$27,114	$6,202	$52,420	$32,902	$118,637	$7,842	$8,120	$278
#12	$9,734	$4,992	$16,736	$8,899	$40,361	$2,668	$2,686	$18
#13	$14,628	$10,381	$27,053	$240	$52,302	$3,457	$3,997	$539
#14	$3,710	$0	$72,747	$2,888	$79,344	$5,245	$7,515	$2,270
Patrons #1 to #14 Average	$11,682	41,790	$17,915	18,773	$90,160	$5,960	$3,604	($2,356)
Total Coop Patron Avg.	$612	$633	$1,444	$485	$3,174	$210	$210	$0

[a] Totals may not add due to rounding.

[b] Calculated based upon each patron's department-by-department purchase volume according to the formula: Supply * 8.25% + Fuel * 1.21% + Feed * 9.83% + Fertilizer * 1.99%

A third board member said, "patron eight exemplifies what has hurt us in the past and what can also hurt us in the future. This patron is only a fuel customer. However, he/she receives the full benefit of profits earned in the supply and feed divisions. In effect, this patron is taking money earned by other patrons' purchases. Of course, if we change this policy, we might lose this patron's petroleum business all together."

With that silence ensued. Board members turned their attention to the bottom line of Table 5. Sure enough, under this new policy the average cooperative patron did not gain or lose. With that the chairman spoke up, "it is best for the long term health of our co-op that you participate in the profits as you participate in generating the profits."

Upon hearing that, the board member who had initially complained about making a change whereby many patrons would lose, spoke up. "Even though some may get a little less, we have to do what is best for the co-op as a whole. Therefore I will make a motion to the effect that this new policy is adopted to be effective for the year 2004." A second was quickly offered and the motion passed unanimously, 9 - 0.

Questions for Students

1. What results did James Deatherage seek to achieve through having Producers Cooperative pay out annual profits differentially as determined by individual department sales? What do you think may have been some of the unintended consequences of this change?

2. What is the appropriate performance measure for a cooperative's success?

3. Why not simply reduce the cooperative's prices so that less of members' personal money would need to be tied up in cooperative stock for a period of five years?

References

Baros, J. 2009. Telling the Story of Texas Agricultural Cooperatives. Study Paper. Texas A&M University, College Station, Texas, U.S.A. 27. http://www.agecon.tamu.edu/pdf_files/graduate/Baros.09a.pdf

Barton, D. 1989. What is a Cooperative? *Cooperatives in Agriculture*. Prentice-Hall. 1-20.

Clifton, K., T. White, R. Williams, and M. Pinheiro. 1996. "Producers Cooperative Association." Term Paper. Texas A&M University, College Station, Texas, U.S.A. 12.

Peterson, C. and B. Anderson. 1996. Cooperative Strategy: Theory and Practice. *Agribusiness: An International Journal*. 371-384.

Producers Cooperative. 2010. http://www.producerscooperative.com (accessed May 23, 2009).

U.S. Department of Agriculture – Rural Business-Cooperative Service. 2007. Cooperative Programs National Data: Farm Supply Cooperatives Memberships and Sales. http://www.rurdev.usda.gov/rbs/coops/data.htm (accessed April 28, 2009).

International Food and Agribusiness Management Review
Volume 13, Issue 3, 2010

Defining and Meeting the Demand for Agricultural Machinery in China: A Case Study of John Deere

Garrett W. Davis[a], DeeVon Bailey[ⓟb] and Katherine M. Chudoba[c]

[a] *IMBA., Royal Agriculutural College, Utah State University, 9540 Old Main Hill, Logan, Utah, 84322-9540, U.S.A.*

[b] *Associate Vice President for International Research, Utah State University, 9540 Old Main Hill, Logan, Utah, 84322-9540, U.S.A.*

[c] *Associate Professor, Department of Management Information Systems, Jon M. Huntsman School of Business, Utah State University, 3515 Old Main Hill, Logan, Utah, 84322-3515, U.S.A.*

Abstract

This paper examines the experience of a major American-based machinery manufacturer, Deere & Co. in China and how the changing structure of Chinese agriculture and government policy in China toward the machinery supply chain appear to offer evidence of a growing market for farm machinery in China. The findings of this research demonstrate the rapid change occurring in each of these areas as well as the features unique to the Chinese market. Any business that wants to expand into the Chinese agricultural machinery market must carefully consider the dynamics of these issues.

Keywords: China, Machinery markets, John Deere

ⓟCorresponding author: Tel: + 1.435.797.2300
Email: deevon.bailey@usu.edu

Other Contact Information: G. Davis: Garrett.wd@gmail.com
K. Chudoba: Kathy.Chudoba@usu.edu

Introduction

China's economy has grown rapidly during the past two decades, and there has been a surge in demand for food products at a time when labor is bid away from rural areas into urban centers (National Bureau of Statistics of China 2007b). With fluctuating grain prices and stress on agriculture worldwide, China now subsidizes rather than taxes agriculture as it did in the past so that incentives exist to increase agricultural production (Gale, Lohmar, and Tuan 2005). The need to increase agricultural production will have profound and lasting impacts on the sectors providing inputs to Chinese agriculture. One of these key sectors is the agricultural machinery industry. Currently, there is minimal machinery usage in rural China, but with the movement of labor into more industrialized urban areas, there is an emerging need to replace that labor by farm mechanization (National Bureau of Statistics of China 2007a). China also wants to increase its production efficiency in agriculture; defined as more production per hectare of land.

Mechanization will play a key role in accomplishing this goal. Relatively little is known about the demand for agricultural machinery in China. However, some studies suggest that these factors have made the market for agricultural machinery in China grow rapidly and project that this market will continue at a rapid pace (Metha and Gross 2007). Our approach is to analyze the strategic approach of a large international agricultural machinery manufacturer to address market opportunities in China, especially related to interacting with Chinese agricultural policy.

Our objectives for this research are twofold:

1. Identify and assess Chinese agricultural policy and economic factors and their impact on agricultural machinery markets.
2. Analyze John Deere's business strategy, to identify key elements used in meeting agricultural machinery demand in China.

To accomplish these objectives, we begin with a description of some of the trends and governmental policies affecting the demand for agricultural machinery in China. They point to a convergence of factors that promote continued and increasing investment in agricultural machinery. Next, we present a qualitative case study of a successful multi-national corporation (MNC), Deere & Co., to explore the features of the emerging market for agricultural machinery in China and how demand for agricultural machinery is met. The problem we address is: What is the impact of Chinese agricultural policy on agricultural machinery markets? How does John Deere successfully compete in this market? Challenges within this market are discussed, along with how Deere & Co.'s Chinese operations have dealt with them. Our findings will be helpful to others who want to develop policies and business strategies to enter a challenging emerging market, such as the agricultural machinery market in China. We present our research in the following sections: Background, Procedures, Results, and Conclusions.

Background: Chinese Agricultural Policy and Economic Factors

Only a few research studies have examined how technology has affected agricultural production in China (e.g., Jin et al. 2002; Van den Berg et al. 2007). One reason is because open markets are just emerging within the country and because publicly available data are limited and scarce. However, several factors are converging to positively influence the demand for agricultural

production equipment, including changes in land tenure rights, a shift of labor to urban areas, demand for grain products, increasing farmer income, availability of credit, and government policies, including taxes and subsidies. We begin by characterizing the typical farm in China, and then address each factor in turn.

Typical Chinese Farm

One determinant of the use of agricultural machinery is farm size. Economies of size suggest that machinery will only be used if there is a large enough farm area to spread its cost over the asset's useful life in a cost competitive way. According to the *2006 Chinese Agricultural Yearbook*, the average Chinese farm is 2.08 *mu*[1] per farmer, which is equivalent to 0.34 acres. This is very small in terms of farm size worldwide (Gale, Somwaru, and Diao 2002). Small farm size is due to the dissolution that took place in 1978-84 of the collective system. This is when the household responsibility system (HRS) placed local townships and villages in charge of land allocation to farmers and rural residents (Lohmar, Somwaru, and Wiebe 2002) and established land tenure rights.

Land tenure rights were first established for a 15-year contract period and later extended to a 30-year period. After the expiration of this contract period, rights may be renewed or possibly reallocated by local officials. In 2002, the Rural Land Contracting Law was passed and spells out in more detail how this 30-year land rights tenure is to be protected from political, frequent reallocations by local governments. It also strives to ensure fair compensation to farmers when reallocation does occur. Land tenure rights affect farmers' capital purchasing decisions. As farmers perceive less risk of change in their tenure assignments (or in other words, increased stability), they are more willing to invest in capital goods (Feder et al. 1992).

Shift of Labor to Urban Areas

While average farm size is quite small, demographic changes in China have led to an increase in the amount of land tilled by an individual farmer. In recent years, rural Chinese have been segmented into two groups. One of these groups chooses to move to urban areas to seek employment and higher wages, and rents their allocated land rights to those who want to continue to work as farmers. According to Zhang, Ma, and Xu (2004: p. 1071):[2]

> The Labor-transfer process here is initiated and regulated by the demand for labor in the off-farm sector. This demand-regulated labor transfer creates the subsequent supply-driven dynamics in land rental markets: when the demand in off-farm labour markets increases, more laborers leave agriculture and relinquish their land rights, creating the supply that spurs land rental transactions.

China's land policy has also been liberalized, making it easier for farmers to rent or lease land tenure rights to others. This allows farm sizes to increase, a necessary characteristic for many capital inputs with relatively high fixed costs and economies of size. Thus, farmers grow their rural operations and income by increasing the size of the land they farm when they rent others'

[1] A *mu* is the Chinese unit of land measurement. 15 *mu*=1 hectare or 6.07*mu*=1 acre.
[2] From this point forward, indented paragraphs are extended direct quotes unless otherwise noted.

land. Investing in agricultural machinery becomes more economical as the cost of capital is spread over larger land areas.

Demand for Grain Products

As farms become larger, labor-intensive crops become less practical. Mechanization is not only more affordable but much more productive because land can be "sized" to optimize the efficiency of equipment and other capital and management. Van den Berg and his colleagues (2007) use a county in China's Zhejiang province as a case study in determining impacts of increasing farm size and mechanization on rice production and rural income. They concluded that as farm size increases, rice production with increased mechanization becomes the best way to concurrently increase grain production and rural incomes. Increasing both grain production and rural incomes are two emphasized agricultural policies in China.

Chinese consumers are demanding protein-rich diets more than ever before (Hsu, Chern, and Gale 2002; Pingali 2006). The movement of the Chinese labor force into urbanized areas also has an effect on these dietary trends (Huang and David 1993). As the demand for protein-rich foods such as beef, poultry, and pork increases, the demand for grains used in livestock feed also increases. While it is true that grains for consumer consumption will decrease as protein increases, the efficiency at which livestock convert grain feeds into food is much less than in grain production itself (Fuller, Tuan, and Wailes 2002). This increasing grain requirement will continue to drive the need for increased efficiency in agricultural production to meet that demand.

The Chinese population is not only increasing its meat consumption, but also its dairy product consumption (Chen 2003). In 2000, 8,274,000 tons of milk were produced, and in 2005, 31,934,000 tons of milk were produced showing milk production almost quadrupling in six years (National Bureau of Statistics of China 2007b). Milk production, especially high-yielding production practices, also requires grains as inputs and therefore will continue to increase China's demand for grains.

Farmer Income

Average farmer income is an essential part of agricultural machinery demand. As farmers' incomes increase, their ability to purchase and invest in capital also increases. The average Chinese farmer's income has steadily increased over time and consists not only of on-farm income, but rural household businesses and off-farm remittances. Farmer's per capita income in China has doubled since 2000 to 4,761 yuan ($697) during 2008. This was the sixth consecutive year of an increase greater than 6% (*China Daily* 2009). This more than doubling of farmers' income nationwide makes the possibility of agricultural machinery purchases more feasible for many more Chinese farmers.

Availability of Credit

As credit opportunities are more readily available, capital investments tend to occur at an increased rate. Rural credit channels and availability have developed in many ways over the past

few decades and have just recently undergone major reform. Since the late 1970s, the majority of agricultural loans were obtained from the state-owned Agricultural Bank of China. In 2001, a political push to increase rural credit to small farmers caused the reform of China's Rural Credit Cooperatives. These institutions now provide more than 80% of China's official agricultural credit. Because of these recent reforms, along with changes in agricultural policy initiatives regarding rural credit, lending to farmers more than doubled between 2001 and 2005, (Gale and Collender 2006) see Figure 1.

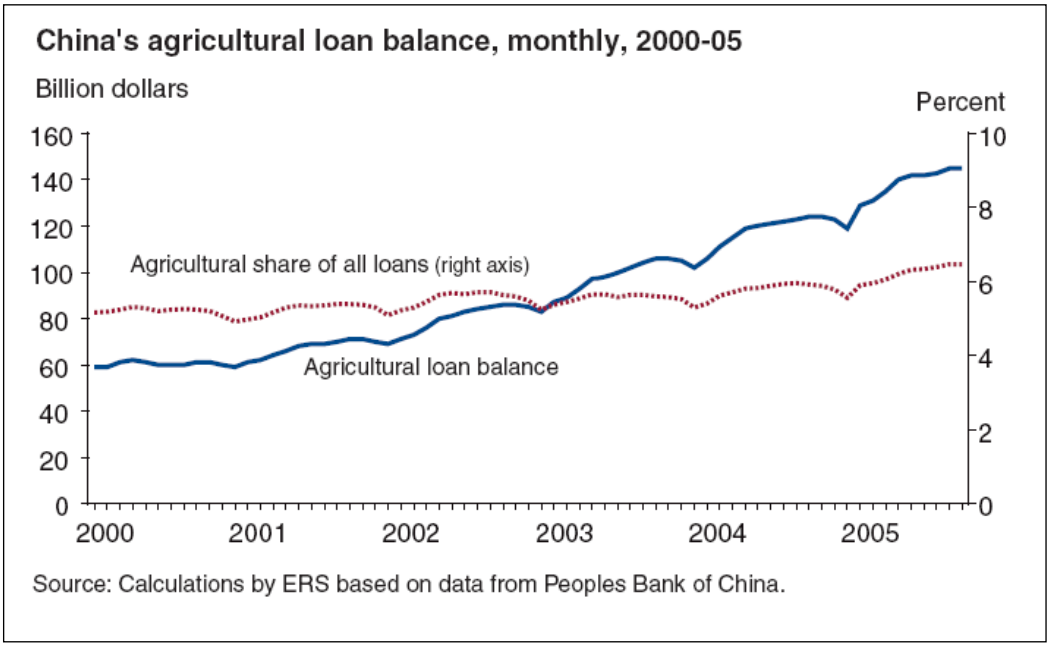


Figure 1. Changes in China's Agricultural Lending

Government Policies, including Taxes and Subsidies

China has deemed food security a priority. This is evidenced through their new agricultural policies where self sufficiency in essential crops is a goal they are moving toward. One food security goal is to ensure that adequate land is preserved for food production use. China has set an arable land minimum level of 120 million hectares (296.5 million acres). Its grain production output goals also help them accomplish their estimated food security needs. In 2006, China's grain production was 500 million tons. China wants to reach and maintain an annual grain output level of 551 million tons until 2010, then to reach 595 million tons by 2020 (*China Daily* 2008). As agricultural productivity becomes a priority, improving agricultural inputs and their availability to farmers becomes a main focus.

Other recent changes in China's agricultural policies include tax elimination and increased subsidies for grain production, high quality seed varieties, and agricultural machinery, as shown in Table 1. China has taxed agriculture for many generations because it has previously been the most wide-spread occupation and the largest tax-revenue generator. However, in 2004 for the first time China implemented agricultural subsidies because, in light of the increasingly industrialized economy, agriculture now contributes roughly only 15% of the nation's gross

domestic product (Gale, Lohmar, and Tuan 2005). Subsidies for agricultural machinery, made available to farmers in 16 provinces in beginning in 2004, make agricultural machinery available at a subsidized price (can compensate for up to 30% of the original price). Dealers collect subsidies from provincial governments (Gale, Lohmar, and Tuan 2005), providing additional assurance that farmers will receive the subsidized price of agricultural machinery and that subsidy investments are being used as intended. Investments have also increased for rural and agricultural infrastructure (i.e., roads, power plants, irrigation, research parks). These policy changes are aimed at increasing agricultural productivity and to encourage farmers to implement more efficient farm practices and agricultural inputs (Gale, Lohmar, and Tuan 2005). The trend toward increased subsidies suggests the Chinese government's increased desire to support and sustain agriculture, ensure food security, and encourage more productive farming methods.

Table 1. Summary of Chinese Agricultural Policies

Policy Estimated Cost[1]	Description	Probable effects
Grain subsidies $1.4 billion	Direct payments of roughly $7.33 per acre planted in grain	Modest income gains for farmers. Effect on grain production is uncertain.
Agricultural tax reduction $5-7 billion	Elimination of agriculture tax within 5 years. Elimination of tax on specialty crops (except for tobacco).	May encourage planting of certain crop varieties
Seed subsidies	Subsidies for high-quality grain and soybean seeds of $7-10 per acre planted.	May encourage planting of certain crop varieties
Machinery subsidies $5 million	Subsidies for purchase of machinery in targeted areas	Increased mechanization but little effect on output. Frees labor for off-farm work.
Rural infrastructure spending $18 billion	Improvement of irrigation facilities, electricity generation, roads, testing, facilities, other rural infrastructure.	Improve productivity and marketing efficiency.

[1]*The Chinese currency is the renminbi(RMB)or yuan. Dollar values throughout this report are calculated using the official exchange rate, currently fixed at RMB 8.28 = US$1. See Shane and Gale for a discussion of Chinese exchange rates.*
Source: Gale, Lohmar, and Tuan 2005: 3.

The Communist Party of China continues to privatize more of its state-controlled industries to reap the benefits of a market economy for its people. It has given more control over key industries to the private business sector while maintaining a portion of the previous state-owned enterprises (SOE) (Shane and Gale 2004). This is seen in agricultural machinery, dairy, and other industries throughout China. Not only does this trend give rise to more efficient markets, it also allows for and encourages foreign direct investment in these industries.

Summary

Attempting to formally characterize the market for farm equipment in China is complicated by a lack of publicly available information that could be used in a model of supply and demand of farm equipment in China. This lack of data and the fact that China has only relatively recently liberalized its market atmosphere to allow outside investment and entrepreneurship in the agricultural and food sectors make it almost impossible to explain the factors affecting the demand for agricultural machinery in China through the use of econometric methods. Instead,

we offer a case study of an American machinery manufacturer to provide a detailed description of the opportunities and challenges related to selling agricultural machinery in China.

Procedures

We conducted a single exploratory case study of John Deere's operations in China (Yin, 1994). The main source of primary data came from interviews with employees of John Deere China Investment Co., Ltd. (JDCI), who has had a presence in China since 1976. A general set of questions was given to company officials, including questions about JDCI's history, background, and other matters eliciting information needed to help prepare for interviews. Responses to the initial set of questions raised additional questions, especially regarding specific details of the organizational workings in China. For example, one initial question was: "How have current Chinese agricultural policies affected John Deere tractors in China?" The response mentioned that farm machinery subsidy policy in China was a major consideration affecting relationships between JDCI and tractor and implement dealers in China. More specific questions about subsidy policies in China were then included in the interview questions. The 11 individuals interviewed at JDCI were those who play a key part in the company's decision and management process, including its president and the Directors of Sales and Customer Support (Marketing), Supply Management, and Manufacturing. Most of the persons interviewed were located at the Beijing corporate office, while others were located at the Tianjin Economic Development Area. The company also facilitated a meeting with one of its independent dealers located in northern Hebei, who asked four of its local farmer customers to participate in this study.

The interviews were held in October, 2008 and were done in person, lasted about one hour, and were conducted in English unless, due to language barriers, Chinese needed to be used. In these cases, the interviewer (first author) or other bilingual individuals helped translate. Interviews were voice-recorded and notes were taken during the interviews. None of the questions directly sought proprietary information.

Each interview was analyzed separately for its main points that focused on how JDCI has met the demand for agricultural machinery in China, how it perceives the market, and its experiences within this market. Slight differences and additions of information to these themes were noted and added to their description in the case study. Not every point of information within a theme was mentioned by multiple individuals. However, the main ideas within a theme usually had multiple individuals who validated them. When a main point was mentioned by only one individual, it was added only if it was believed to be an essential part of understanding the agricultural machinery market in China or of meeting that market's demands. When available and relevant, sources other than the visit to JDCI were also used to add validity to the themes identified. Through the use of multiple sources, data triangulation was achieved. These additional sources included published secondary data and information from national statistical databases, news articles, and organizational publications. Time series statistical data was analyzed for relevant trends that supported or contradicted findings from the JDCI visit. This contributed to a more complete and valid picture and description of these themes.
Some practices were standard throughout the company's world-wide operations, but particular attention was paid to points that were unique to the Chinese market. Once the main points of each interview were identified, multiple interviews were compared to identify common themes. Identifying common themes from multiple sources strengthens the validity of these themes. This

iterative process of comparison and contrast of data (Strauss and Corbin, 1998) allowed us to identify relevant themes and detect any inconsistencies between new intuitions and our data. The process continued with a combination of inductive and deductive analysis until no new relationships emerged.

John Deere in China

The first visit to China by John Deere executives occurred in 1976. This visit was made by former CEO William Hewitt, who headed the U.S.-China Business Council that was then visiting China. Two years later, John Deere was invited by Chinese officials to participate in "Friendship Farms" where John Deere provided some tractors and combines to China.

> In 1982, the Ministry of Agriculture [MOA] and the Ministry of Mining and Engineering Industries approached Deere to enter into five 'Tech Transfer' relationships with Jiamusi and Keifang (combines) plus Shenyang, Tianjin, and Changchun (tractors). Deere saw this as an opportunity to become further entrenched in the market with one or two generation older technology. After ten years (1991), these tech transfer relationships were suspended with only Shenyang and Jiamusi actually having succeeded in adopting more than just Deere cosmetics into their own Soviet rooted designs (JDP).[3]

The first joint venture for John Deere in China was set up in Jiamusi in 1997 which later became a wholly-owned foreign enterprise in 2004 under the name John Deere Jialian Harvester Co. Ltd. Another joint venture, John Deere Tiantuo Co. Ltd., was formed with Tianjin Tractor Manufacturing Co. Ltd. in 2000. This was done in part to increase market share in the smaller horsepower tractors and to gain greater access to the Chinese agricultural machinery market. In 2005, John Deere opened a new transmission factory in the Tianjin Economic Development area named John Deere Tianjin Co. Ltd. The most recent addition to JDCI is the acquisition of Ningbo Benye Tractor Co. Ltd. in August of 2007. Again, this joint venture gave greater capabilities to JDCI in producing low horsepower tractors and increasing market access.

This case study of JDCI focuses on how this U.S.-based company has met the growing demand for agricultural machinery in China. As the study progressed, certain overarching themes were identified which emanated from multiple interviews. Some of these themes were of a general nature, such as standardized practices throughout the global industry. Here, we focus on overarching themes specific to the Chinese market which we examine in detail:

- Intellectual Property Rights (IPR)
- Government Relations
- Legal Environment
- Supplier Relations
- Growth Market/ Market Dynamics

[3] President of John Deere's operations in China.

Intellectual Property Rights (IPR)

IPR issues and concerns in China relating to agricultural machinery have had a long-standing history. These issues relate to the enforcement (or lack of enforcement) of trademark, copyright, patents, and other IPR. JDCI's Legal Counsel told us:

> IPR enforcement [in China] is an issue, but great improvement has been made especially within the last five years. Larger cities such as Beijing, Shanghai, etc. … have better enforcement with judges who understand the new legislation and have some experience with it. Rural areas are a challenge and IPR legal action in these areas is sometimes not worth the cost of litigation (JDLC[4]).

Because of this, JDCI completes a cost-benefit analysis of pursuing litigation on certain IPR issues. Sometimes, if the potential future harm of an IPR violation is large if left unchecked, then even though the immediate financial benefit is low, JDCI will take action. The president of JDCI indicated that on average, about 80% of IPR cases put through litigation proceedings in China are found in favor of the plaintiff (the company holding the IPR). "If companies are willing to actively pursue [IPR], they will be rewarded" (JDP).

Another example of IPR issues was mentioned by the Director of JDCI engineering regarding spare parts and accessories. He stated,

> This is where protection of IPR is important in a place where [the Chinese] are masters of duplication. Service parts can be a big part of your business. Having the protection to avoid duplication of service parts is a challenge. If the part is relatively simple, it is easy for them to make it and sell it at half price (JDE[5]).

Thus, protecting IP before and after market is a priority for JDCI.

As IPR issues continue to be a factor in China, JDCI has taken steps to protect its investments. JDCI exercises caution in how Chinese operations use current John Deere IP. Adjustments to product development processes and procedures have been made to continue to successfully meet the demands of the Chinese agricultural machinery market while protecting the company's IP. "They haven't had to redesign systems but they have had to adopt a 'just what we need' policy: getting agreement on what they need to do their jobs and get access to that and nothing more. In other areas [of the world], if you have access to the system, you have access to everything" (JDE).

Government Relations

Government relations are crucial and must be an effective part of doing business in China. Because China has a centrally-controlled government, new legislation can have a very quick and powerful effect on any business. Local, provincial, and national government levels all have separate ways of affecting industry and business requirements and standards. As a company

[4] John Deere legal counselor in China.
[5] John Deere director of engineering in China.

becomes better at cooperating with these decision-making officials, both the government and business can benefit from more transparent and efficient operations. "The People's Republic of China has had policy changes in November 2007 and March 2008. Government policy changes frequently in China. Therefore, there is a larger 'policy risk' of doing business in China" (JDGRM[6]). A few of the current issues being considered by the Chinese government that JDCI believes are important to its business and the agricultural machinery industry include land reform and food security. One example of how the cultivation of government relations has been beneficial was shared by JDCI's president regarding its harvester factory.

> A harvester company that received John Deere technology in the 1970's friendship farms now has set up a factory right next to John Deere Harvester factory and produces yellow and green machinery called Jiangliao John Deere. They would also stop customers from picking up their John Deere orders or would redirect them to their own factory. Therefore, John Deere petitioned officials to stop the use of the John Deere name or John Deere (who are investing and are the province's largest employer of 1,600 employees at that location) will stop production in that city immediately. Officials complied. To solve the other problems, more government relations are being developed to hopefully have the factory moved to a location other than the John Deere site (JDP).

Because of good communication with government officials, a very important issue to JDCI's business was resolved. Further government relations will also play a key role in this and many other issues of JDCI doing business in China.

> Don't try and tell the Chinese government what to do, help them understand that you have some solutions to their problems. Show them how you can help the Chinese people and improve the current situation (i.e. setting up demonstration farms and showing solutions to the people and government and not just trying to collect the money or sell a product) (JDP).

Legal Environment

China has a centrally-planned economy with a legal environment much different from the United States. New and current legislation changes the way local or foreign-based corporations do business in China. The interpretation and implementation of legislation unique to China also affects what businesses must do to be legally compliant. We focus our discussion on two aspects of the current legal situation that are important to the agricultural machinery industry and JDCI: subsidies and mergers and acquisitions/joint ventures (M&A/JV).

A major legislative action passed in 2004 has changed how the agricultural machinery industry functions in China. This action provided for subsidies by provincial and national governments for farmers' purchase of agricultural machinery. "To sell machinery in China you need to be on the government subsidy list. Regulations are very strict and once applied for; it takes one year to get on the list" (JDP). Government subsidies currently compensate farmers for up to 30% of the purchase price of machinery and so most farmers will not purchase machinery that is not on the subsidy list. In fact, a JDCI dealer said that 98% of tractors sold are subsidized. He continued

[6] John Deere's director of government relations in China.

by saying that a farmer will only purchase a tractor without a subsidy if all of the year's subsidized tractors have already been sold and he does not want to wait a year to buy a subsidized one.

Each province has its own variation on subsidy implementation, which means JDCI must deal with each province's implementation measures. An overview of the current agricultural machinery subsidy process and implementation was provided by JDCI together with additional information from the Organisation for Economic Cooperation and Development (OECD).

> Since 2004, the government has provided a subsidy for the purchase of agricultural machinery … The programme is implemented at the provincial level and it is up to local governments to decide on the machinery and models eligible for the subsidy. The subsidy has been used to target the mechanisation of wheat harvesting and rice planting, but in 2007 trials started to include support for mechanisation of corn harvesting (OECD 2008).

To qualify for the subsidy list, some preliminary evaluations must take place. The list is updated once a year, and if the deadline is missed, there is a one-year delay before the product is placed on the subsidy list. This does not preclude a company from putting machinery on the market, but the machinery will most likely not sell well because the government subsidy is not available. Part of qualifying for the subsidy list is to have each tractor model comply with safety and performance testing such as horsepower, drawbar power, fuel economy, and noise.

> You have to sell 30 tractors before May-June timeframe and then give five tractors to the government to be tested and be evaluated. These 30 tractors are sold at a lower price and then followed and documented to help in the evaluation. By the end of the year, the MOA makes their decision on additions to the subsidy list. They will allow John Deere and others to make minor changes after the approval (JDAPM[7]).

The level of subsidy provided to farmers has been increasing every year since subsidies were implemented (Figure 2). This trend indicates that increasing investment in agricultural machinery is a high priority for the Chinese government, and further changes in subsidy legislation and implementation will continue to greatly affect the agricultural machinery industry.[8]

Additional evidence that government subsidies are changing the Chinese farmer's purchasing decisions and increasing the demand for agricultural machinery in China is obtained from interviews with the farmers.

> CF1[9] Farms 300 mu. which is rented, owns 30 mu., and does service contracting on 600-700 mu. This is his 2nd year of farming with his current tractor which is an 80 hp John Deere tractor bought in Oct, 2007. He previously has owned a 10 hp tractor purchased in 1988.

[7] John Deere's Apollo tractor program manager.
[8] This also supports the projections of Mehta and Gross (2007). That is, increased subsidies would be expected to lead to increased growth rates in the demand for agricultural machinery.
[9] CF1 – CF4 indicates separate interviews with four separate farmers. Descriptions of farm and farmer's use of tractors are summaries of information provided by the individual farmers themselves but are not direct quotes.

CF2 Contracts 400 mu and owns 200 mu. This is his 1st year farming (2008) with his two new 82 hp John Deere tractors. He previously purchased in 1990 a small 15hp tractor.

CF3 Contracts 300 mu and owns 10 mu. 2008 is his first year farming with his new 82 hp John Deere tractor. He previously purchased in 1987 a 55 hp Tiantuo tractor and a small 12 hp tractor.

CF4 Contracts 400 mu and does not farm any of his own. This is his first year farming with his new 82 hp John Deere tractor. He previously purchased in the 1980's, two small 12 hp tractors.

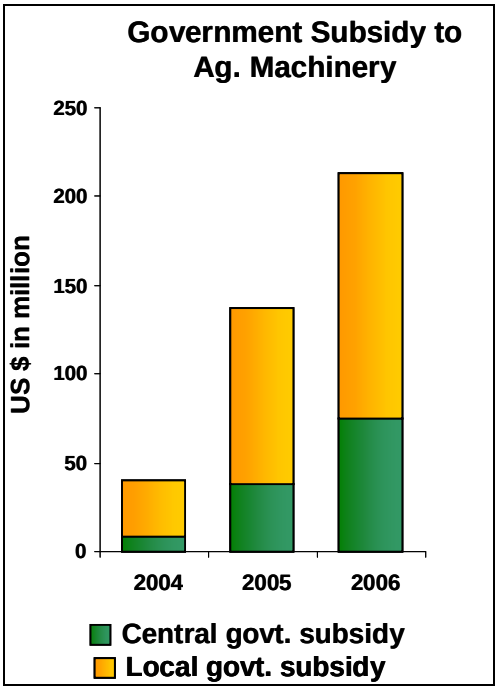


Figure 2. Chinese Government Subsidy Levels
Source: JDCI

All of these farmers purchased their first tractors in the 1980s and only recently decided to purchase larger and newer equipment because of the subsidies. Increasing farmer income is also a factor, but these farmers indicated that government subsidies sped up their decision to buy farm equipment.

Setting up new businesses and the location of businesses are also regulated to a degree by the Chinese government. When companies wish to grow through M&A, the Chinese government must first approve the action. This also occurs in the United States under certain circumstances when very large companies are involved in an M&A action, especially when anti-trust issues or national security issues are involved. But in China, government approval is always a factor, especially when a large number of competitors are state-owned enterprises (SOEs).

Recently, JDCI acquired a privately owned Chinese competitor, Ningbo Benye. This was done to increase market share and to enhance low-hp tractor production. Government response to this acquisition was positive.

> The Government was very supportive of John Deere. John Deere has history with the Chinese government through technology transfers and friendship farms. Within the 30 years of the Chinese opening [of John Deere], many companies have come and gone, but John Deere has stuck with it. The government has been very supportive of John Deere because they know they are trying to help the Chinese farmers and the Chinese people (JDP).

However, not every joint-venture or acquisition is always approved nor is this always a smooth process through the Chinese government. JDCI shared their insight as to the reasons why some companies have been more successful than others in penetrating the market and growing their operations in China through M&A and JVs.

> The government's viewpoint of FDI [foreign direct investment] has changed over time. When John Deere has created JVs, other FDIs 10 years ago, China really needed FDI. Today they are becoming more of an equal across the globe and they have tightened the clamps on who they will allow to invest in China. The U.S. does the same thing when FDI occurs in industries they believe are critical to national securities. When China's CNOOC (China National Offshore Oil Company) wanted to [purchase Unocal], the U.S. believed it was not in the interest of national security. China's construction industry is very protected and nothing higher than a 50/50 JV will currently be allowed to occur (JDP).

As China continues to address its many legal issues and to pass legislation in accomplishing government goals, businesses need to understand how China's dynamic legal system will affect their operations and the market in which they work. In the agricultural machinery market, government subsidies are a driving factor. Regulation of how a foreign company can grow is also very important to consider in successfully meeting demand for agricultural machinery in China. Establishment of a new factory or facility is also regulated to an extent. These issues of the Chinese legal environment are not all that exist in the agricultural machinery industry but they are some of the main legal challenges and differences of doing business in China that JDCI has dealt with and learned from.

Supplier Relations

One of China's competitive advantages is labor-intensive goods because the cost of labor is low compared to developed countries. This is a primary reason why JDCI has about 90% of its suppliers from China. One feature of the supplier market is that competition is fierce because more than one industry competes for the same suppliers. "In China, the view regarding suppliers is that they pick you, not that you pick them" (JDSCM[10]). JDCI's volume of business with suppliers is low compared to other customers such as those in the automotive industry so they must "rely on their core values, respect for the supplier, and their reputation, and longevity as a

[10] John Deere's director of supply management, strategic sourcing, and supplier development in China.

company. They also want to nurture and develop their suppliers and the relationships with them" (JDSCM).

JDCI wants to help develop their suppliers to facilitate and protect JDCI quality while saving both JDCI and the supplier time and money. They have instituted a Standardized Work and Pre-production Approval Process (PPAP) to help suppliers with their production processes. JDCI also uses incentive programs to develop their Chinese suppliers.

> Incentive programs are used but they are not monetary incentives. John Deere will offer training, management tools, assessments, recommendations, and other supplier development methods (lean training, technical professionals, etc…) as an incentive to suppliers to become better and more efficient. This usually turns out to be a win-win situation as suppliers save costs, increase efficiency, consistency, quality, etc. … and John Deere benefits from a more standardized product or process and less problem solving efforts are needed (JDSCM).

SOEs are a major factor in the Chinese supplier base. Since they are government-policy driven and do not have to make a profit, additional challenges occur with these types of suppliers.

> SOE's have a very underdeveloped management system so when you do business with those kinds of companies, you have to follow every problem from start to finish. Sometimes they give you a low price to get your business. Afterwards, when production starts, they will ask for a price increase and you may not have as much flexibility in dealing with the situation … If using an SOE for a very critical part of a product, you need to have a backup supplier planned in advance in case things go wrong, to insure your product can still be produced on time. Sometimes if an SOE has problems, John Deere's alternative suppliers are not interested because of the volume John Deere uses (JDTPM[11]).

Chinese suppliers are not as developed as JDCI's suppliers in traditional markets and as a result, need additional and more frequent attention. Language, business culture, and many other factors unique to China are important in Chinese supplier relationships. SOE suppliers can bring additional challenges in dealing with supplier problems, pricing, timing, and other issues that are important to being successful in doing business in China. Selecting and working with reliable suppliers and facilitating their development have assisted JDCI to meet cost, quality, and timing goals in bringing to market agricultural machinery.

Growth Market

Because many companies are racing to capture a part of the emerging Chinese market, it has created a very fast-paced business environment. The annual GDP growth rate in the United States only takes about three months to be achieved in China (Green 2007). Tractors and other forms of agricultural machinery are relatively new to the Chinese farmer, but the market is also growing rapidly and the number of firms selling tractors in China is increasing. JDCI's business strategy in China has adapted to the fast-growing agricultural machinery market.

[11] John Deere's GT5 transmission program manager in China.

> Because John Deere usually takes four to five years to develop a new product and have it ready for the market, they have decided to use other entry strategies, such as acquiring Benye, to enter the small tractor market quickly and in only one year. If they cannot keep up with the speed of their competitors introducing new product into the market, they will lose out on market share (JDBPD[12]).

Part of responding to this growing market is to develop products unique to China's agricultural processes. "Seeders, tillage equipment, roto-tillers, rice transplanters and others are being developed especially to help develop product lines to allow more exclusive dealer arrangements" (JDP).

Quantifying this growth is challenging due to limited public data and the speed of change occurring in China. But there are a few studies suggesting that China is a rapidly growing market for agricultural machinery and that most major agricultural equipment manufacturers are operating in China. For example, a market study completed by the Freedonia Group in 2006 projects rapid growth of the Chinese agricultural machinery market until 2010 (Table 2).[13]

Table 2. China Agricultural Equipment and Supply, 2000-2010 (Million Dollars)

				% Annual Growth	
Item	**2000**	**2005**	**2010**	**05/00**	**10/05**
Pop. (millions)	1,269	1,311	1,351	0.7	0.6
$GDP/Capita	4,260	6,450	9,250	-	-
Gross Domestic Product (bil $2000)	5,403	8,450	12,500	9.6	8.1
% agriculture	14.8	11.2	8.5	-	-
Agricultural Output (bil $2000)	801.0	949.0	1,063.0	3.5	2.3
$ equipment/$000 ag output	7.1	12.1	18.2	-	-
Agricultural Equipment Demand	5,650	11,510	19,390	15.3	11.0
Farm Tractors	1,585	3,250	5,470	15.1	11.0
Harvesting Machinery	930	2,060	3,470	17.2	11.0
Planting & Fertilizing Machinery	485	970	1,630	14.9	10.9
Haying Machinery	240	570	970	18.9	11.2
Plowing & Cultivating Machinery	485	1,000	1,690	15.6	11.1
Other Agricultural Equipment	1,210	2,085	3,510	11.5	11.0
Parts & Attachments	715	1,575	2,650	17.1	11.0
Net Exports	-650	-700	-790	-	-
Agricultural Equipment Shipments	5,000	10,810	18,600	16.7	11.5

Source: Taken from Mehta and Gross (2007)

The Freedonia study also mentions that China is now the second largest agricultural machinery producer (Mehta and Gross 2007). China's rapidly growing demand for agricultural equipment can be considered a unique case for a developing country because the developing world is typically where obtaining investment for agricultural machinery is the most difficult. Addressing

[12] John Deere's manager for business planning and development in China.

[13] The Freedonia Group study projected that agricultural equipment demand in China would grow by 11% per year between 2005 and 2010.

the market for agricultural machinery in China is critical for agricultural machinery manufacturers wishing to grow their sales because markets in most other parts of the developing world are growing at a much slower rate than China (Mehta and Gross 2007). The strategies John Deere has pursued in China are potentially helpful in understanding the conditions and procedures that might help overcome some of the problems associated with lack of capital on the part of farmers in the developing world who want to invest in farm machinery.

Another characteristic of China's economy is the relatively small level of investment needed to enter the Chinese market. The agricultural machinery market in China is composed of MNCs and many local companies, including privately owned corporations and government SOEs. Figure 3 shows the market share for the main competitors in the Chinese market. Because JDCI acquired Ningbo Benye in August 2007, they are transitioning the Benye brand to the John Deere brand. This increased their market share dramatically. When combining JDCI's and Benye's tractor market percentages, JDCI's total market share is 19%, or the #3 Chinese tractor market leader.

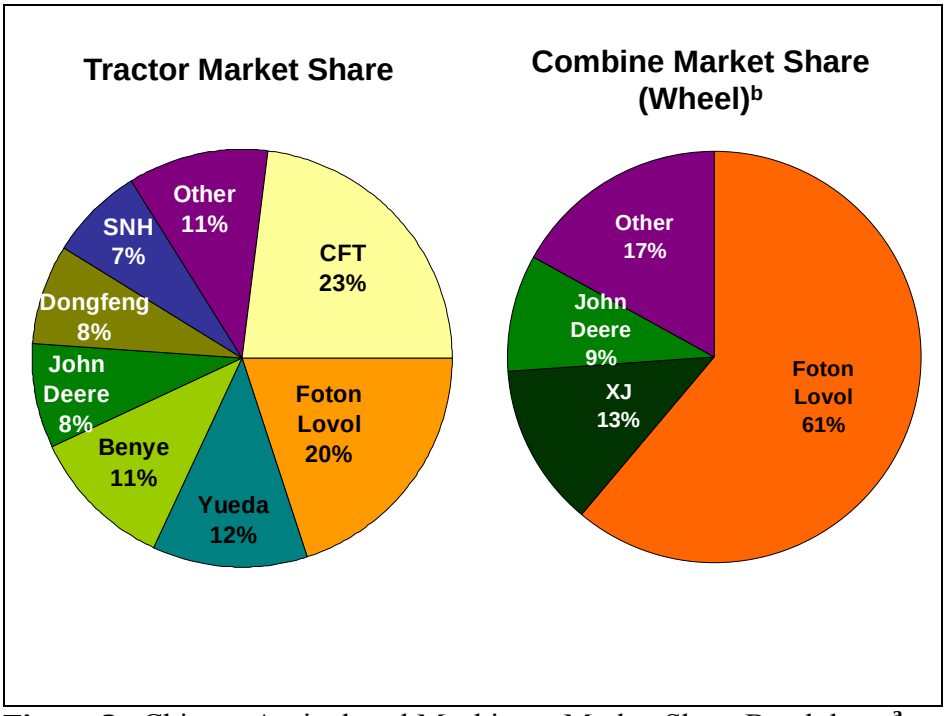


Figure 3. Chinese Agricultural Machinery Market Share Breakdown[a]
[a] See Table 3 for definition of acronyms.
[b] "Wheel" refers to combines with tires as opposed to combines with tracks which are used in wet conditions.
Source: JDCI 2008

Comparing the characteristics of the leading market competitors seen in Figure 3 provides some insight into the major companies in the Chinese agricultural machinery market. Each company has unique qualities which allow different business strategies to be implemented. A summary of these competitor characteristics is illustrated in Table 3.

One main difference among the companies is whether they are privately- or publicly- owned. SOEs have capital readily accessible to grow and manage business operations and, at least in the short-run, may not be required to make a profit. This gives SOEs at least a short-run competitive advantage over private enterprises. However, foreign partners entering the Chinese machinery market with advanced technology have the advantage of competing with superior products compared to SOEs. But, the foreign companies lack distribution systems in China.

Table 3. Comparison of Major Chinese Agricultural Machinery Competitors

Chinese Competitors[a]	Year Est.	Horsepower	Ownership Type	Parent Companies
China First Tractor (CFT)	1955	17-188	SOE[b]	
Foton Lovol	1998	20-265	SOE/some private	Beiqi Foton Motor Co.
Mahindra/Yueda[c]	2009	16-125	JV Mahindra 51% SOE 49%	
Dongfeng	1952	6-90	Formerly SOE, now private	
Shanghai New Holland (SNH)[c]	2001	<100	JV CNH 60% SOE 40%	Fiat/HASCO
Zhongshou (XJ)	1997	55-160	SOE	SINOMACH
John Deere/Benye[c]	2007	20-50[d]	Acquisition of a private company	Deere & Co.

[a] Acronyms provided for selected company names to match information in Table 3 to information in Figure 3.
[b] SOE = state-owned enterprise; JV = joint venture; CNH = Case New Holland (official name of the company is CNH though).
[c] Indicates at least partial foreign ownership.
[d] Only 20-50 horsepower tractors are manufactured at the John Deere/Benye facility. John Deere manufactures 80 horsepower tractors in other facilities in China besides John Deere/Benye and imports tractors that are over 80 hp.

One main difference among the companies is whether they are privately- or publicly- owned. SOEs have capital readily accessible to grow and manage business operations and, at least in the short-run, may not be required to make a profit. This gives SOEs at least a short-run competitive advantage over private enterprises. However, foreign partners entering the Chinese machinery market with advanced technology have the advantage of competing with superior products compared to SOEs. But, the foreign companies lack distribution systems in China.

Consequently, all major foreign companies have partnered with local Chinese companies to gain access to market distribution. Part of this market access is tied to the horsepower range of products. This affects partnership choices because horsepower determines the market segment (large state farms compared to smaller individually-operated farms). For example, Shanghai New Holland has completed two JVs in China, one with a smaller horsepower SOE and the other with a larger (>100hp) horsepower producer, specifically to gain distribution to both large and small producer market segments. John Deere has done the same (a JV and an acquisition) and Mahindra (one JV with Yueda which has access to both market segments).

China First Tractor is a SOE that has been in the market since the mid 1950s with a high level of engineering capability and is the largest agricultural machinery-producing SOE in China. This allows large capital access for operation and improvement of production capabilities.

Dongfeng produces smaller horsepower tractors and has a smaller operation compared to other producers in China. Being established as a SOE, they have reaped the benefits of the distribution network the Chinese government had allocated. They now are privately owned and operated by local investors.

Foton Lovol is a recent addition to the market even though their parent company is a SOE that has been in operation for over 50 years. A unique point of this competitor is the private/SOE mix that places increased autonomy and, consequently, added market agility to its operation. They have quickly grown to be the second largest producer of tractors and the largest producer of combines in China.

To compete against other companies, JDCI has continued to offer higher quality products and to build its reputation in China with the long-term market in mind. John Deere's first-mover strategy in China has given it long-term experience and time to develop the necessary infrastructure and marketing networks to do business successfully. More recent MNC additions to the Chinese market are in the process of developing these business components. "Having a presence in China is an advantage and the competition is just getting here. Therefore, they need to establish everything that John Deere is already using such as a dealer network" (JDP).

Market Dynamics

Common market segments for agricultural machinery in China are comprised of state farms, large land contractors, and private service contractors. The large majority of JDCI's current customers are in the service contractor segment. This makes sense due to the number of service contractors in China. Most Chinese farmers do not have large farms and there are a limited number of state farms, compared with the number of private Chinese farms. Even though there are many farmers without agricultural machinery, they are willing to pay a small fee to service contractors to plow, plant, till, and harvest their small farming acres. These service contractors are investment payback driven and are very price sensitive. "Customers are not very loyal. For a tractor, they will change brands for only 100 RMB [Chinese Yuan]" (JDM[14]).

To effectively meet Chinese demand for agricultural machinery, JDCI has made some adjustments to its marketing processes. For example, when setting prices, it has learned that dealers sometimes offer customers a price that discounts the entire margin. The company must tell dealers that the retail price is the minimum price for a product. Market forecasting in China is difficult because of frequent changes in government policies.

> In general, the government efforts and investment in boosting grain production and building a harmonious society keep the demand for agricultural machinery high; driving demand towards larger hp tractors but it destroys the normal market rhythm and normal seasonality of sales, making forecast almost impossible (JDP).

Advertising has also been adapted for local conditions. Some of John Deere's standard publications have been tailored for China. One of the company's magazines is targeted toward dealers and government officials while another is targeted to generate new customers. The most

[14] John Deere's director of sales and customer support in China.

effective forms of advertising include demonstrations and county fairs where Chinese farmers can see how agricultural machinery works. As many have never owned machinery, hands-on demonstrations explain better than words the benefits to the farmers. Another reason for advertising through demonstrations is, regardless of literacy challenges, the farmers will still understand what JDCI's products are. One literacy challenge is recognition of the John Deere logo. "It has the words 'John Deere' under the leaping deer, which customers cannot read. JDCI has looked into creating a logo with Chinese characters instead of the company's English name" (JDM). However, most of JDCI's target market has adequate literacy rates. "Most of the rural residents who are illiterate would not be able to afford a John Deere tractor in the first place. Most of their target market has at least a high school education" (JDM).

Limitations, Implications, and Conclusions

The demand for agricultural machinery in China continues to increase. It is a rapidly changing and dynamic environment that has been greatly affected by China's centrally controlled government. Through the case study of JDCI, we identify specific issues that multinational companies should consider if they want to become successful players in the Chinese agricultural machinery market. Government policies and practices surrounding IPR, government relations, the legal environment, supplier relations, and managing a growth market in a developing nation are key components of the unique aspects of conducting business in China. The experience of JDCI provides guidance to other organizations that want to better understand how the agricultural machinery market operates in China.

Limitations

Because of the time and resource limitations to this research, only one MNC was studied. A multiple-case study of several MNCs in the Chinese agricultural machinery industry would bring additional insight into how businesses have successfully met Chinese agricultural machinery demand. If multiple MNCs have dealt with the same challenges in the Chinese market that this research has identified, then increased validity and generalizability would result. Gathering large amounts of primary data by surveying Chinese farmers and their reasons for purchasing agricultural machinery and their general situation in the agricultural industry would have been helpful in studying this topic. These data could have been analyzed to discover the weight of each factor in the average Chinese farmer's decision to purchase agricultural machinery. Since climate, policies, and the agricultural industry vary by location, these surveys could be done in multiple provinces to obtain an even more accurate observation of the Chinese agricultural machinery market.

A challenge to this study is the method that JDCI uses in measuring success in the Chinese market. Most companies measure their sales and return on investment; JDCI does the same. However, when asked regarding this information, JDCI chose not to make this available. However, a proxy measure of success might be given by the longevity of John Deere's operations in China. JDCI is also expanding through construction and acquisition of new local competitors. This would not be occurring unless profits and sales are increasing. This is supported by John Deere's 2007, 2008, and 2009 Annual reports which indicate that sales are

growing much more rapidly outside of the U. S. and Canada than inside the U. S. and Canada. The 2007 report states that sales in emerging markets, including China, nearly doubled.[15]

Implications

The themes emerging from the study of John Deere in China give some insights into this agricultural machinery market in China. One must ask: What can other companies learn and apply from the John Deere experience? Even though John Deere is only one example of how a company has successfully competed in China's market, the lessons of John Deere are relevant for any company wanting to compete in this market. Above all, JDCI has had a long-term view of the potential of the Chinese agricultural equipment market. They have exhibited patience, perseverance, and a willingness to learn how to operate in this market, not only based on their own perceptions, but also using the experience of their Chinese partners. Without question, this long-term strategy requires substantial up-front investments that may not be possible for all companies. It also demonstrates buy-in by investors and management from the very beginning of the decision to invest in China.

JDCI can be seen as paving the way for other foreign MNCs to enter China. This can be seen in comparing the similar strategies to JDCI that other competitors such as Mahindra and CNH have used in JVs with local Chinese competitors. JDCI has provided a service to later-entering firms in the focus it has placed on encouraging favorable legislation which allow the agricultural machinery market to grow and Chinese agriculture to become more efficient. As JDCI has invested in these efforts, the entire market has benefited, especially foreign MNCs.

Significant policy and legal issues remain though, and if the Chinese government will address these issues, especially related to IPR, the entire market would benefit. Today's farm equipment relies on sophisticated computer systems that provide increased functionality and improve performance (Mehta and Gross 2007). Because JDCI sells a tangible good, the product can be reverse-engineered once introduced to the market. This prevents the latest and best technology from coming directly into the Chinese market. Concerns relating to IPR also make it necessary for JDCI to develop key control points where the release of technology, even internally, is controlled. Better enforcement of IPR would help eliminate these inefficiencies.

Our data point to the critical importance of managing supplier relations and the supply chain, which supports the findings of other researchers (Mehta and Gross 2007). More specifically, however, we describe how MNCs must integrate supply chain management practices with constraints imposed by government policies. Concurrently, companies must try to amend those policies that are detrimental to efficient operations. JDCI has implemented something similar to a U. S. lobbying model in China. JDCI's lobbying effort focus not just on farm equipment issues, but agricultural policy more broadly. For example, government subsidies for tractor purchases have been a critical element of equipment manufacturer success in China. Future

[15] While this does not directly measure profitability, accelerating sales imply profitability especially when investments by John Deere continue to expand in China. See http://www.deere.com/en_US/ir/media/pdf/financialdata/reports/2010/2009annualreport.pdf, http://www.deere.com/en_US/ir/media/pdf/financialdata/reports/2009/2008annualreport.pdf, and http://www.deere.com/en_US/ir/media/pdf/financialdata/reports/2008/2007annualreport.pdf

strategies must consider how profitability can be maintained without subsidies. Providing financing to customers is one way (Mehta and Gross 2007). Relaxing land tenure regulations that support increases in the block–size of land that one farmer or a group of associated farmers can farm is another. This also supports the notion that MNCs must be involved in trying to influence Chinese land policy.

To compete in a dynamic and quickly growing Chinese market, access to the market is a key component of being successful. Building from scratch is difficult in a country that is learning how to utilize markets, and growth can be greatly accelerated with a locally established network. This suggests that M&A/JV with a company having a dealership network is essential. CNH stated when completing their Shanghai New Holland JV: "Shanghai New Holland will have the benefit of the New Holland brand's depth of technology and broad distribution as well as Shanghai Tractor's distribution channels and excellent reputation" (Walsh 2001). This statement exemplifies the principle of foreign partners bringing technology to China as local companies open their market access to these MNCs. This is very essential in the Chinese agricultural machinery market.

One would usually consider that functioning in a command economy would suggest that risks are high and that a company would be forced to focus on short-term high profits to compensate for the level of risk. JDCI believes that the potential payoffs in China justify long-term investments. The company believes it can deliver a long-term relationship in China because of the technology and management it brings to the table. However, they have needed to closely manage both of these resources in China especially because of IPR issues.

Conclusion

The demand for agricultural machinery in China is growing. Much of this growth is driven by the Chinese government and its desire to increase rural incomes and agricultural efficiency. The Chinese government also pursues these objectives as a way to increase political stability and national food security. There are many peripheral issues about the agricultural machinery market in China such as IPR, legal environment, and supplier relations that will continue to evolve. The findings of this research demonstrate the rapid change occurring in each of these areas as well as the features unique to the Chinese market. Any business that wants to expand into the Chinese agricultural machinery market must carefully consider the dynamics of these issues. Companies can also learn how to better adapt to these issues in China by understanding how JDCI has dealt with them. For example, as companies become actively involved in shaping government understanding of an industry, the results can be very beneficial to doing business in China and to the Chinese people. The composition of the Chinese agricultural machinery market is changing as companies grow through JVs and M&A. This can be seen in JDCI and other MNC's business expansion in China. Market players are racing to meet the demands of the Chinese farmers as the market continues to expand. However, if government priorities change, this market could quickly decelerate.

This research also has implications for Chinese agricultural machinery dealers because it provides them with a broader picture of what is occurring throughout China. Even though this research focuses on the Chinese agricultural machinery market, many of the challenges of

meeting market demands that have been identified will be similar to those found in other centrally controlled countries. However, future research must be done in these economies to determine the relevance of these findings to agricultural machinery markets in other nations.

References

Agricultural Policies in Non-OECD Countries: China. Organisation for Economic Co-Operation and Development (OECD). 2007. 1-15.

National Bureau of Statistics of China. 2006. *China Agriculture Yearbook*. English ed. China Agriculture Press.

National Bureau of Statistics of China. 2007. *China Statistical Yearbook*. English ed. China Statistics Press.

National Bureau of Statistics of China: China Agricultural Census. 2007. *National Bureau of Statistics of China*. http://www.stats.gov.cn/english/# (accessed January 5, 2009).

China's Grain Output to Reach 540 bn kgs by 2020. 2008. *China Daily,* July 2. http://www.chinadaily.com.cn/china/ 2008-07/02/content_6814212.htm (accessed October 3, 2009).

Chinese Farmers' Income up 8% in 2008, Tough 2009 Ahead. 2009. *China Daily,* February 2. http://www.chinadaily.com. cn/bizchina/2009-02/02/content_7439350.htm (accessed February 18, 2009).

Chen, Kathy. 2003. Got Milk? The New Craze in China is Dairy Drinks. *Wall Street Journal*, February 28. http://www.mindfully.org/ Food/2003/China-Dairy-Drinks28feb03.htm (accessed September 30, 2008).

Feder, G., Laurence J. L., and Xiaopeng Luo. 1992. The Determinants of Farm Investment and Residential Construction in Post-reform China. *Economic Development and Cultural Change,* October: 1-26.

Fuller, F., Tuan, F., and Eric Wailes. 2002. Rising Demand for Meat: Who Will Feed China's Hogs? *Economic Research Service/USDA*. http://www.ers.usda.gov/publications/aib775/aib775h.pdf (accessed September 22, 2008).

Gale, Fred and Robert Collender. 2006. New Directions in China's Agricultural Lending. *Economic Research Service/USDA*, January. http://www.ers.usda.gov/publications/wrs0601/wrs0601.pdf (accessed March 10, 2009).

Gale, Fred, Somwaru, A. and Xinshen Diao. 2002. Agricultural Labor: Where Are the Jobs? *Economic Research Service/USDA*, April. http://www.ers.usda.gov/publications/aib775/aib775p.pdf (accessed September 22, 2008).

Gale, F., Lohmar, B. and Francis Tuan. 2005. China's New Farm Subsidies. *Economic Research Service/USDA*, February. http://www.ers.usda.gov/publications/WRS0501/WRS0501.pdf (accessed September 29, 2008).

Green, Stephen. 2007. On the Ground─Asia: China Years, How Many Are You Living? *Standard Chartered Bank,* September 19. https://research.standardchartered.com/researchdocuments/Pages/ResearchArticle.aspx?&R=48839 (accessed March 30, 2009).

Hsu, H., Chern W. S., and Fred Gale. 2002. How Will Rising Income Affect the Structure of Food Demand? *Economic Research Service/USDA*, April . http://www.ers.usda.gov/publications/aib775/aib775f.pdf (accessed September 28, 2008).

Huang, Jikum and Cristina C. David. 1993. Demand for Cereal Grains in Asia: The Effect of Urbanization. *Agricultural Economics*. 107-124.

Jin, Songqing, Huang, J., Hu, R., and Scott Rozelle. 2002. The Creation and Spread of Technology and Total Factor Productivity in China's Agriculture. *American Journal of Agricultural Economics*, November: 916-930.

Lohmar, Bryan, Somwaru, A., and Keith Wiebe. 2002. The Ongoing Reform of Land Tenure Policies in China. *Economic Research Service/USDA*, September. http://www.ers.usda.gov/publications/agoutlook/sep2002/ao294f.pdf (accessed September 22, 2008).

Mehta, Anand and Andrew C. Gross. 2007. The Global Market for Agricultural Machinery and Equipment. *Business Economics*, October: 66-73.

Pingali, Prabhu. 2006. Westernization of Asian Diets and the Transformation of Food Systems: Implications for Research and Policy. *Science Direct* 281-298.

Shane, Mathew and Fred Gale. 2004. China: A Study of Dynamic Growth. *United States Department of Agriculture*, October. http://www.ers.usda.gov/publications/WRS0408/WRS0408.pdf (accessed September 29, 2008).

Strauss, Anselm C., and Juliet Corbin. 1998. *Basics of Qualitative Research: Techniques and Procedures for Developing Grounded Theory.* 2nd ed. Thousand Oaks, CA: Sage.

Van den Berg, M. Marrit, Huib Hengsdijk, Joost Wolf, Martin K. Van Ittersum, Wang Guanghuo, and Reimund P. Roetter. 2007. The Impact of Increasing Farm Size and Mechanization on Rural Income and Rice Production in Zhejiang Province, China. *Agricultural Systems* 841-850.

Walsh, Jeffrey T. 2001. CNH Joint Venture with Shanghai Tractor & Internal Combustion Engine Corporation Receives Government Approval. *News Release: CNH Global N.V.,* April 9. http://investors.cnh.com/phoenix.zhtml?c=61651&p=irol-newsArticle_print&ID=233248&highlight (accessed May 18, 2010).

Yin, Robert K. 1994. *Case Study Research: Design and Methods*. 2nd ed. Sage Publications, Inc.

Zhang, Q.F., Ma, Q. and Xu Xu. 2004. Development of Land Rental Markets in Rural Zhejian: Growth of Off-farm Jobs and Institution Building. *The China Quarterly,* December:1031-1049.

International Food and Agribusiness Management Review
Volume 13, Issue 3, 2010

Industry Speaks

Carbon and Energy Life-Cycle Assessment for Five Agricultural Anaerobic Digesters in Massachusetts on Small Dairy Farms

Chelsea Morris[Φa], William Jorgenson[b], and Sam Snellings[c]

[r]*Researcher, AGreen Energy LLC, 580 Harrison Ave Suite 404, Boston, Massachusetts, 02118, U.S.A.*

[b]*Managing Partner, 580 Harrison Ave Suite 404, Boston, Massachusetts, 02118, U.S.A.*

Researcher, AGreen Energy LLC, 580 Harrison Ave Suite 404, Boston, Massachusetts, 02118, U.S.A.

Abstract

In the United States anaerobic digestion units are in place on several farms, but primarily handle manure and very small fractions of other organic material. AGreen Energy's business model aims to increase the profitability of dairy farmers and the food processing industry by utilizing organic feedstocks produced in urban areas, while reducing the risk to investors by installing an expensive technology which better meets the needs of environmental regulators.

An assessment is conducted that quantifies environmental impact through estimates of useable energy produced and carbon emissions avoided by AGreen Energy's project to install anaerobic digesters on five Massachusetts farms. The analysis shows the anaerobic co-digestion of manure and source separated organics under project conditions results in a net energy gain of 1:2.9 and a GHG emissions reduction of 50% over business as usual, justifying the technique as a sustainable residual management tool for dairy operations as well as food industry businesses.

Keywords: anaerobic digestion, co-digestion, dairy operations, food processing, greenhouse gas emissions, net energy gain

[Φ]Corresponding author: 617.510.5245
Email: contact@agreenenergyllc.com

Introduction

The dairy industry continues to face challenges and changes from increasing energy costs, tightening environmental standards for air and water emissions, and volatile milk prices. These changes are especially difficult for smaller dairy operators who buck the trend of the 5,000+ cow mega-dairies. AGreen Energy, LLC, a management company of five farmers and businessmen in the Northeast United States, plan to demonstrate that the viability of the small farm can be improved while meeting stricter environmental standards through the on-farm co-digestion of farm manure and off-farm SSO.

Anaerobic digestion of manure and other organic material is a widely accepted practice in many European Union nations and an emerging one in the United States. Dairy waste is carted off from the milking parlor floor and to a large sealed container where it is heated and mixed with other organic material, such as SSO, for a period of 15-35 days. Naturally occurring bacteria break down the organic matter, or digestate, under anaerobic conditions (without oxygen) to produce methane gas. The methane gas is burned in a generator to produce electricity used on site or sold to the electrical grid. After the digestate is fully stabilized by the process it has several secondary uses including bedding for cows and fertilizer for crops.

In the United States anaerobic digestion units are in place on several farms, but primarily handle manure and very small fractions of other organic material. AGreen Energy's business model aims to increase the profitability of dairy farmers and the food processing industry by utilizing organic feedstocks produced in urban areas, while reducing the risk to investors of installing an expensive technology and better meeting the needs of environmental regulators.

Dairy farmers see the most benefit from handling their waste with a turn-key anaerobic digestion unit. Income is earned from savings on energy usage from the methane driven generator, reduced fertilizer costs from use of a better homegrown product, and a less expensive alternative to sawdust bedding material. In addition to replacing the electricity demand at the farm, excess power will be sold to the grid and used in the local community. The farmer becomes not only a source for milk and dairy products, but provides the community with renewable energy. Exhaust heat from the generator, after satisfying existing farm heat demand, can be used to heat hoop houses with vegetable crops in the winter. Demand for local produce in the Northeast during the winter greatly outstrips the supply. After processing, the digested manure is used as a cheap, sustainable fertilizer. This will reduce the need for additional chemical or organic fertilizers. Additional digested product not used on crops can be sold to other local farmers or used as a bedding alternative to sawdust. The dairy operator also enhances his or her standing with surrounding community by eliminating unpleasant odors originating from traditional lagoon style manure storage and raw manure spreading.

The food processing industry stands to gain considerably with agricultural anaerobic digestion presently and in the future. In our model, AGreen Energy provides an additional revenue stream to the farmer through contracts to accept food residuals from processing facilities. These fees are priced to compete with current fees paid by generators for landfill or composting disposal. From a food processor's viewpoint, the disposal route runs nearly the same as before. Liquid haulers pick up the food residuals at regular intervals (daily, weekly, biweekly) and the disposer is

charged at a per volume basis. The price is competitive to other disposal methods, but the service renders greater benefits.

Waste streams from soup-making, seafood processing, and other food products can be challenging, or expensive, to dispose of properly, often ending up in the municipal wastewater stream or landfilled. These streams can be diverted for inclusion in an anaerobic digestion "recipe" where they are stabilized and returned to the soil. SSO producers partnering with dairies secure present and future diversion opportunities ahead of state and federal regulation of organic materials in landfills. State yard-waste landfill bans are already supported by the US Environmental Protection Agency, and general organic material bans have been adopted by several European nations.

Contracting with a renewable energy source can be a communication platform to consumers on how a supplier's product supports sustainable environmental efforts. Food processors partnering with AGreen Energy enhance their supplier credentials by meeting retailer's requests to recycle all by-products from production. They become a source of sustainable procurement, which many companies including Unilever and Wal-Mart have adopted as part of their operational philosophy. Long-term contracts with AGreen Energy to remove organic waste will reduce processor energy expenses and the overall carbon footprint.

State and Federal Regulators will find agricultural anaerobic digesters can be used to meet several environmental needs. The technology can be used to improve air and water quality for existing and expanding herds in a quantifiable way. When agricultural materials such as milk-house waste and manure, and food residuals are treated as waste, they are often handled and disposed of at the lowest cost. On the farm, this has in several cases led to the construction of inadequately sized or maintained manure lagoons. If an organic material waste stream is reframed as a valuable feedstock, it is handled more carefully with additional funding is available for their handling and storage.

Anaerobic digestion is a tangible technology implementation allowing smaller farms to become more economically sustainable while affordably meeting state environmental guidelines. Generating power with agricultural anaerobic digestion is a way to meet Renewable Power Standards existing in 39 states and join the USDA effort to meet the 40% reduction of greenhouse gases by the year 2020. Finally, agricultural anaerobic digesters can help local and state agencies meet their long-term goal of solid waste reduction and efforts towards zero-waste facilities.

Investors find the organized entity, a management LLC, reduces the risk of any one digester investment through pooling of operations using sophisticated process controls with professional management. A steady return business of 9 to 15% IRR is attractive to those seeking utility-like investment returns. The business operates like any other utility, with the added benefit of meeting the most stringent of green standards. These standards for air and water are easily audited and verified to meet environmental desires in investments. Social responsibility and sustainable practices can be demonstrated through a codified method for investors seeking this class of investment. The business model is also replicable to expand geographically as more States adopt Renewable Power Standards and similar regulatory measures.

In this assessment we aim to quantify the positive energy benefit and carbon reduction for the Massachusetts project. It is important to note that this model of resource sequestering is made possible by the unique geography of the Northeast. Small and medium-sized dairies located near a large metropolis make SSO feedstock available for diversion to farm digesters as well as the premium renewable-electricity price paid possible. Small dairies are a strong and vocal force in New England. Their willingness to test new ideas and remain innovative and independent is integral to their success.

Scope

This assessment models the useable energy produced and carbon emissions avoided by AGreen Energy's project to install anaerobic digesters on five Massachusetts farms. The emissions model quantifies the greenhouse gas (GHG) emissions in carbon dioxide equivalents incurred on each farm for the current manure management system (baseline) and the anaerobic digestion system (project). The energy model estimates the net energy gain, a ratio of energy expended to energy consumable. This is the commonly used notation for comparing renewable and non-renewable fuels.

Methodology

The carbon emissions model is based on the Organic Waste Digestion Project Protocol developed by the Climate Action Reserve for quantifying greenhouse gas (GHG) emissions. This is a peer-reviewed model used to quantify and normalize avoided emissions for the purpose of carbon credits. The model is a comparison of GHGs generated under business as usual conditions, landfilled SSO and lagoon-style manure management regimen, to the anaerobic co-digestion of these two materials. The manufacture and construction of the digester unit produces negligible emissions over the lifetime of the facility in this analysis and thus are not included in the model (Sanders 2002, Finnveden 2004). Emissions occurring when the digestion effluent is spread on agricultural fields were not calculated because of the difficulty in modeling. However, it is recommended that the farmers use a trailhose versus a sprinkler when applying the effluent to minimize nitrous oxide emissions (Edelmann). Transportation was not considered in this part of the analysis because the anaerobic digestion of these materials does not require additional transportation of the materials over the business as usual case. Note that the Organic Waste Digestion Project Protocol does not have a prescribed method for estimating transportation emissions.

The energy model has been constructed specifically for this project. It is a sum of the generated energy and input energy for processing, transporting, and pumping materials. The parameters for this study extend to the SSO collection plant in near Boston, Massachusetts to include the transportation. The transportation model is a simplified variation of the US Department of Energy's GREET model for transportation fleets. Transportation was considered in this model to attempt to include as much of the system as possible and provide an accurate estimation of net energy gain. Unlike the carbon emissions analysis, the energy model is not a comparison of two processes, but rather an estimation of a system with the boundaries expanded to include as many components as reasonably possible.

Data used for both models are a combination of data types. Project specific data was used when possible, such as mass flows of manure and SSO. In absence of specific data, such as chemical oxygen demand, published values with nearly identical circumstances were used. Additionally, the Organic Waste Digestion Project Protocol assumed universal values for microbial kinetics and methanogenesis variables. Figure 1 outlines the assessment boundaries for both the emissions and energy models. Most activities were included in both types of assessments (emissions and energy), however in the comparison format of the emissions model, the activities generating GHG at the landfill and on the farm manure lagoon were included. The energy assessment only included activities related to the production of biogas and therefore did not include activities at the landfill or manure lagoon.

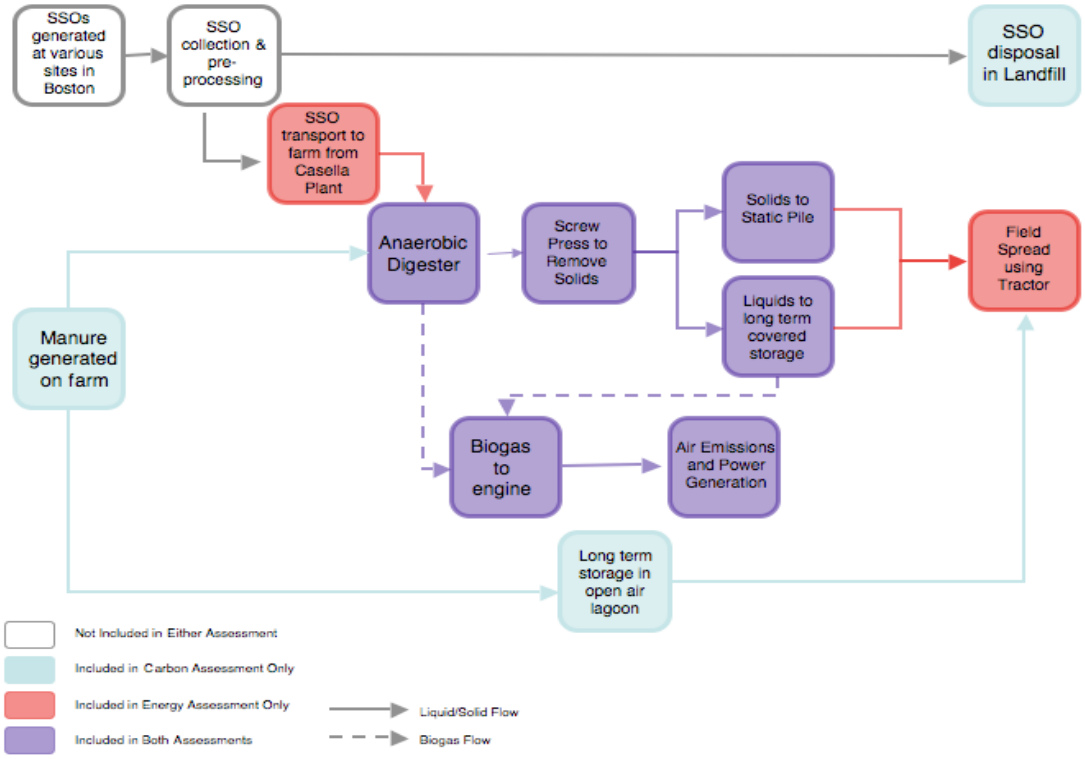


Figure 1. Assessment boundaries and system schematic for project and baseline cases

Results and Discussion

In total, the five-farm project will avoid 27,000 metric tons of carbon dioxide equivalents per year, about half of the emissions produced on the farms today. This is roughly equivalent to the GHG emissions created by about 5,000 passenger vehicles per year.

In the baseline case, landfilling the SSO created the largest source of emissions (94%). The model assumes the food waste decomposes uncovered for three years in the landfill before it is enclosed. The carbon dioxide equivalent emissions during these three years represent 80% of SSO emissions. Anaerobic degradation at landfills is common as waste is piled and open to

atmosphere before the section is capped. Food waste streams in many cities are also diverted to incinerators and composting facilities. The landfilling scenario was chosen for this model based on the reasonable expectation that without the project, Casella would be sending SSO to landfill and in time, composting facilities. Composting provides a significant reduction in GHG emissions in comparison to landfilling due to discouraged anaerobic growth. Anaerobic digestion however, sequesters all emissions from the decomposition of SSO and offsets the use of non-renewable sources of energy. A 2004 life cycle assessment (LCA) conducted in Sweden found anaerobic digestion of food wastes preferable to composting, landfilling, and incineration for GHG emissions and consumption of non-renewable energy (Finnveden). In the Finnveden study, food waste treated with anaerobic digestion decreased GHG emissions assuming the biogas replaced electricity generated by coal and heat generated by natural gas. For simplicity in calculations, the LCA assumed the unlikely case that all waste would be treated with the same process.

The energy input to the anaerobic digestion process represents only 34% of the total output of the system, a net energy gain of about 1: 2.9. For every 1 unit of energy used, 2.9 units of energy from biogas were produced. This is a significant gain for each farm annually. In comparison to other agricultural fuels such as ethanol from corn (1:1.3, currently best accepted value, USDA 2002), biogas from co-substrates recovers much more energy per initial input. However, the energy balance is greatly dependent on the operation of the system. Therefore, during start-up and other less biogas-productive months, the whole system may see this gap shrink. It is not uncommon for the energy input to grow to 50% of the total output.

Many scientific studies recognize the reduction anaerobic digestion has on environmental impact. Environmental impact is a quantified measurement of effects on human health and ecosystems from a particular activity. In a comprehensive environmental impact study, biofuels produced from methane waste streams result in the lowest impacts when compared with biodiesel, alcohol, and fossil fuels (Zah et al. 2007). This is largely because the waste is considered a raw material to be used in agriculture as fertilizer and as an energy source to replace non-renewable sources.

The project specific models as well the published literature, place anaerobic digestion of manure and food waste at the top of the list of environmentally sound biofuels, in terms of energy, emissions, and environmental impact. The project generates energy for a community, reduces carbon emissions for a region, and protects human health and local ecosystems.

Conclusion

Co-substrate anaerobic digestion technology addresses the waste management challenges of dairy operators, SSO producers, and waste treatment facilities in an economical and environmentally sustainable manner. Cost effective organics management by co-substrate anaerobic digestion grants stakeholders additional benefits. Dairy operators temper volatile milk prices with steady income from contracts with SSO producers. SSO producers easily dispose of their food residuals while meeting and improving their environmental sustainability standing. Consumers and retailers concerned with environmental impact recognize and reward the producer's corporate responsibility efforts. Methods to quantify environmental impacts are

readily available to the SSO producer for use in marketing materials and corporate sustainability goals. The processor stays ahead of federal and state environmental standards and secures disposal contracts at competitive prices. USEPA has placed state adoption of numeric nutrient criteria high on their list of priority goals. Partnering with emerging technology ensures that SSO produces will not see fallout from cost increases at waste treatment facilities.

The project specific models, as well the published literature, place anaerobic digestion of manure and food waste at the top of the list of environmentally-sound biofuels, in terms of energy, emissions, and environmental impact. The project generates energy for a community, reduces carbon emissions for a region, and protects human health and local ecosystems. Partnering with agricultural digesters can be an easy and effective statement to clients of your commitment to a sustainable prosperous environment for all.

References

Audsley E., ed. 1997. *Harmonisation of Environmental Life Cycle Assessment for Agriculture.* European Commission, DG VI Agriculture, Brussels.

Berglund, Maria, and Pal Borjesson. 2006. Assessment of Energy Performance in the Life-Cycle of Biogas Production, *Biomass and Bioenergy,* 30(3):254-266.

Edelmann W, U. Baier and H. Engeli 2005. Environmental Aspects of the Anaerobic Digestion of the Organic Fraction of Municipal Solid Wastes and of Agricultural Wastes. *Water science and technology* 52(1-2):203-208.

Finnveden, G., J. Johnasson, P. Lind and A. Moberg 2004. Life Cycle Assessment of Energy from Solid Waste—Part 1: General Methodology and Results. *Journal of Cleaner Production* 13(3):215-229.

Sanders, D.L., E. Audsley, C. Cañete, T. R. Cumby, I. M. Scotford and A. G. Williams 2003. Environmental Benefits of Livestock Manure Management Practices and Technology by Life Cycle Assessment, *Biosystems Engineering.* 84(3):267-281.

Shapouri, H., J.A. Duffield, and M. Wang. 2002. *The Energy Balance of Corn Ethanol: An Update*. AER-814. Washington, D.C. http://www.usda.gov/oce/reports/energy/aer-814.pdf (Assessed January 21, 2010)

Zah et al. 2007. *Life Cycle Assessment of Energy Products: Environmental Assessment of Biofuels,* 2007. http://www.bioenergywiki.net/images/8/80/Empa_Bioenergie_ExecSumm_engl.pdf (Assessed May 20, 2010).

International Food and Agribusiness Management Review
Volume 13, Issue 3, 2010

Industry Speaks

Designing a Scientific Management System for a Growing Science-Based Company

[ⓘ]*Novus International, Inc., Attn: Human Resources, 20 Research Park Drive, St. Charles, Missouri, 63304, U.S.A.*

Abstract

Each employee plays a critical role in supporting a company's long-term strategy. The challenge is how to create an employee-strategy integration. The Novus Management System, described herein, provides the tools to do so. From structuring the organization, to filling individual roles and to assigning key tasks, everything comes together to create an organization in which the right people are doing the right work at the right time. Requisite Organization principles—and by extension the NMS—help define what people are accountable for and what they have the authority to do; how teams should be assembled to perform most effectively; and how managers and subordinates are to work together to improve processes and achieve goals.

Keywords: human resource management, requisite organization, management system

[ⓘ]Corresponding contact: Email: hr@novusint.com

Introduction

I am often asked to define the Novus Management System (NMS). Very simply stated, it is a living set of principles that guide us in most effectively structuring, staffing and managing our organization.

Each Novus employee plays a critical role in supporting our long-term strategy. For that reason, it is essential that we help all employees to do their work as effectively as possible. The NMS gives us the tools to do so. From structuring our organization, to filling individual roles and to assigning key tasks, everything comes together to create an organization in which we have the right people doing the right work at the right time.

Requisite Organization principles—and by extension the NMS—help us define what people are accountable for and what they have the authority to do; how teams should be assembled to perform most effectively; and how managers and subordinates are to work together to improve processes and achieve goals.

But the NMS is not a set of policies and procedures that limit creativity. Quite the opposite, the NMS provides an approach to thinking about problems in a way that keeps us moving forward as an organization. At its core, the NMS is designed to help all employees bring their full capabilities to bear. And by doing so, each employee is best positioned to help Novus successfully implement its long-term strategy.

Sabrena M. Hamilton
Vice President, Global Human Resources

Supporting Novus's Long-Term Strategy

Novus International, Inc. wanted to create a system to manage its growth in a manner that was as disciplined as the methodical approach that its scientists employ to discover innovative nutritional solutions for the food and agriculture industry. The Novus Management System (NMS), based on Requisite Organization principles, has provided a scientific framework to guide that growth.

In 20 years, Novus has increased the size of its product portfolio from 1 to over 100, grown to more than 800 employees working in more than 90 countries, and now generates revenues approaching $1 billion per year. The magnitude of that accomplishment is based on the many minute details carefully planned and integrated into the company's requisite structure.

Background

In 1991, Monsanto Company sold its Feed Ingredients division to Mitsui & Co., Ltd. and Nippon Soda Co., Ltd. The new company, Novus International, Inc., had only one product for the poultry industry, but great potential based on its deep roots in scientific research at Monsanto, which

began conducting livestock and poultry feed metabolism studies in the 1950s. The new owners gave senior management a free hand to re-invent the company—to transform a former division of a traditional chemical company into a dynamic engine that could generate a continuous stream of innovative, industry-leading solutions.

One of the new Chief Executive Officer's early activities was to attend a week-long seminar that featured Dr. Elliott Jaques, the originator of Requisite Organization. Requisite Organization is a set of management principles based on research done in 15 countries over a period of 55 years. Dr. Jaques defined the term "requisite" as "required by the natural order of things."

According to Requisite Organization principles, managers make decisions from a framework based on research-proven principles that enable employees to work effectively toward a common goal based on common values, standards and procedures. These principles ensure that the company functions in a consistent manner across all business units.

Senior management recognized the potentially powerful synergies between Requisite Organization and Novus. Both are based on scientific research focused on discovering innovative solutions that leverage the vast productivity that lies within the "natural order of things." Shortly after Novus was founded, senior managers began applying Requisite Organization principles as they created the NMS.

This system is designed to fully engage every employee, at every level, in moving the company's long-term strategy forward. It provides guidelines and processes to optimize the company for maximum productivity and effectiveness. Within this framework, all employees are empowered to contribute the creativity, skills and knowledge needed to sustain the continuous stream of innovation that gives Novus its competitive edge.

Trust, Clarity and Open Communication

Open, two-way communication is a Requisite Organization principle that Novus embedded into its management system, with trust and clarity as related requisite principles. The system requires managers to clearly define the tasks they assign in specific terms, according to the standard of "QQTR"—Quantity, Quality, Time and Resources.

- Quantity: The measurable output expected from an assigned task must be specified precisely
- Quality: Parameters that define the expected quality of output
- Time: The explicitly stated time limit within which the task must be completed
- Resources: The resources (financial, material, technical or human) that are available for the task

These guidelines ensure that managers define their expectations at a level of detail that eliminates question or confusion.

"QQTR helps establish the two most important tenets of Requisite Organization: trust and clarity. Everyone has confidence and trust in the process because they understand exactly how things are going to happen," said Tricia Beal, Communications Director.
The successful completion of the company's global intranet project, NovusConnect, in only one year is an example of how requisite task assignment can greatly improve a team's effectiveness. "We built this corporate infrastructure within a very compressed schedule. At many companies, it would have taken at least 18 months to successfully complete a project of this magnitude," Beal said.

Full Engagement at All Levels

Every task performed by every employee is linked to the company's long-term strategy and Critical Success Factors through a chain of three-year objectives, short-term goals and key accountabilities. At the top level, the company has three fundamental aspects of business focus and culture:

- Long-Term Strategy: "To responsibly grow revenues and profits by leveraging and expanding our investments in innovation and people; optimizing our operations and portfolio of products and customers; and improving the organization's business processes."
- Critical Success Factors: Growth, Profitability, People and Reputation.
- Novus Integrity System: A framework to reinforce the company's basic commitment to conduct its business in an ethical manner, in compliance with corporate policies and all applicable U.S. and international laws.

Novus's senior managers develop between 20 and 30 three-year objectives in support of the company's four Critical Success Factors—about four-to-six objectives for each Critical Success Factor. They then assemble teams to develop short-term goals based on these objectives. These short-term goals, typically 12-to-18 months in duration, are assigned to a manager who is accountable for that goal. The selection of this manager is, in effect, the first step in initiating a plan to implement that goal.

Novus managers identify the key accountabilities required to support the short-term goals. They assign these accountabilities in a process that starts at the highest level of the organization and cascades throughout the entire company. This process ensures that the right people are assigned to do the right work at the right time, and that they have the clarity of purpose to move forward. Scott Hine, Executive Director, Strategic Initiatives, was the manager accountable for a three-year objective to increase the profitability of a major product line. "The clarity we had was a great advantage. It made it possible for us to move forward purposefully, without any in-fighting or turf battles, without distraction or delay," Hine said. "We took the shortest, most direct route to our objective. As a result, we achieved the cost savings goal we targeted and made substantial progress in support of one of our Critical Success Factors."

Structure

The NMS establishes six levels of work across the company worldwide. Only four levels of work separate the Chief Executive Officer at Role Level VI from an individual contributor at Role Level I. In accordance with Requisite principles:

- These levels are ranked according to the complexity, degree of responsibility and magnitude of the challenge required.
- A role's level of work is determined by the length of time required by its longest task. The longer the time required by a role's longest task, the higher that role is ranked.
- The roles of manager and subordinate should be placed close enough to enable clear communication, but far enough apart so the manager can add value to the subordinate's work.

A Level I position, for example, would follow a clearly defined pathway, with a time span that lasts no more than three months. A Level IV director would develop solutions to business challenges that may take two-to-five years to implement.

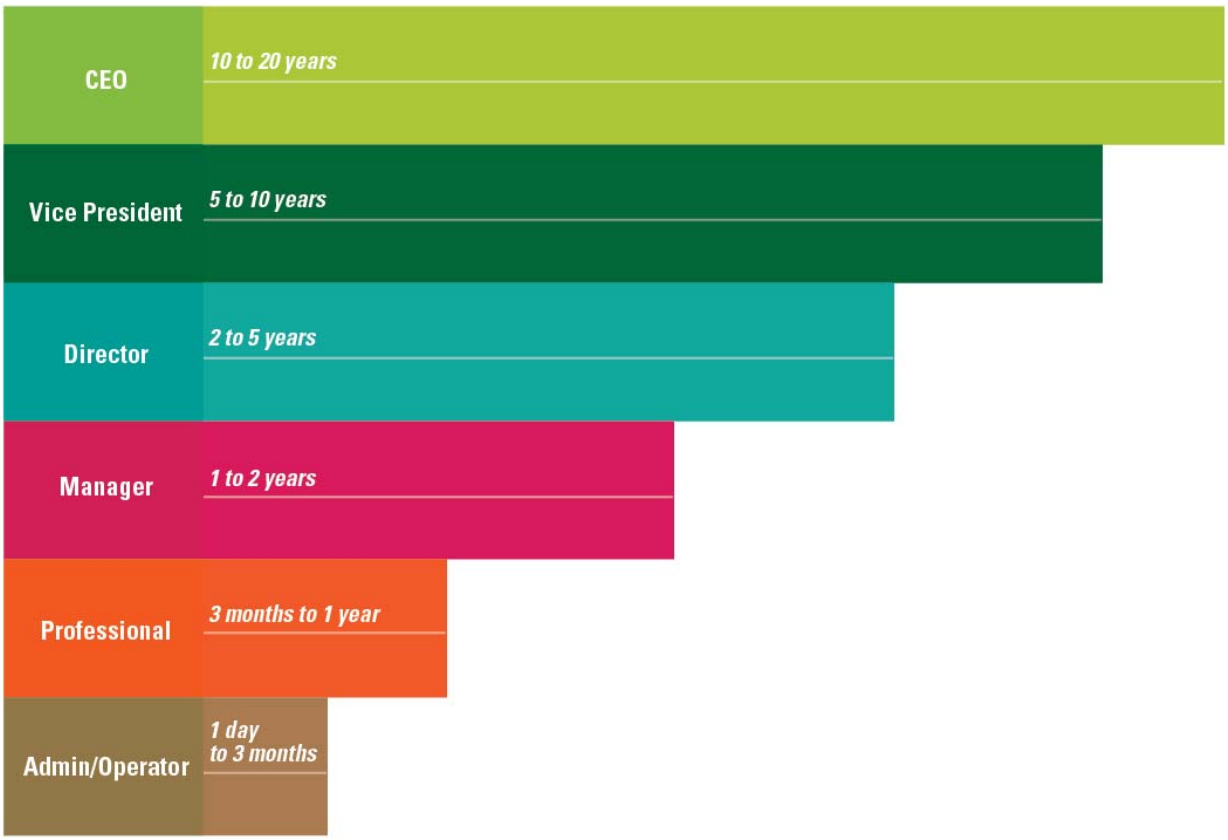


Figure 1. Level of work (expressed in time span) for each of the Novus role levels.

"Requisite is about having the right people do the right work at the right time. It's the natural order of how things work," said Sabrena Hamilton, Vice President, Global Human Resources. "Requisite Organization is hierarchical. People know where their roles fit in the organization. They know what work is expected, and what authority they have to execute that work."

Staffing

Having the right people in the right roles is key to the success of a knowledge-based company like Novus. In a requisitely structured organization, staffing and hiring decisions are made according to clearly defined criteria within a precisely defined process.
Every position has a Key Accountabilities Document (KAD) that links that role to the chain of short-term goals, three-year objectives, Critical Success Factors and long-term strategy. That document also defines a standard that hiring managers use to assess a job candidate's ability to perform the work of that role.

As would be expected, Novus gives important consideration to a candidate's knowledge and experience. But like the QQTR process that clearly defines expectations for a specific task, the KAD brings specificity and clarity to a range of factors that affect a candidate's ability to perform work at the level the role demands. Just as complexity is a key factor in determining a role's placement in the organization, Complexity of Information Processing—the mental activity required to do the work of a role—is an important consideration in determining a candidate's suitability for a particular role.

Another consideration within the requisite hiring process is: How highly does the candidate value the work? A top-performing sales professional, for example, might value interacting with customers more highly than administrative tasks; that employee would be more highly motivated to work directly with customers than in a management position. This aspect of the interview process is not left to the manager's discretion on an ad hoc basis.

"We look for a long-term staffing solution, not a quick fix for a given project. We see the positive results of this approach in employee morale and job satisfaction," said Maria Burt, Human Resources Manager and Recruiter.

Authority and Accountability

It is characteristic of the Requisite organization that everything is articulated clearly and precisely, even matters that other organizations might regard as being self-evident. The value in articulating the "obvious," however, is that not everything is in fact obvious to everyone—and there is some risk in leaving basic assumptions unspoken.
The NMS clearly articulates the fundamental proposition that managers are accountable for their own output as well as the output and behavior of their subordinates. Managers have the authority to veto the appointment of a subordinate, initiate the removal of a person from a role, assign tasks to a subordinate and evaluate a subordinate's effectiveness.
Subordinates also have clearly defined accountabilities and authority. The NMS requires subordinates to bring their full capability to work every day, to continue to develop their

professional knowledge and skills and to provide their managers with timely feedback. The manager-subordinate relationship at Novus is a two-way working relationship. Employees are able to work at their full capabilities when they work with their managers in an environment of trust.

In this environment, Novus does not evaluate employees on the basis of an annual performance appraisal that is the norm at many companies. Strictly speaking, an annual performance appraisal is not necessary when continuous and open communication is routine for managers and subordinates. Instead, Novus integrates a Personal Effectiveness Appraisal (PEA) into the on-going, two-way communication between Manager and Subordinate. Managers assess employees' effectiveness in terms of their specific accountabilities rather than in terms of performance as defined in quantitative terms dependent upon various factors external to the employee's role. The formal annual PEA meeting is an opportunity to summarize conclusions drawn from previous discussions—without any surprises for the employee.

Training and Development

As an organization designed to optimize employee engagement at all levels, Novus understands the importance of training and development. As a Requisite organization, Novus has a system to ensure that all employees regularly receive the training and education they need to move forward with their careers as the company moves forward with its long-term strategy.
Training is available in four major categories:

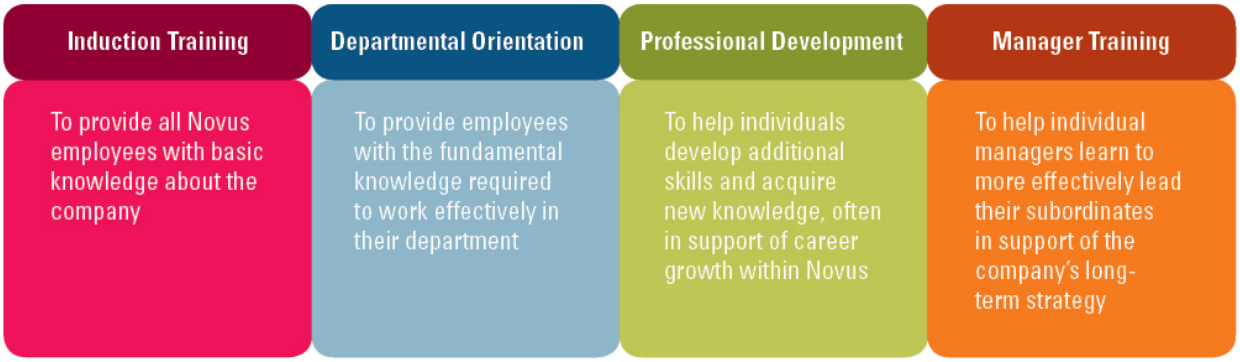


Figure 2. The Novus Learning System offers four categories of training and development

Courses are offered as instructor-led workshops; as e-learning, through the Novus Online Learning System; and through blended learning, which combines e-learning and instructor-led workshops. Employees have every opportunity to better prepare themselves for the challenges they face in a dynamic, competitive global market. Dan Meagher, Vice President of Sales, credits the effectiveness of the training system with the company's success in fully integrating a new product line with its own sales into the sales organization in only four months.

Conclusion

The NMS has fine-tuned the company's corporate culture to unleash employee commitment and creativity at every level, and to direct that energy in a highly focused manner towards clearly defined corporate goals.

In the past 20 years, the company has methodically leveraged its core expertise in nutritional research to expand from one product for the poultry industry to more than 100 products for poultry, beef, dairy, pork, aquaculture, feed quality, companion animals and people.
This innovation and agility would not be possible without a corporate culture that combines entrepreneurial thinking with organized structure and a motivating corporate Vision: to help feed the world affordable, wholesome food and achieve a higher quality of life.

For the complete story, download: Novus Requisite Organization at Novus International, Inc. at: www.novusint.com/NMS

For further information or questions contact: hr@novusint.com

