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Executive Summaries

RESEARCH

Supplying Improved Seed to Farmers in Rural Kenya: The Case of Freshco Kenya Ltd. *Edward Mabaya, Laura K. Cramer, Veronica K. Mahiga, Huang Q. Pham, Tara M. Simpson, and Xiaowei Tang*

Freshco, a small producer and distributor of hybrid maize seed and macadamia seedlings, was one of the first private companies to enter the Kenyan seed market after its liberalization. The company's mission is to distribute agricultural inputs that increase the wealth of smallholder farmers with a vision to be the most preferred producer and supplier of seed in East Africa. Currently the company produces and markets six high yielding maize varieties that are suited for diverse agro-ecological conditions. Despite the company's encouraging growth in the local maize seed market, Freshco's executives recognize the need to scale up its operations to maintain growth. However, the maize seed industry presents a broad set of challenges. Competition is fierce, and government bureaucracy and poor infrastructure add to the difficulties of managing a business in a developing country. The East Africa region and Kenya's developing seed industry are both extremely dynamic contexts; preparing for different challenges and taking advantage of opportunities that emerge is imperative for Freshco's long-term profitability. As Freshco pursues its vision of becoming a seed industry leader, the CEO of the company will need to maintain a keen insight and understanding of the environment in which it operates. There are a number of trends, actual and potential, that will have a significant impact on Freshco: (1) revitalized interest in seed development in Africa, (2) regional integration efforts, (3) aggressive market penetration by multinationals and (4) continued presence and impacts of not-for-profit organizations in the region.

Competitive Analysis and Market Power of China's Soybean Import Market *Baohui Song, Mary A. Marchant, Michael R. Reed, and Shuang Xu*

Globally, China is the number one soybean importer, and the U.S., Brazil, and Argentina are the top three soybean exporters. In 2005, China's soybean imports accounted for 41% of the world total, and soybean exports from the above three soybean producing countries accounted for over 90% of the world total. This research develops and estimates a U.S.-China two-country partial equilibrium trade model (that includes Brazil and Argentina as competitors) to test which country has

stronger market power in the Chinese soybean import market. This model incorporates U.S. residual soybean supply, Chinese residual soybean demand, and the market equilibrium condition, whereby residual supply equals residual demand. This equation system was estimated simultaneously.

Results of this competitive structure analysis imply that the U.S. and South America are seasonal complementary soybean suppliers for China. Empirical result supports the hypothesis that Chinese soybean importers have stronger market power relative to U.S. soybean exporters. It seems that the increased availability of South American soybeans throughout the marketing year seems to have allowed more market power for the Chinese. The implications are that the US, Argentina, and Brazil have a common interest in developing new and expanding existing markets for soybeans to help combat this market power of the Chinese. More market outlets for soybeans will bring new customers to compete with the Chinese for exported soybeans, reducing the reliance on Chinese imports and possibly shrinking Chinese marketing margins.

Efficiency and Productivity Changes in the Indian Food Processing Industry: Determinants and Policy Implications

Jabir Ali, Surendra P. Singh, and Enefiok Ekanem

This paper evaluates the performance of various segments of the Indian food processing industry in terms of total factor productivity (TFP) and efficiency change during pre and post market liberalisation periods. The Indian food processing industry has immense potential for generating income and employment through value addition due to availability of resources, labour, technology, a huge market and favourable business environment. The 10% per annum output growth of the industry is largely driven by the incremental use of input. However, this growth is constrained by the lack of productivity augmenting technologies, as a major quantity of the food is being produced in the unorganized sector where resource utilization is very limited. The average technical efficiency score is estimated to be 0.902 under the Variable Returns to Scale model, with an average scale efficiency score of 0.870. This implies that the average technical inefficiency could be reduced by 10 percent by improving scale efficiency and eliminating pure technical inefficiencies. It is also important to note that technical efficiency scores for the food processing industry have declined during the 1990s as compared to the 1980s.

The analysis of returns to scale in the food processing sector suggests that most of the sub-sectors have moved from increasing returns to scale to constant and decreasing returns to scale during the last two decades, with the exception of meat and meat products, fish and fish products, fruits and vegetables, and starch and starch products. This result indicates that additional investment in the food processing segments, with increasing returns to scale, will give encouraging and profitable output, while food segments with decreasing or constant returns to scale will need reorientation and modernization in the production process. The Indian food industry needs to modernize its production system for improving the capacity

utilization of factor inputs, mainly in the areas of raw material, capital and energy. As raw material constitutes about 85 percent of production cost, proper methods of sourcing quality raw material for food production should be adopted to shorten the supply chain of the food processing industry.

Market Segmentation Practices of Retail Crop Input Firms

Aaron Reimer, W. Scott Downey, and Jay Akridge

While market segmentation and the associated idea of target marketing are not new, there are questions about how the strategy of market segmentation and target marketing is being used in retail agribusiness firms. Previous research has demonstrated that distinct groups of farmers/customers exist (Alexander, Wilson and Foley 2005). However, retail crop input firms tend to be of modest size and are geographically bound. Both lack of resources and confinement to a specific geographic market present challenges for successful implementation of a market segmentation/target marketing strategy (Stolp 1998).

In this study, market segmentation/target marketing practices were explored in two types of crop input retailers: independently owned and operated firms (9 firms) and agricultural cooperatives (11 firms). A number of questions related to market segmentation/target marketing strategy were assessed via a web-based survey and telephone interviews. Referencing Best's seven-step framework, market segmentation is compared and contrasted by firm type; gaps in market segmentation strategy execution are identified; and challenges to implementing a market segmentation strategy are considered.

Results show that market segmentation/target marketing was employed by 85% of the crop input retailers in the sample. Key gaps identified in market segmentation strategy execution include measuring market segment attractiveness; evaluating market segment profitability; developing a product-price positioning strategy for a tailored offering; expanding the positioning strategy to include promotional and sales elements of the marketing-mix; and evaluating the progress/success with each target market segment. Addressing these key gaps will aid industry professionals as they work to serve the needs of a continuously evolving farmer/customer base.

CASE STUDIES

Greene Gardens

Gregory A. Baker and Kirk O. Hanson

This teaching case describes the 2006 E. coli outbreak in the California spinach industry. It unfolds over a period of about one month, with four separate eventful days described in detail. At the end of the narrative for each day, the reader is provided with several questions and asked to decide how he or she would respond to the events and justify his or her decision.

The case may be used to teach business ethics, crisis management, marketing, communications, and public relations. It lends itself well to teaching with little or no student preparation. The four one-page sections of the case may be passed out one at a time and the instructor can lead a discussion of each section before moving on to the next. The case realistically portrays the decisions of food industry managers confronting a food poisoning crisis and the ethical and management choices they face.



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Supplying Improved Seed to Farmers in Rural Kenya: The Case of Freshco Kenya Ltd.

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Abstract

Freshco, a small producer and distributor of hybrid maize seed and macadamia seedlings, was one of the first private companies to enter the Kenya seed market after its liberalization. Currently, the company produces and markets six high yielding maize varieties that are suited for diverse agro-ecological conditions. Despite the company's encouraging growth in the local maize seed market, Freshco's executives recognize the need to scale up operations to stay competitive. The company's challenge is to recognize business opportunities and customer needs in an environment susceptible to ecological, political, and socioeconomic change.

Keywords: Kenya, seed industry, smallholder farmers, scenario planning.

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Introduction

As 2006 closes, the team at Freshco Kenya Ltd. (“Freshco”) celebrates its third consecutive profitable year. Morale at the Kenya-based seed company is high—revenue has shot up 30% over the past year, and the company is preparing to release three new, promising maize varieties. Freshco’s CEO, Gichanga Karanja, “Captain Karanja”, is a confident man with a broad smile who likes to tell his team that “nothing is impossible.”

But the maize seed industry presents a completely new set of challenges. Competition is fierce, and government bureaucracy and poor infrastructure add to the difficulties. Captain Karanja knows that Freshco needs to scale up operations, but how should this growth be achieved? And equally important, how should Freshco prepare for the upcoming changes in the industry and in Kenya, changes that will have important consequences for the business? These questions occupy the staff members as they embark on a new year of operation in 2007.

Welcome to Freshco

Freshco, a small producer and distributor of hybrid maize seed and macadamia seedlings, was one of the first private companies to enter the Kenya seed market after its liberalization in 1996. The government-run monopoly, Kenya Seed Company, was converted to a private company and other businesses were permitted to join the competitive private sector. Captain Karanja and his business partner, Peter Munga, started the company in 1996 by selling macadamia seedlings to growers for Equatorial Nut Processors, a macadamia processing business owned by acquaintances. Freshco entered the maize seed market in 1997 as a distributor for Pioneer Hi-Bred International and later for Monsanto, but its management soon realized the company could be more profitable by building in-house capacity to grow and sell its own hybrid maize varieties. Freshco seized the opportunity to become a local Kenyan seed producer and sold its first line of Freshco branded seed in 2002. Since then, gross profits have increased 369%, from USD\$73,924 in 2002 to USD \$272,467 in 2006 (exchange rate in March 2007, USD \$1 = 68.9 Kenyan shillings), and market share has grown from an estimated 0.25% in 2004 to 1.5% in 2006.

Freshco’s mission is “to increase the wealth of our shareholders by increasing the wealth of small scale farmers through provision of quality seed and other improved planting materials” (Freshco’s *Marketing Plan 2007*). The company focuses on providing quality products that deliver new breeding technologies and maize varieties into the hands of its customers. Its vision is to be the most preferred producer and supplier of seed in East Africa. In addition to supplying high quality seed and planting material, Freshco prides itself on being close to smallholder farmers and providing agricultural advice as part of its customer service. Captain Karanja encourages his two sales agronomists, David and Amos, to be in constant

contact with the retailers selling the company’s seeds and the farmers purchasing them. In Captain Karanja’s mind, Freshco’s job does not end once its product leaves the store shelf; its job goes all the way to when the farmer harvests cobs heavy with swollen kernels of maize. This credo is embodied in the company’s slogan: *Our Technology. Your Wealth.*

Macroenvironment in Kenya

Freshco is headquartered in Nairobi, the capital of Kenya, a country with a population of 34.7 million. There are 42 ethnic groups in the country, the Kikuyu being the majority, while other major groups include Luhya, Luo, Kalenjin, and Kamba. The Rift Valley is the most populated province; one-fourth of the population lives and works in this region (CIA, 2007).

Kenya’s current president, Emilio Mwai Kibaki, was elected in 2002, the third president of the country since independence from the British in 1963. Kibaki’s national policy centers on promoting the domestic private sector and reaching out to international economies. Foreign investors have gained confidence during his leadership, and rural households have begun to commercialize their agricultural output. Real GDP growth increased from a near standstill in 2002 to 4.6% in 2004 and 5.7% in 2005. Income per capita increased significantly to US\$530 in the same period (World Bank, 2006). Table 1 gives the macroeconomic indicators for Kenya from 2000 to 2005.

Table 1: Kenya’s macroeconomic indicators

Indicators	2000	2001	2002	2003	2004	2005
Population (million)	30.69	31.36	32.04	32.73	33.47	34.26
Annual population growth (annual %)	2.23	2.17	2.13	2.14	2.22	2.33
GDP (current US\$ billion)	12.71	13.06	13.19	15.04	16.09	17.98
GDP growth (annual %)	0.60	4.38	0.40	2.77	4.34	2.80
Gross national income per capita (US\$)	430.00	420.00	400.00	430.00	480.00	530.00
Inflation, GDP deflator (annual %)	6.08	1.55	0.85	6.96	6.92	3.73
Net inflows of foreign direct investment (US\$ billion)	111.00	5.00	28.00	82.00	46.10	–
Agricultural land (% of land area)	46.32	46.49	46.49	46.58	–	–
Agriculture, value added (% of GDP)	32.36	30.65	28.27	27.79	26.75	27.36

Source: World Bank, World Development Indicators

“–” means data are unavailable.

Major challenges to economic growth remain because of the country’s poor infrastructure and banking system as well as its agroclimatic challenges. Despite extensive investments in infrastructure projects by the government and external

financiers, Kenya's roads and electricity system are of poor quality. This shortcoming directly impacts production costs for the economy in general and is a drawback for investors. Also, the banking system in Kenya is unable to meet the needs of many small and medium-sized enterprises for credit and technical advice. Commercial banks either avoid lending to the agribusiness sector because of the higher transaction costs and difficulties in assessing and managing risks or lend money at high interest rates. Cyclical droughts have plagued Kenya historically and food scarcity from the current prolonged droughts in most of Kenya has pushed food prices up.

Kibaki's government sees the agricultural sector as a primary means to increase per-capita income, generate employment and develop trade. Currently, it is revitalizing and diversifying the agricultural sector, making it more commercially oriented and capable of attracting private investment and competing in international markets.

The Agriculture Sector in Kenya

Agriculture has always been the mainstay of Kenya's economy. It is the major source of livelihood in rural areas, where most of the population lives, and it employs approximately three-fourths of the labor force (CIA, 2007). Agriculture accounted for 30% of the country's GDP during the past six years, although in recent years its share has decreased. To increase agricultural productivity, Kibaki's government has encouraged farmers to adopt quality inputs such as hybrid seeds and modern farming practices.

Kenya's territory is divided into various agroecological zones ranging from the lowland to highland zones. The lowland zone, or the semiarid and arid areas, lies in the east and northeast of Kenya, covering about 80% of the land surface and occupied by about 20% of Kenya's population. The low amounts of rainfall and low soil fertility in these regions prohibit any economic gains from growing staple food crops. The Kenyan highlands, however, have a more favorable agroecology for crop production and better market opportunities. Annual rainfall supports the growing season and the well-drained soils are suitable for growing wheat and maize. The area has a diversity of farming systems, varying from subsistence farming to export-oriented commercial farming.

The Maize Seed Industry in Kenya

Maize is the staple crop of Kenya's agriculture sector. It is grown on 30% of arable land and constitutes 3% of Kenya's GDP. Nearly every small farmer grows maize, and Kenyans consume an average of 98 kg per person per year (Nyoro et al., 2004). Production has been increased by the better varieties created through the introduction of scientific plant breeding in formal laboratories, yet farmers'

traditional methods of selecting and saving seeds from their own maize crops continues. Although many Kenyan farmers still use this informal system of seed acquisition today, a formal market system has been gaining ground in recent decades. Kenya liberalized the seed industry in 1996, converting the government-run Kenya Seed Company (KSC) into a private seed company. This allowed newly formed private Kenyan seed companies to join the field along with international corporations. KSC has continued to dominate the market, however, and 10 years after liberalization, more than half of the company's shares continue to be held by the government (Nambiro et al., 2004).

The Kenya Agricultural Research Institute (KARI) conducts most maize seed variety development within Kenya, and international agriculture research centers such as the International Center for the Improvement of Maize and Wheat (CIMMYT) also contribute breeding research and new germplasm. The process of releasing a new variety of seed can take 10 or more years from the beginning of breeding experiments to final passage through performance trials. The release of new varieties is regulated by the Kenya Plant Health Inspectorate Service (KEPHIS). KEPHIS holds National Performance Trials to test the quality of each new variety before it is released for sale on the national market. Because breeding research and development is time consuming and costly, most local private companies have not invested in this aspect of seed production. When new varieties are under development, KARI makes arrangements with private companies to pass on breeding rights. The companies then take the new varieties through performance trials, and once the varieties are released, begin multiplying the seed for sale to Kenyan farmers.

The improved varieties that are being sold by companies contain extensive improvements over farmer-saved seeds. Most of the varieties being sold are hybrids. A hybrid plant is produced by crossing two different parents to produce an offspring that has characteristics of both parents. Hybrid maize varieties are, in general, higher yielding than OPVs, but new seed must be purchased each year because kernels that are replanted will not contain the same characteristics or yield. Seeds that are saved by farmers have lower yields and may not contain the disease resistance or other traits that are bred into hybrids by the research centers.

Most seed companies use farmers with large land holdings to grow the seed they sell. When this seed is harvested, the companies have it sorted to remove any kernels that do not meet size standards. Once the seed has been sorted, it is treated with chemicals to protect it from insects and mold, coated with a dye to distinguish it from food maize, and packaged. Because all seed sold in the formal sector must be certified by KEPHIS, this agency is involved at every step of the preparation process. To achieve certification, seed companies must submit forms, pay fees, and request visits by KEPHIS inspectors at different stages in the growing, harvesting, and packaging cycle. This process can be burdensome to seed companies but is

constructed to maintain quality assurances and prevent poor quality seed from entering the market.

Seed that has been grown in one season is prepared for sale to the farmers for planting in the subsequent season. It reaches smallholder farmers through agricultural supply retailers, called stockists, who are located within town centers. In addition to selling seeds these stockists also sell fertilizers, pesticides, and livestock supplies. Seed companies deliver to the stores of stockists, and smallholder farmers visit stockists to purchase seeds and other agricultural input needs. Seed companies may also sell directly to large farmers that are growing maize for the commercial market, to nongovernmental organizations (NGOs) that distribute seeds to program participants, or to institutional buyers such as schools or prisons. The characteristic structure of the seed industry in most African countries is illustrated in Figure 1.

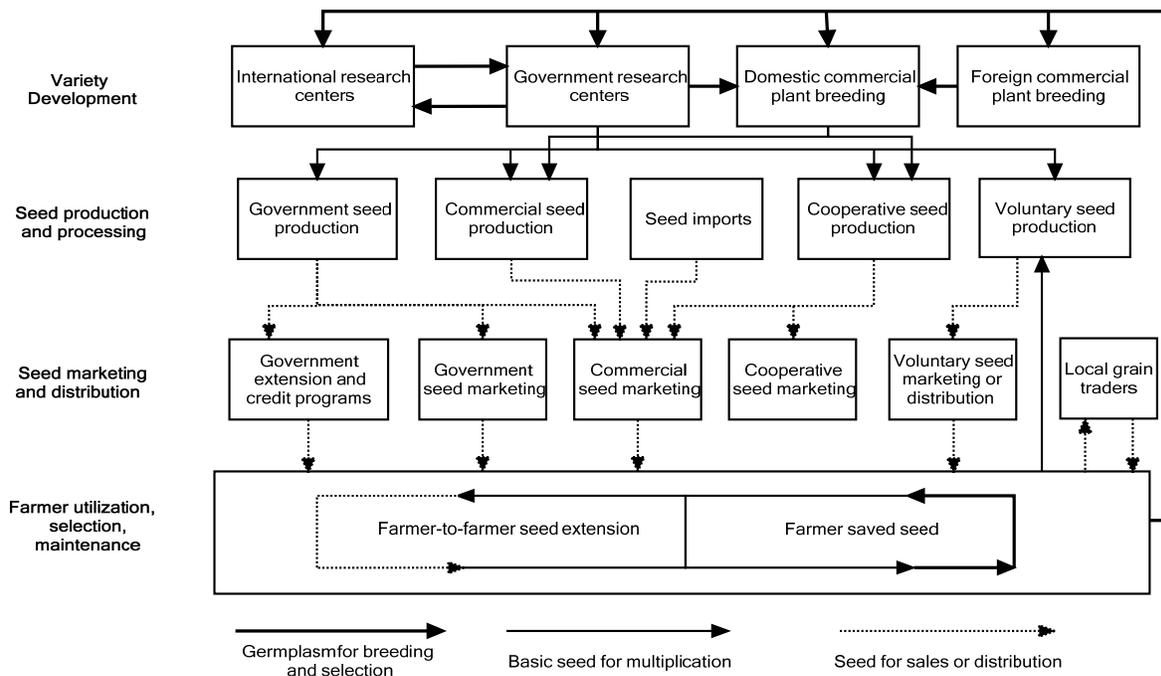


Figure 1: Characteristic seed system in African countries (Tripp 2001)

Maize is planted in Kenya at the start of the long rains, usually in March. Seed companies stock enough inventory in stores before the rainy seasons to satisfy customer demand. In areas where there is an additional short rainy season that will support a second crop, from October to December, farmers also plant in October. The periodic surge in seed purchases causes the majority of activity and profits to occur in brief periods of time, with long periods of low activity and profit during the rest of the year.

Competitors in Kenya's Seed Industry

The number of varieties available to Kenyan farmers has increased greatly since liberalization of the seed sector. In addition to popular varieties sold by KSC that have been on the market for many years, farmers can now choose seeds from multinational companies and domestic suppliers. Many farmers also continue to obtain seeds from the informal sector.

Former parastatal: After many years as the only seed provider in the country, KSC remains the largest shareholder in the seed market. According to internal Freshco documents, KSC continues to hold approximately 90% of the maize seed market, or over 15,000 tons.

Multinational corporations: Pioneer Hi-Bred International and Monsanto continue to sell their product lines in Kenya, along with Pannar Seed, a multinational seed company based in South Africa. These companies are selling varieties developed for other parts of the world but have the resources to invest in research and development for Kenyan varieties if they decide the potential in Kenya is great enough. Combined, multinational corporations hold 6.75% of the maize seed market, according to Freshco documents.

Domestic companies: Other domestic seed companies are Oil Crops Development Ltd. and Western Seed Company, while there are many smaller producers. These companies are all trying to increase their sales. Based on Freshco's internal document, *Marketing Plan 2007*, market share data for other competitors in 2004 are listed in Table 2. The company document also notes that Freshco's estimated market share rose to 1.5% in 2006.

Table 2: Maize seed market shares in 2004

Company	Market Share	Amount (MT)
Pioneer Hi-bred Seeds	3.00%	600
Monsanto	2.00%	400
Pannar Seeds	1.75%	350
Western Seed	0.75%	150
Oil Crops Development Ltd	0.50%	100
Freshco	0.25%	50
Others	0.10%	20
TOTAL	8.35%	1670

Informal sector and community-based seed systems: Not all farmers have adopted the use of improved seed (either hybrids or OPVs) due to a lack of education, inability to purchase seed, limited or no access to stockists, or other reasons. In addition, some farmers that do plant hybrid seed may also continue to plant local

OPVs to complement the characteristics of their purchased seed. Adoption of hybrid varieties ranges from above 90% in areas where maize grows well to about 30% in areas that are difficult for maize production (Smale et al., 2006). Some NGOs also encourage community-based seed systems, in which community members produce seed that is not certified by national authorities but does adhere to certain standards identified and controlled by community members.

Inside Freshco

Captain Karanja describes Freshco's role in the Kenyan agricultural sector as increasing the wealth of small scale farmers through provision of quality seed and other improved planting materials. By having this technology within reach, farmers are able to achieve higher yields, which contributes to increased consumption, better health, and greater income generation through the sale of surplus produce. Freshco maintains a close connection to maize breeders at KARI and CIMMYT, which give the company access to new varieties.

The bottleneck in Freshco's production chain is its difficulties recruiting and retaining farmers with large enough parcels of land where its seed can be multiplied. KEPHIS regulations require isolation distances between fields used to grow certified seed and other maize crops. The number of farmers in Kenya owning tracts of land large enough for the inclusion of these isolation borders is limited.

Freshco has also found that farmers have not returned all of the seed harvested. Although the company draws up contracts with the farmers, pressing legal charges is difficult because of inadequacies in the judicial system.

Once Freshco receives the seed from its contract growers, it pays to have the seed sorted, treated, and packaged at the facilities of another seed company in Nakuru, the provincial capital of Rift Valley located a few hours away from Freshco's headquarters. The seed is then stored at a nearby storage facility before delivery to stockists.

Product Portfolio

Freshco's current product line includes three hybrid varieties that are late maturing and well suited for highland ecological zones and one hybrid variety that matures earlier and is adapted for lower altitudes. The company provides information to stockists on which varieties are best suited for which ecological zones, and stockists pass this information to farmers. Farmers then choose the varieties that are best adapted to their field conditions and that contain the desired characteristics, such as two cobs per stalk or a particular disease resistance. In addition to its current product line, Freshco is also preparing to release three new varieties: two types of

quality protein maize (QPM) and one with resistance to a parasitic weed called striga. The company plans to have these in the market by the 2008 growing season. The QPM varieties are hybrids that have higher protein content than normal varieties. One of these is a high altitude variety and the other is suited for medium altitudes with moderate rainfall. These will be the first hybrid QPM varieties in Kenya, and Freshco has an exclusive contract with KARI for these varieties. Freshco will pay royalties to KARI throughout the duration of its 10-year contract. QPM will be a valuable addition to the range of choices for farmers; in addition to helping combat protein malnutrition in humans, it can also be fed to livestock for faster growth rates.

The third new variety Freshco is planning to introduce is a striga-resistant variety bred by CIMMYT. Striga, a parasitic plant that drains soil nutrients, has infested about 80% of the farmland in western Kenya, where most maize is grown. Farmers planting in striga-infested soil may lose 20% to 80% of their yields and sometimes their entire season's labor. Experiments from CIMMYT demonstrate that the striga-resistant variety, which is coated with herbicide, can increase average yields more than fourfold at a cost of less than US\$4 per hectare. Even under unfavorable market prices, the new variety has a benefit-to-cost ratio of more than 25:1 (CIMMYT, 2007). The research institute estimates that in East and Central Africa the potential market for this new variety may be as high as 40,000 tons of seed if all striga-infested areas are included.

Freshco sells seed in one, two and five kilogram bags with English-language labeling. Freshco prices its products just below KSC's prices, although the executive team believes its products are superior to those offered by KSC. Management wants to attract more customers and gain more market acceptance before raising prices.

Human Resources

Captain Karanja is Freshco's Chief Executive Officer. There are 14 additional full-time staff members, and the company employs an additional 200 to 300 seasonal workers during the busiest times of the year. Senior staff members include a finance and administration manager, a production manager, two sales agronomists, and a processing facilities manager. Support staff includes an accountant and two administrative assistants. The company's organizational chart is shown in Figure 2.

Finances and Short-term Objectives

Freshco's sales revenue and profits have been increasing steadily since the company was founded. Sales revenue from maize seed almost doubled between 2004 and 2006. The company's breakeven point is 200 metric tons for the seed production and marketing division, and it holds an estimated 1.5% of market share. Freshco's gross profits during the period 2002-2006 are charted in Figure 3.

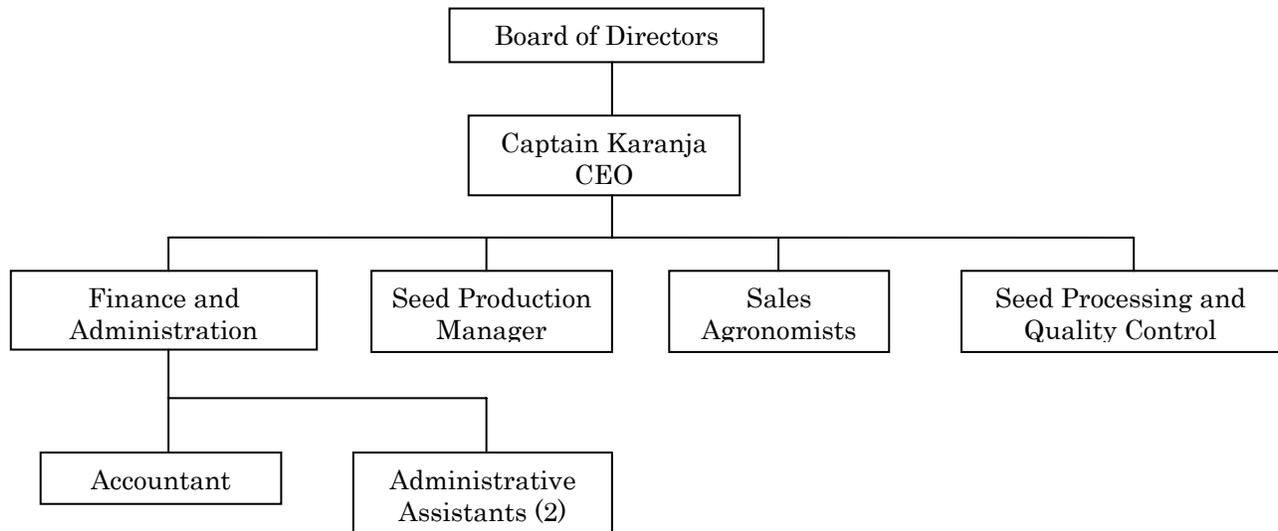


Figure 2: Freshco Organizational Chart

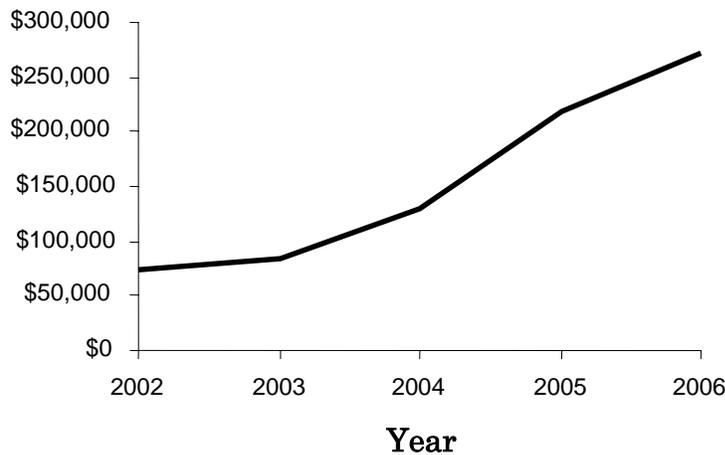


Figure 3: Freshco's Gross Profit, 2002-2006

The company's planned objectives for the short-term future are:

- Double the market share from 1.5% to 3% by the year 2009.
- Increase the number of hybrid varieties to cater for lower altitude ecological zones.
- Increase the distribution network to cover more areas in Kenya.
- Actively involve farmers in field testing of new varieties through demonstration plots.
- Increase awareness of the Freshco brand and its varieties throughout Kenya via field days, business fairs, farmers' field schools, and stakeholders meetings.
- Double the volume of seed maize production by the year 2009.

Marketing Strategy

Marketing holds high priority at Freshco. At 20% to 25% of expenditures, marketing is the biggest cost after production. Farmers who have never used Freshco seeds are reluctant to risk a season's crop on a variety they have never tried. While the company positions its products as high quality and innovative, Captain Karanja admits that marketing remains the biggest challenge for his organization. Freshco's marketing team has segmented its market by customer location (low, medium, and high altitude) and by buyer type (smallholders and commercial farmers, among others). Table 3 shows a simple metric tool used to make assessments of the different buyer segments by the marketing team. The team uses this tool to select the most attractive segments. The sales agronomists, Amos and David, then target Freshco's products at the selected segments in the major maize growing regions of Kenya, visiting customers and stockists, planting demonstration plots, and handing out promotional materials. The team tailors the price, place, and promotion of its products according to the market segment it is targeting.

Amos, who joined the company two years ago after working at various other seed companies for the past 30 years, emphasizes the importance of smallholder farmers to a small enterprise like Freshco. "The smallholder farmers are the lifelines of the company. We sell almost all our products to them," he said. He acknowledges, however, that Freshco needs to think about diversifying its market segments.

Smallholder Farmers

Freshco focuses almost exclusively on smallholder farmers. The largest segment, smallholders produce about 70% of the maize in Kenya and represent 95% of Freshco's revenues. Many farmers live in the high potential maize region of western Kenya's North Rift Valley region, which produces over 30% of the national maize. Smallholders grow maize, along with other staple crops such as legumes, tubers, bananas, cereals, and cash crops like coffee, tea, tobacco, and macadamia nuts on plots of land ranging from 0.25 to 5 acres (Ouma et al., 2002). They grow crops for subsistence, in good years producing a surplus they can sell in the local market. Most of the work is done manually, although some small farmers may have access to equipment such as tractors that they can rent as needed. The average maize yield achieved by smallholders is 1710–2250 kg per acre (RATES Center, 2003).

When smallholders need to purchase seeds, they choose the variety based on their past experiences, advice from stockists, and neighbor recommendations. Opinion leaders are influential in disseminating information about new crop techniques and varieties among their peers. The most popular varieties meet criteria such as high yield; large grain size; resistance to diseases, pests, and drought; and good taste and ease of cooking. In general, smallholders prefer to buy seeds in 2 kg bags, which is

Table 3: Freshco’s evaluation of its buyer segments

Features	Smallholder Farmers	Commercial Farmers	Institutional Buyers		NGOs
			Schools	Govt.	
<i>Demand concerns</i>					
Market size (+)	5	3	2	2	4
Market growth (+)	5	1	3	3	4
Stability of demand (+)	5	4	2	2	3
Purchasing power (+)	1	3	4	4	5
Presence of informal sector (-)	1	4	3	3	5
<i>Geography</i>					
Geographical dispersion (-)	1	4	3	3	5
High-land variety preference	5	5	5	4	2
Mid-land variety preference	5	4	4	3	2
Low-land variety preference	2	1	4	4	5
<i>Marketing concerns</i>					
Ease of access (+)	5	4	3	1	2
Training needs (-)	1	3	2	5	5
Visibility of promotion(+)	4	2	5	1	3
Word of mouth (+)	5	4	3	1	2
<i>Financial concerns</i>					
Margin per quantity (+)	2	4	3	3	5
Packaging costs (-)	1	4	3	3	1
Transaction costs (-)	2	2	4	3	5
Payment issues (-)	2	1	5	5	5

Key: 1 = Unattractive, 2 = Somewhat unattractive, 3 = Neutral, 4 = Somewhat attractive, 5 = Attractive

enough for their farm, although significant portions also like the 10 kg bags because the price per kilogram is less (Ouma et al., 2002).

To reach this segment, Freshco uses a combination push/pull strategy. From October to January, Freshco markets its products to farmers directly. The company plants about 200 demonstration plots across the country each year to attract new customers. Farmers selected to host these demonstrations receive free seeds, pesticide, and other inputs from Freshco in exchange for showcasing Freshco’s crop on their land. The sales agronomists also visit these plots periodically to ensure they are adhering to company standards. The company also provides some extension services, including training farmers on the best methods for growing Freshco’s maize seeds and for controlling pests and diseases.

From February to April, Freshco turns its attention to the stockists, who command enormous credibility among farmers. Freshco promotes its products to this influential group mostly through agricultural trade shows, which are usually hosted

by NGOs, KARI, or other companies, and through in-person visits to explain the benefits of Freshco products. The company also offers a 5% margin to stockists on farmer sales, double what KSC offers. In addition, the sales agronomists give stockists promotional items, such as t-shirts, calendars, and posters. At the start of the growing season, Freshco transports its seeds to its stockists countrywide from its central storage facility in Nakuru. Usually, larger stockists get the first delivery and distribute seeds to smaller stockists. Delivery on Kenya's roads is often challenging, and transportation costs run high.

Commercial Farmers

Freshco derives 5% of its revenues from commercial farmers, most of whom grow from 50 to over 100 acres of maize. This segment produces about 30% of the maize in Kenya and operates farms purely for profit. The large-scale commercial farmers (over 100 acres of land) own storage facilities on site and rely on capital-intensive machinery, such as plows and maize shellers, for most operations and hire workers for the rest. Their heavy investments in equipment provide them access to formal credit through their ability to offer attractive collateral to banks. They focus exclusively on maize and produce about 2250 to 2700 kg per acre (RATES Center, 2003). Among commercial maize farmers, almost 100% are using improved hybrid varieties.

Despite the attractiveness of selling to commercial farmers, accessing this segment is resource-intensive and presents marketing challenges. Because they buy such a large quantity of seeds (100 kg on average), commercial farmers are pursued by many companies and often do not entertain offers from less well-known companies like Freshco. Freshco's sales agronomists usually make several house visits to each potential customer, although many times just arranging a visit is a challenge in itself.

Nongovernmental Organizations

A new potential market segment for Freshco is NGOs, which established a presence in Kenya in the 1990s and in recent years have reinvigorated their efforts. NGOs buy maize seed in bulk, often paying higher than market prices, and redistribute the seeds to small farmers in disaster or poverty-stricken regions in Kenya. Because of their development focus, NGOs are willing to purchase seeds from lesser-known local seed companies in an effort to stimulate the local economy. Despite this goal, they tend to purchase from companies with whom they already have established ties. Also, because their purchases are dependent on funding levels and the conditions in target regions each year, they remain variable customers.

Freshco does not currently have ties with NGOs, but Captain Karanja and the sales agronomists believe that this segment will become increasingly important in the future. As a result, they are exploring ways to market to this segment.

Institutional Buyers

Institutional buyers include government institutions, prisons, and schools, all of which purchase in bulk. Government institutions prefer drought-tolerant varieties that they can distribute to marginal areas. Freshco currently does not sell these varieties but plans to commercialize one for 2008. These institutions buy from intermediary traders, who negotiate prices with the seed companies. Differentiation is difficult because of limited access to these institutions. Schools usually buy commercial grain, but sometimes they will grow maize to educate students about farming techniques. Students' exposure to maize seeds can lead to their sharing their experiences with parents. Schools usually buy a different variety each year, however, so demand is inconsistent. KSC has traditionally dominated this segment. While selling to institutional buyers has several advantages, Freshco knows that the process of becoming a supplier and negotiating contracts is bureaucratic and time-consuming.

Growth Strategy

Freshco already has the exclusive production and distribution rights for the QPM and striga-resistant varieties. While the potential market for these varieties is large, Freshco knows adoption will take many years. A marketing strategy to promote sales of these varieties is under development, and Captain Karanja and his team hope this will be a significant area of future growth.

Management of Freshco is planning to import vegetable seeds from India and distribute them in Kenya as another means of growth. In January of 2007, Captain Karanja traveled to India to meet with the directors of Bejo Sheetal, a medium-sized producer of vegetable seeds. He reached an importation agreement with the company, which included providing training for Freshco personnel on production techniques. This is an important step toward product diversification for the company.

Because of their high value and low transportation costs, vegetable seeds yield substantial profit margins. They also offer a good source of stable revenue for seed companies because farmers purchase vegetable seeds on a year-round basis.

The market is large, as over 90% of smallholder farmers in all regions of Kenya, except the most arid ones, grow vegetables and fruits (Muendo and Tschirley, 2004). Vegetables such as pumpkin, cowpea, kale (a type of cabbage) and amaranth (a nutritious leaf vegetable) are produced for household consumption and market

sales. Most farmers use saved seeds to grow traditional vegetables but buy exotic varieties, such as tomato and onion seeds, from stockists.

The market for vegetables is also growing with increased economic growth and greater urbanization. Currently, about six local companies sell vegetable seeds in Kenya. Three import seeds, while the others produce and import seeds. While Kenya does not have import duties, other charges add about an 18% markup to the imported seed (Muendo and Tschirley, 2004). Multinationals from Holland and South Africa also compete in the market. Because the vegetable seed market in Kenya is currently much less competitive than the maize seed market, Captain Karanja believes there is room for local companies like Freshco to enter this market and make a profit.

Freshco executives also want to export maize seed and macadamia seedlings to Uganda and Tanzania, which have climates suited for Freshco's highland maize varieties and macadamia production. The company is exploring possible collaborations with seed companies in these other countries.

Preparing for the Future

As Freshco pursues its vision of becoming a seed industry leader, the company will need to maintain a keen insight and understanding of the environment in which it operates. The East Africa region and Kenya's developing seed industry are both extremely dynamic contexts. Taking advantage of opportunities that emerge will have a major impact on Freshco's long-term profitability.

There are a number of trends either currently underway or with the potential to develop in the future that would have significant impact on Freshco: (1) revitalized interest in seed development in Africa, (2) regional integration efforts, (3) aggressive market penetration by multinationals, and (4) continued presence and impacts of NGOs in the region. Each of these trends is discussed in detail below.

Trend 1: Revitalized Interest in Seed Development in Africa

A new focus has emerged among donors, foundations, research institutions, and universities to support the development of a viable seed industry in Africa. Motivations for such interest are varied and include a perceived need to support private Kenyan seed companies that have emerged since the deregulation of the sector, greater appreciation of the benefits of public-private partnerships, new theories of alleviating hunger by sustaining access to seed, and recognition of the value in strengthening and developing seed systems.

As part of this focus, the Bill and Melinda Gates Foundation and the Rockefeller Foundation have teamed to create the Alliance for a Green Revolution for Africa

(AGRA). AGRA's first activity is the Program for Africa's Seed Systems (PASS), which will focus on developing ecologically appropriate crop varieties, training the next generation of crop breeders and agriculture scientists, and improving and networking seed and agro-input supply chains (Rockefeller Foundation, 2007).

Other interest in food security and seed sector development includes the U.S. Agency for International Development's (USAID) work with farmers, private seed producers, and farm product distributors on increasing improved variety access and usage through the Agribusiness Development Support Project. Other USAID initiatives include the Kenya Business Development Services Program, which supports small and medium-sized enterprises, and the Maize Development Program, which improves variety research. The Seeds of Development Program through Market Matters Inc. is also active in strengthening the seed industry's management and marketing capacity.

The Kenyan government, through institutions such as KARI, is also revitalizing its seed development activities. There is greater emphasis on developing ties between the public and private sectors, without which KARI research efforts risk resulting in unmarketable technologies. KARI links with the seed industry during its development and trials of varieties in addition to promoting companies during events such as farmer training and demonstration plots.

Trend 2: Regional Integration Efforts

The treaty for the establishment of the East African Community (EAC) was signed in November 1999, establishing a partnership between Kenya, Tanzania, and Uganda. The previous EAC, established in 1967 between the same countries, disintegrated in 1977. The new EAC seeks to establish a customs union, common market, monetary union, and political federation. The Customs Union Protocol, which took effect in January 2005, has largely eliminated intraregional tariffs and nontariff barriers and created common external tariffs (Busse and Shams, 2005). Steps toward market and fiscal policy integration continue, and strategies have been created for private sector and rural development, but full integration will occur sometime in the future.

In addition to the EAC, the Association for Strengthening Agricultural Research in Eastern and Central Africa (ASARECA) was established in November 1993 between Burundi, Democratic Republic of the Congo, Eritrea, Ethiopia, Kenya, Madagascar, Rwanda, Sudan, Tanzania, and Uganda. The ASARECA links members' national agricultural research institutes with the goals of "increasing the efficiency of agricultural research in the region so as to facilitate economic growth, food security and export competitiveness through productive and sustainable agriculture" (ASARECA, 2007).

The East and Central Africa Program for Agricultural Policy Analysis (ECAPAPA) is a program within ASARECA that coordinates regional efforts in seed regulation harmonization. The initiative focuses on easing the movement of seed and germplasm across national boundaries and creating regional seed markets to benefit the public, private, and consumer sectors (Minde, 2003). An initial project in 1999, “Harmonization of Seed Policies and Regulations in Eastern Africa,” made strides to reduce barriers between Kenya, Tanzania, and Uganda. It is anticipated that the project will be reinvigorated and ultimately the remaining countries in ASARECA will be incorporated into a larger regional harmonization program.

These regional integration efforts present numerous opportunities and challenges to Kenyan seed companies such as Freshco. The full repercussions of the initiatives will emerge as systems become established off the groundwork that has been laid to date. Regional integration and harmonization of seed regulations will allow for ease of access to new markets and land for seed production. Tanzania and Uganda have lower land and labor costs than Kenya does; Uganda especially has favorable growing conditions. Challenges can arise, however, as competitors from neighboring countries enter the Kenyan market.

Trend 3: Aggressive Market Penetration by Multinationals

Companies such as Cargill, Monsanto, Pannar, Pioneer, and Syngenta are world leaders in seed research, development, production, marketing, and sales. They typically have large budgets devoted to advertising and promotional activities. Local Kenyan seed companies currently have an advantage in that they better understand local conditions and needs. Multinational companies have established varieties and the resources to continue their modification for Kenya’s agroecological conditions.

Currently, market penetration efforts by multinationals are modest. If they see opportunities in the expanding seed market, however, they have vast resources to penetrate the market and can become formidable competitors to Freshco. If the EAC is fully implemented as discussed above, multinational seed companies can seek to enter this larger market, as the benefits that would serve local companies would also attract international competition. Currently KSC dominates the seed sector; even it could come under stiff competition, however, should multinationals increase their efforts in the region.

Institutions such as the African Agricultural Technology Foundation (AATF) in Nairobi are working to develop public–private partnerships with multinational companies that place negotiated royalty free technologies in the hands of national research institutes, local companies, and ultimately local farmers. Adopting an open approach toward collaboration with multinationals in seed distribution or licensed technology production could be beneficial to Freshco in the future.

Trend 4: Continued Presence and Impacts of NGOs in the Region

The provision of seed aid, distinct from food aid, has been a phenomenon in East Africa since the early 1990s (Sperling, 2000). Seeds in such programs primarily consist of maize and, to a lesser extent, beans and other drought tolerant crops. Such aid is generally referred to as “seed and tools” programs, designed to help farmers recover after times of food shortages. The effectiveness of such programs in Kenya has been questioned, as seeds are often provided late, transparency can be limited, and the quantities supplied are small (Sperling, 2000). Kenyan smallholders routinely suffer droughts and poor environmental conditions, in addition to continuing issues of limited seed access, small plots, high seed costs, and poorly adapted varieties. The routine provision of seed in Kenya goes beyond the purpose of seed aid while not effectively succeeding in improving the overall smallholder condition.

For the seed industry, NGO presence and involvement in seed aid and seed development programs in East Africa can be both a help and a hindrance. In addition to Kenya, seed aid programs are also routinely conducted in Ethiopia, Somalia, and Sudan. Given the country’s stability, many NGOs continue to be based in Kenya while working in the broader region. Tensions and environmental factors in the region suggest NGOs will likely remain significant players in Kenya for years to come. NGOs are also working on development-focused seed programs such as extension services and “seed loans.” As noted previously, the presence of a sizeable NGO market can benefit Kenyan seed companies such as Freshco.

Though NGOs provide an additional market segment for the seed industry, they can also distort the seed market by offering seeds free of charge. This practice tends not only to inflate market prices but also to make farmers less willing or inclined to purchase seeds. Some NGOs do provide hybrid seed, though given their high value, farmers often sell them to purchase other goods (Muhammad et al., 2003). Even when higher yields are recognized, smallholders often lack the financial resources to purchase hybrids independently. Many NGOs continue to prefer supplying and marketing OPVs, which also decreases knowledge of hybrid benefits and adoption. NGOs have also been criticized for stifling emerging agro-input dealers and higher yields by promoting low-cost and low-input organic farming.

Given the complexities of NGO involvement in seed aid and development programs, they simultaneously offer potential profits for the seed industry while undermining the development of a viable seed sector. Moreover, program priorities and availability of funding often evolve, and the future could see NGOs that focus on rural enterprise development and income-generating activities. This support would help farmers acquire the funds to purchase seeds but reduce the amount of seed NGOs purchase from seed companies. Ultimately NGOs represent a double-edged sword that Freshco will continue to battle.

Conclusion

Freshco Kenya Ltd. is relatively young in the Kenyan private agricultural sector. Staff members' combined expertise and experience demonstrates, however, the potential to not only recognize business opportunities but also customer needs in an environment susceptible to ecological, political, and socioeconomic change.

While they focus on producing quality seeds, Captain Karanja and his team's presence throughout the supply chain is just one of the tactics pertinent to the dynamism of agribusinesses. Through creative thinking and careful market analysis, Freshco can engage in ventures structured to respond to specific market demands and fluctuations. Indeed, with new varieties on the horizon and increased interest in African seed enterprise development, the emerging private agricultural sector in Kenya has the blueprint for success in place. All that is required now, Captain Karanja counsels his staff, is determination. "Nothing is impossible," he reminds his colleagues.

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Competitive Analysis and Market Power of China's Soybean Import Market¹

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Abstract

This research conducts a competitive structure analysis of the Chinese soybean import market which leads to the hypothesis that China's soybean importers may have stronger market power in China's soybean import market. Then, this research develops and simultaneously estimates a two-country partial equilibrium trade model to test U.S.-China market power of soybean trade. The empirical result supports our hypothesis that Chinese soybean importers have stronger market power relative to U.S. soybean exporters. This Chinese market power can be countered by U.S. and South American companies through developing new and expanding existing markets for soybeans throughout the world and investing in Chinese soybean storage and crushing capacity.

Keywords: Chinese soybean import market, competitive structure analysis, market power, two-country partial equilibrium trade model

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Introduction

Globally, China is the number one soybean importer, and the U.S., Brazil, and Argentina are the top three soybean exporters. In 2005, China's soybean imports accounted for 41% of the world total, and soybean exports from the above three soybean producing countries accounted for over 90% of the world total (USDA-FAS, 2006a). Given the above aggregate market shares of these soybean traders in the world soybean market, it is reasonable to assume that the world soybean market is not perfectly competitive. Since China is the largest soybean import market, this research will focus on the Chinese soybean importer. The Chinese soybean import market may be characterized as either a monopsony where China, as the major soybean importer, has stronger market power relative to soybean exporters from the U.S., Brazil, and Argentina or as an oligopoly where the U.S., Brazil, and Argentina, as major soybean exporters, have relatively stronger market power. Knowing who has stronger market power for soybean trade and the competitive structure of the Chinese soybean import market can provide important information to U.S. soybean producers, agribusinesses, and exporters as they make marketing decisions and for policymakers as they formulate policies to enhance U.S. competitiveness of the soybean industry in the world market.

Objectives

In this research, our objectives include 1) to provide an overview of the world soybean industry; 2) to perform a competitive structure analysis of the Chinese import market, 3) to develop and simultaneously estimate a two-country partial equilibrium soybean trade model to test the market power of the Chinese soybean import market, and 4) discuss the implications of this competitive structure for producers and agribusinesses in exporting countries.

Overview of the World Soybean Industry

Leading Global Soybean Producers

Globally, the top four soybean producing countries include the U.S., Brazil, Argentina, and China, as shown in figure 1 (USDA-FAS, 2006a). In 2005, soybean output from these four countries reached 200 million metric tons, accounting for 90% of the global total. Among them, the U.S. led the world in soybean production with an output of 84 million metric tons in 2005. Brazilian soybean output reached 57 million metric tons, about 76% of U.S. production, and ranked second in the world. Argentina produced 41 million metric tons of soybeans and China produced 18 million metric tons.

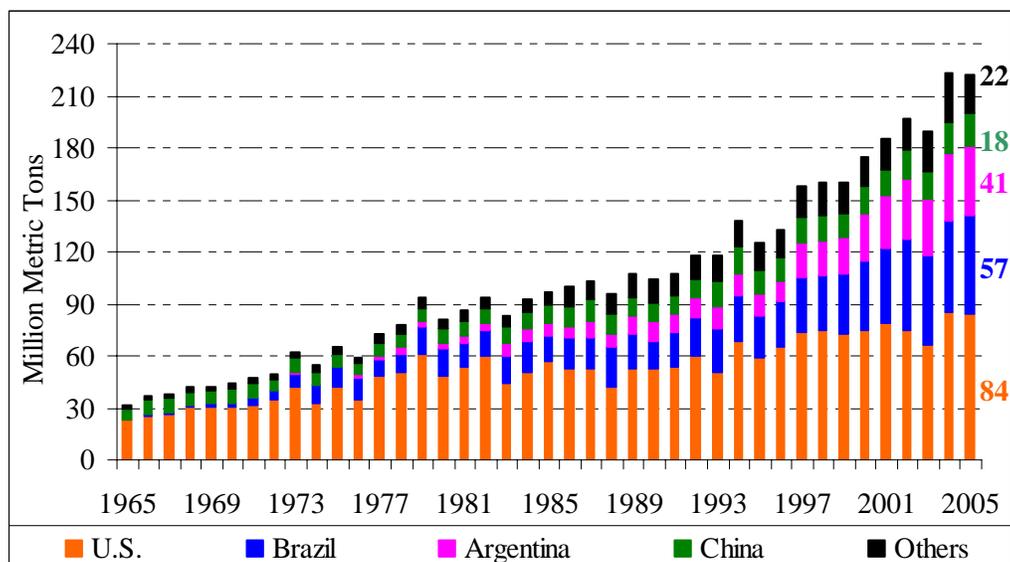


Figure 1: Leading Global Soybean Producing Countries

Source: USDA-FAS, 2006a.

Figure 1 also indicates that the growth of soybean production was quite stable for the U.S., China, and other countries. In the last four decades, the average annual growth rates of soybean production in the U.S. and China were 5% and 3%, respectively (USDA-FAS, 2006a). In contrast, soybean production in Brazil and Argentina increased dramatically in recent years. From 1964 to 2005, the average annual growth rates of soybean production in Brazil and Argentina were 14% and 27%, respectively. From these trends shown in figure 1, it is reasonable to expect that within a few years Brazil may surpass the U.S. and become the largest soybean producer in the world, if the U.S. and Brazil continue on their current growth rates. The growth rate of Argentinean soybean production is even higher than that of Brazil, and Argentina has also become a strong competitor for the U.S. in the world soybean market.

Leading Global Soybean Consumers

Leading global soybean consuming countries (or economic groups) include the U.S., China, Brazil, Argentina, and the EU-25. Figure 2 compares soybean consumption among these countries (USDA-FAS, 2006a). The U.S. is the number one soybean consumer in the world. In 2005, U.S. soybean consumption reached 51 million metric tons, accounting for 61% of U.S. soybean output. For Brazil, 32 million metric tons were consumed in 2005, accounting for 56% of its production. Argentina's soybean consumption reached 31 million metric tons in 2005, accounting for 76% of its production.

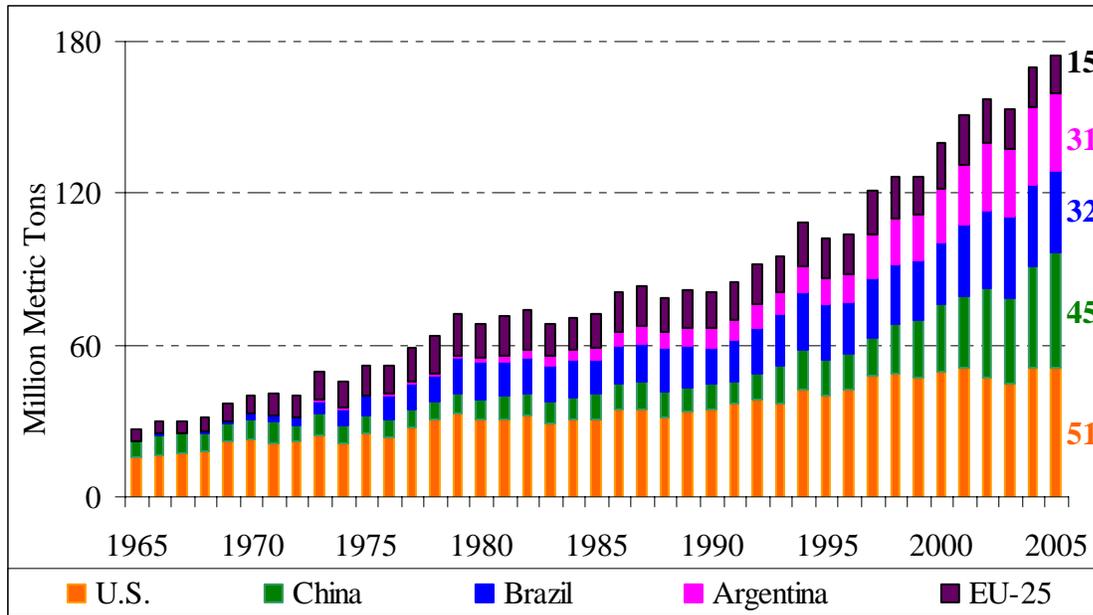


Figure 2: Leading Global Soybean Consumers
Source: USDA-FAS, 2006a.

In contrast, China’s soybean consumption was 45 million metric tons in 2005, while China’s production was only 18 million metric tons, resulting in 27 million metric tons of imports from other countries, mainly from the U.S., Brazil, and Argentina. Main reasons for the rapid increase in China’s soybean consumption include (1) income growth—leading to an increased demand for soyoil; (2) the development of China’s livestock industry—leading to an increased demand for soymeal used for feed; and (3) extensive domestic and foreign investment in crushing facilities along China’s coastal cities—leading to an increased demand for imported soybeans.

Leading Global Soybean Exporters

The top three soybean exporters in the world include the U.S., Brazil, and Argentina. Figure 3 shows that Brazil’s soybean exports reached 25 million metric tons in 2005, surpassing the U.S. for the first time, and Brazil became the number one soybean exporter in the world. The U.S. exported 24 million metric tons of soybeans, a reduction of 3 million metric tons compared to 2004 (USDA-FAS, 2006a). Brazil’s soybean exports increased dramatically in the last decade from 4 million metric tons in 1995 to 25 million metric tons in 2005, an increase of over 500%. Soybean exports from Argentina also increased in recent years, and reached 10 million metric tons in 2005. Brazil and Argentina have been expanding their market shares in the world soybean market, competing with U.S. soybean exports.

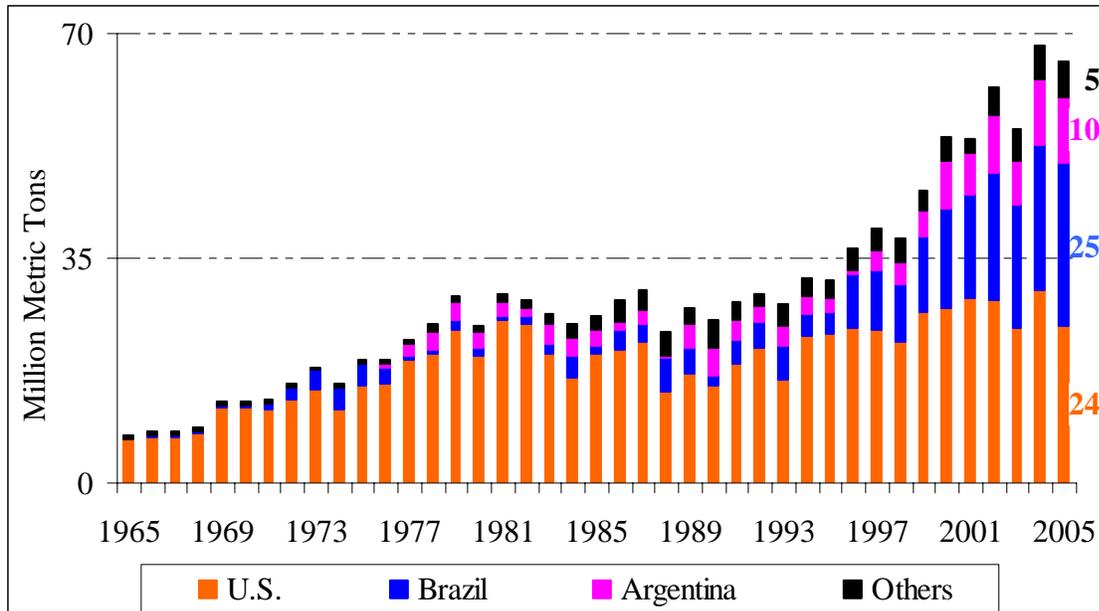


Figure 3: Leading Global Soybean Exporters

Source: USDA-FAS, 2006a.

The export shares in the world soybean market for Brazil, the U.S., and Argentina were 39%, 37%, and 16%, respectively in 2005 (USDA-FAS, 2006a). The sum of soybean exports from these three countries accounted for 92% of the 2005 global total. The trends for market shares and the structural changes in the world soybean market are shown in figure 4.

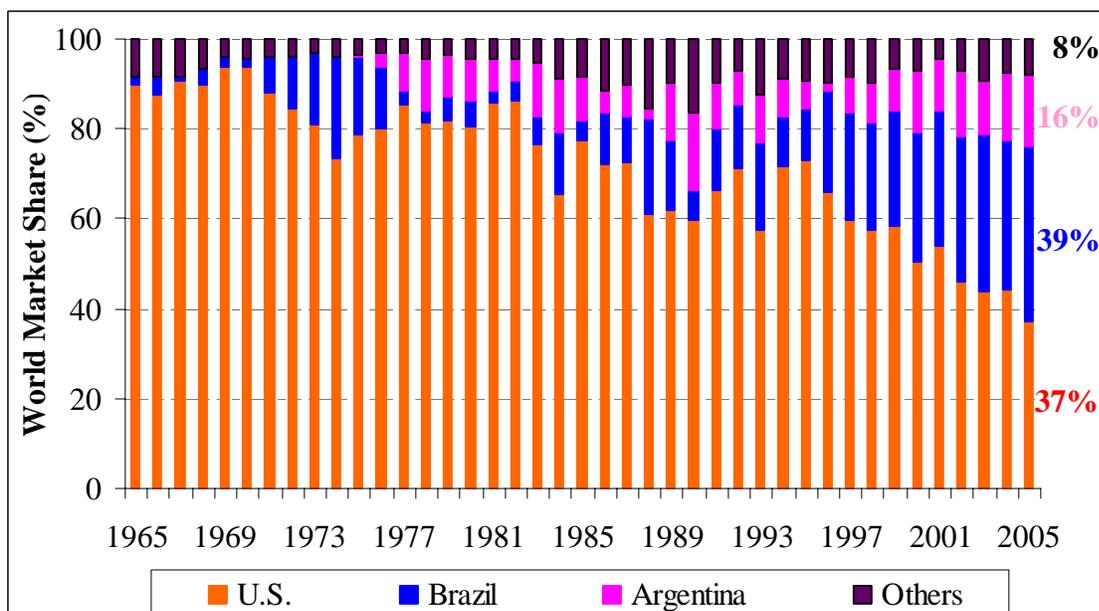


Figure 4: Export Share of Top Soybean Exporters in the World Soybean Market

Source: USDA-FAS, 2006a.

The U.S. soybean export share in the world market has been decreasing, especially in the last decade. In 1995, the U.S. soybean export share was 73%, but fell to 37% in 2005, a 36% market share drop in the world soybean market. In contrast, Brazilian market share in the world soybean market increased from 11% in 1995 to 39% in 2005, gaining 28% more within a decade. Argentina also competes with the U.S. in the world soybean market, and Argentinean market share increased from 6% in 1995 to 16% in 2005.

Leading Global Soybean Importers

The leading global soybean importers include China, the EU-25, Japan, and Mexico as shown in figure 5. China’s soybean imports skyrocketed in the last decade from 0.8 million metric tons in 1994 to 27 million metric tons in 2005, an almost 27-fold increase, while soybean imports into the EU, Japan, and Mexico remained quite stable (USDA-FAS, 2006a). Reasons for China’s dramatic increase in soybean imports include China’s rapid increase in soybean demand as discussed in the previous section and relative slow increase in domestic soybean production, creating a large demand for imports. In 2005, China’s soybean imports accounted for 41% of the world total. The EU-25 imported 14 million metric tons of soybeans in 2005, which was 22% of global soybean imports. Soybean imports for Japan and Mexico were 4 million metric tons each. Japanese and Mexican soybean import shares were each only about 6% of the world total.

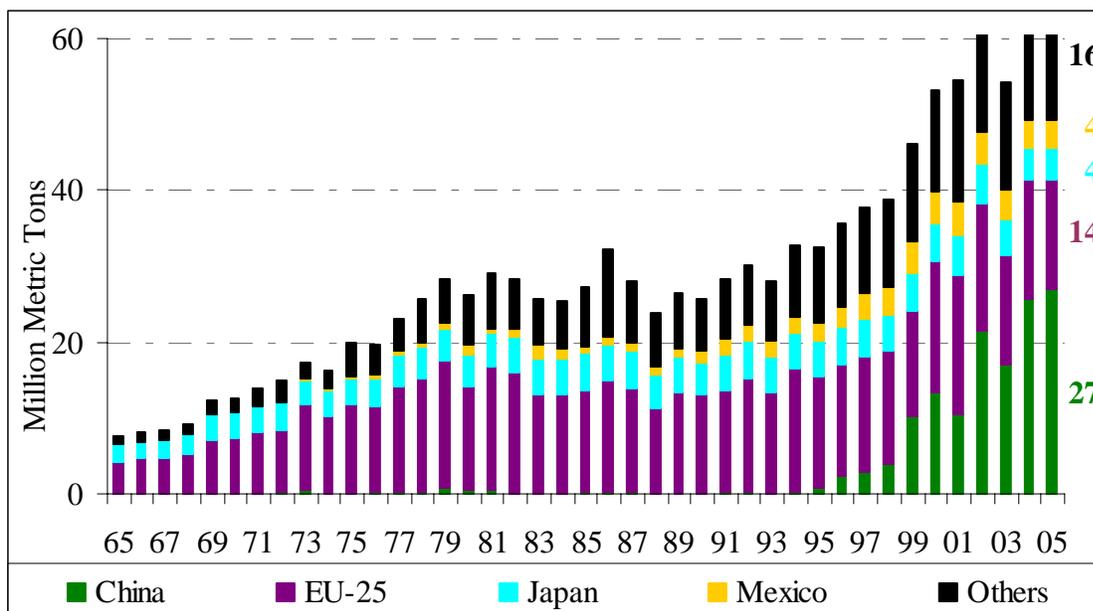


Figure 5: Leading Global Soybean Importers

Source: USDA-FAS, 2006a.

Competitive Analysis of China's Soybean Import Market

One Basic Assumption

As discussed in the introduction, the U.S., Brazil and Argentina are three main soybean suppliers for China. Since data for Brazil and Argentina are difficult to obtain. Thus, the two-country partial equilibrium soybean models for Brazil-China, and Argentina-China were not estimated in next section. However, to gain a better understanding of the competitive structure of the Chinese soybean import market, soybean exports from Brazil and Argentina should be considered as well. For the competitive structure analysis of the Chinese soybean import market, we assumed that Chinese soybean importers have stronger market power over exporters in the U.S., Brazil, and Argentina. By examining the historical trends of soybean surpluses in leading soybean exporting countries and soybean shortages in leading soybean importing countries, we find evidence to support this assumption.

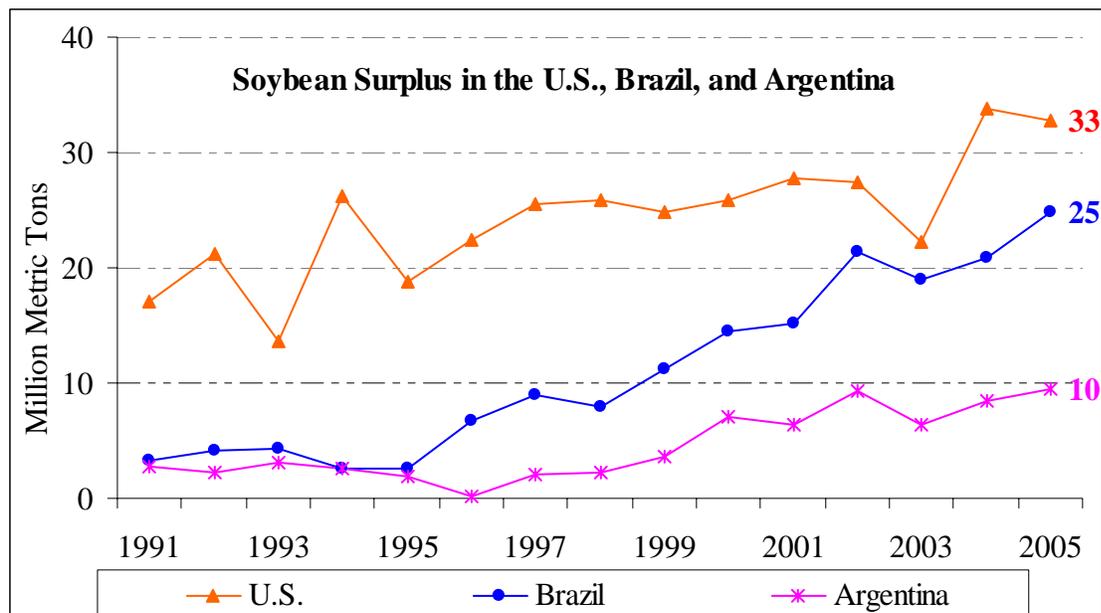


Figure 6: Soybean Surplus in Main Soybean Exporting Countries
Source: USDA-FAS, 2006a.

Figure 6 shows that soybean surpluses (defined as the difference between domestic production and consumption in soybean exporting countries) for the U.S., Brazil, and Argentina increased annually in recent years. In 2005, soybean surpluses in the U.S., Brazil, and Argentina reached 33, 25, and 10 million metric tons, respectively (USDA-FAS, 2006a). To avoid large accumulation of soybean stockpiles, export markets become crucial for these three countries.

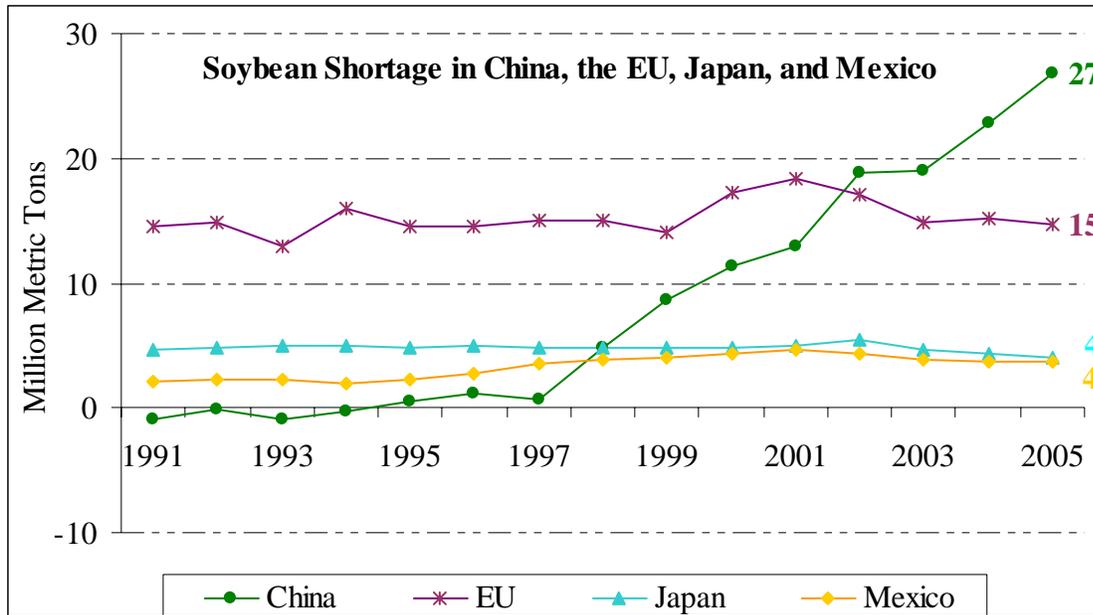


Figure 7: Soybean Shortage in Main Soybean Importing Countries
 Source: USDA-FAS, 2006a.

Figure 7 shows the trends of soybean shortages (defined as the difference between domestic consumption and production in soybean importing countries) for the top soybean importers in the world, including China, the European Union, Japan, and Mexico. In contrast to the stable soybean shortages in the EU, Mexico, and Japan, China’s soybean shortage increased dramatically in recent years, from almost null in 1991 to 27 million metric tons in 2005.

The above analysis indicates that China is and will continue to be the most important soybean market for the U.S., Brazil, and Argentina. Three large soybean suppliers—U.S., Brazil, and Argentina facing one large soybean buyer—China with rapid import growth support the assumption that Chinese soybean importers may have stronger market power than soybean exporters from the U.S., Brazil, and Argentina.

The U.S. and SA Are Seasonal Complementary Soybean Suppliers for China

Because China is the most important market for the U.S., Brazil, and Argentina, these three soybean exporters compete with each other in the Chinese soybean import market to expand their soybean market shares. However, the question is “what is the relationship between the U.S. and South America in the Chinese soybean import market?” This section seeks to find an answer. To simplify the problem, Brazil and Argentina are considered as a group, South America (SA) soybean supplier.

Figure 8 shows that Chinese annual soybean imports from SA were slightly lower than that from the U.S. before 2001 and in 2004. From 2001 to 2003 and 2005, Chinese annual soybean imports from SA surpassed imports from the United States. In 2005, China imported over 15 million metric tons of soybeans from SA with Brazil's 8 million metric tons and Argentina's 7 million metric tons. In contrast, China imported 11 million metric tons of soybeans from the United States. Over a ten-year average (1996-2005), the U.S. and SA had close market shares in the Chinese soybean import market with U.S. at 47% and SA at 53%. These annual data imply that the U.S. and SA have been strong competitors in the Chinese soybean import market.

To understand the competitive structure of the Chinese soybean import market, using only annual data analysis is not enough to be informative. Further analysis of monthly data will be helpful in identifying different characteristics of U.S. and SA soybean exports to China.

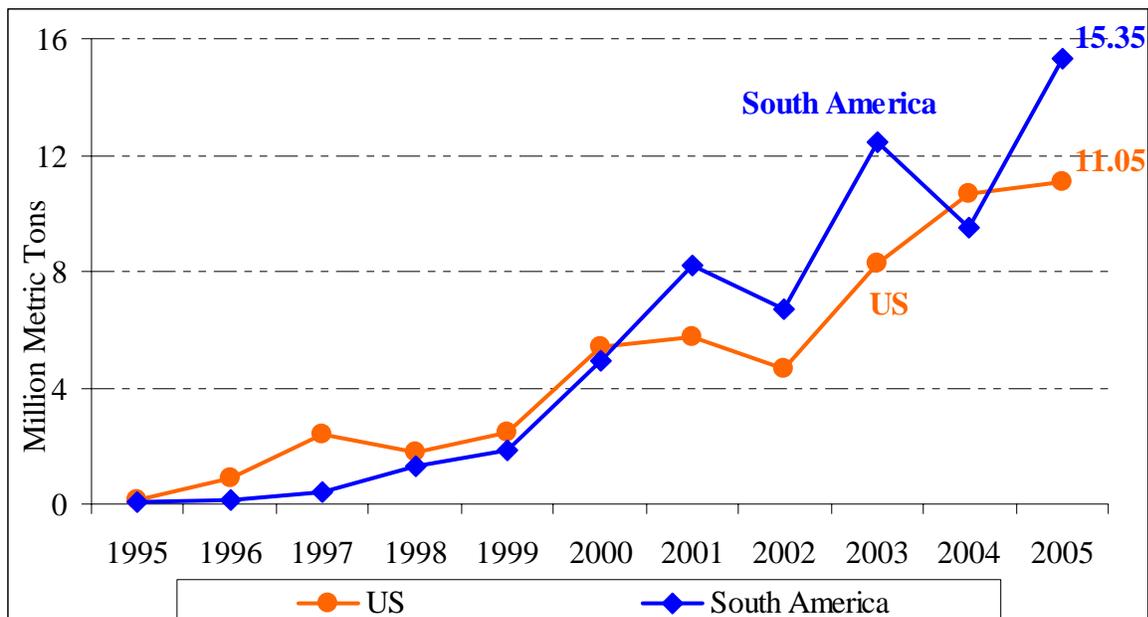


Figure 8: Chinese Soybean Imports from the U.S. and South America
Source: The Chinese Minister of Agriculture, 2006.

Since the U.S. is located in the northern hemisphere and SA is located in the southern hemisphere, they have opposing growing seasons, i.e., different production time periods to supply soybeans to markets. The harvest season for U.S. soybeans is in October and November, and for SA, March and April. Figure 9 plots the U.S. monthly soybean stocks and figure 10 shows the monthly soybean stock levels in Brazil (Argentina data is not available). Figure 9 indicates that generally, U.S. soybean stocks reach the highest level in November. Then due to consumption and exports, U.S. soybean stocks decrease to their lowest levels in August and

September, with some years in October. For Brazil (figure 10), the soybean stocks normally reach their highest level in April. Then due to consumption and exports, Brazilian soybean stocks decline gradually, and reach their lowest levels in January and February.

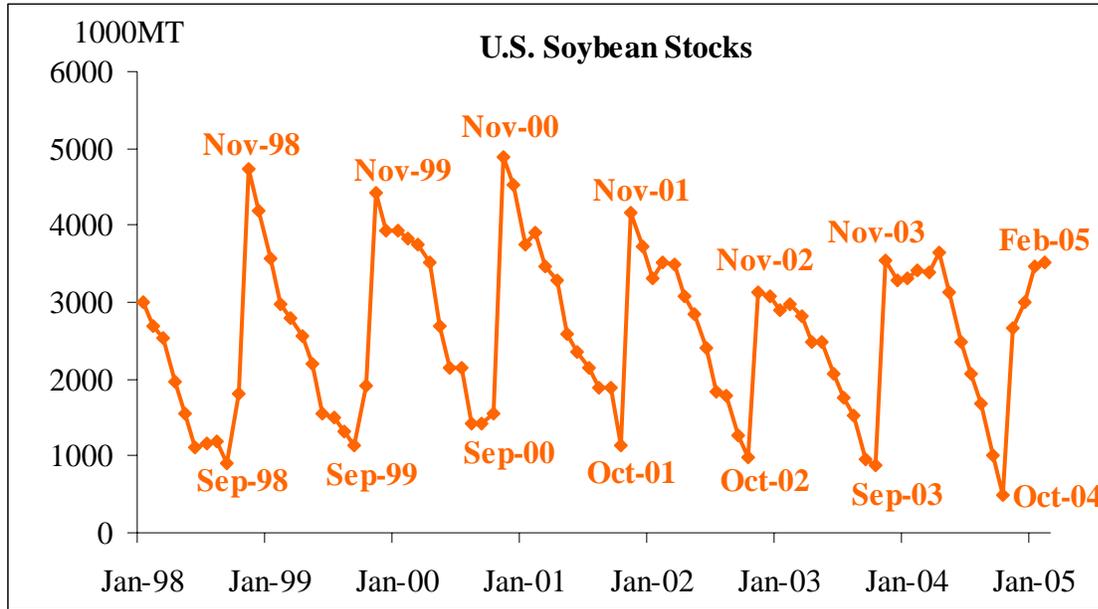


Figure 9: U.S. Soybean Stocks (1000MT)
Source: USDA-FAS, *Attache Report* (1998-2005).

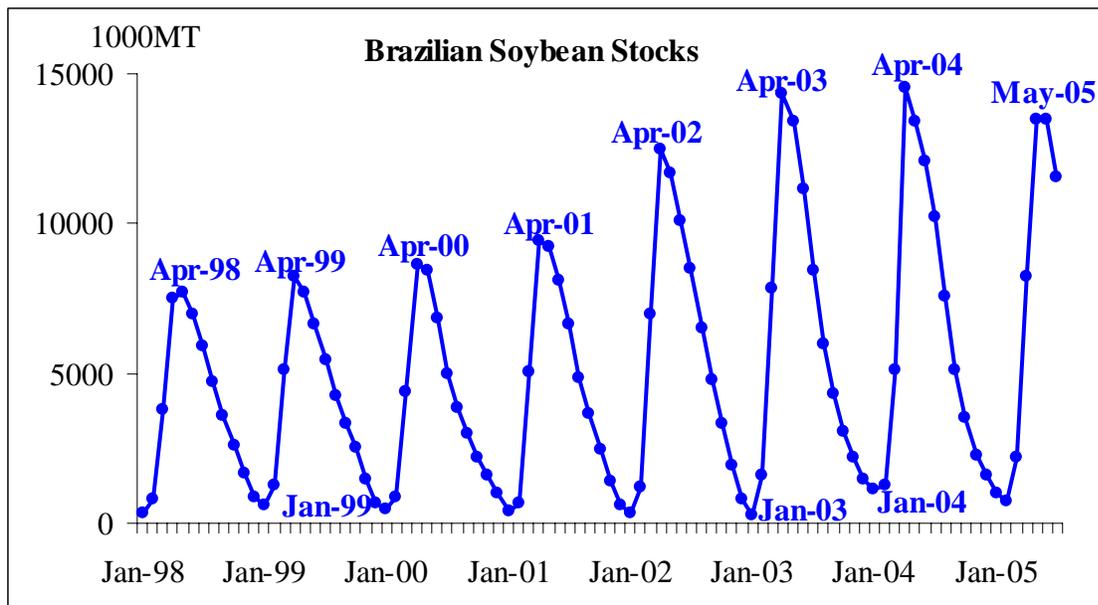


Figure 10: Brazilian Soybean Stocks (1000MT)
Source: USDA-FAS, *Attaché Report* (1998-2005).

Because of the difference in soybean growing seasons for the U.S. and SA, their soybean exports differ over time. Figure 11 depicts the U.S. and SA's average monthly soybean exports to China from 1999 to 2005. Figure 11 clearly shows that soybean trade in the Chinese import market can be divided into two periods. The first period (period I) includes June, July, August, September, and October. In period I, SA exports just-harvested soybeans to China, with little or no storage costs, while the U.S. exports soybeans from its stockpiles to China with additional storage costs. South America has the seasonal advantage and results in a dominant position in the Chinese soybean import market.

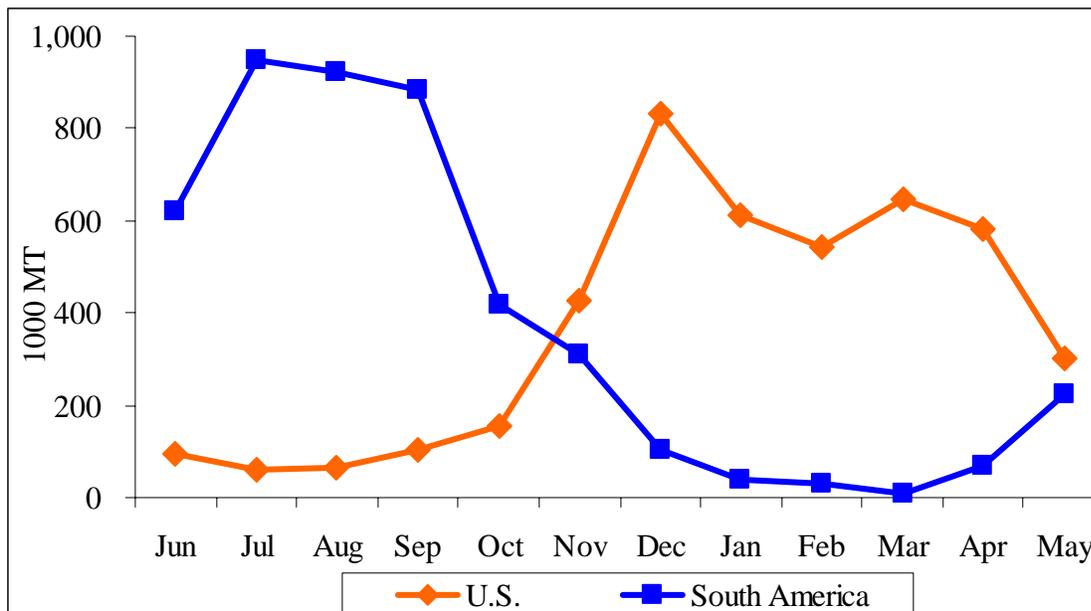


Figure 11: Average Monthly Soybean Exports from the U.S. and South America (Brazil and Argentina) to China (1999-2005).

Source: The Chinese Ministry of Agriculture, 2006.

In the second period (period II), which includes November, December, January, February, March, April, and May, the U.S. exports just-harvested soybeans to China and becomes their main soybean supplier. South America supplies only a small amount of their soybeans to China from their stockpiles incurring storage costs. Therefore, the U.S. has the seasonal advantage in this period, resulting in a dominant position in the Chinese soybean import market. The above analysis implies that South America and the U.S. are seasonal complementary soybean suppliers for China, with South America dominating period I and the U.S. dominating period II.

From the importers' perspective, Chinese soybean importers may have stronger market power relative to soybean exporters from both the U.S. and SA, and they

can exercise their monopsony power to maximize their soybean import profits. Strategically, to reduce the risk of price increases, Chinese soybean importers will not rely on only one soybean supplying country. Chinese soybean importers will work with different soybean supplying countries to diversify their supply risk. In that case, because of the market power of Chinese soybean importers and seasonal production differences, the U.S. and SA actually become seasonal complementary soybean suppliers for China, with SA dominating period I and the U.S. dominating period II. In next section, a two-country partial equilibrium trade model will be developed and used to empirically test the market power in China's soybean import market.

Empirical Test of Market Power in China's Soybean Import Market

Literature Review

Lerner (1934) developed an index (the Lerner Index) to measure market power of a single firm. The Lerner index is defined as $LI = \frac{P - MC}{P}$, where the variable P is the market price and MC is the marginal cost. The Lerner Index is able to measure the degree of market power of a firm in an imperfect market, but it was difficult to use empirically because marginal cost data are typically unavailable. However, the Lerner Index does provide a provocative idea to measure market power. Based on the Lerner Index, subsequent literature found other ways to approximate the Lerner Index to measure market power in an imperfectly competitive market.

Baker and Bresnahan (1988) first developed the residual demand elasticity (RDE) model to measure market power of a single firm in an imperfect market. Baker and Bresnahan took three U.S. brewing firms – Anheuser-Busch, Coors, and Pabst – as their samples to estimate and analyze the residual demand curves faced by these three companies. They found that for the period 1962-1982, Coors had substantial market power, Anheuser-Busch had some market power, and Pabst had no market power. Baker and Bresnahan's work provided a new approach to measure market power of a single firm with differentiated products within a national market.

Goldberg and Knetter (1999) adopted the RDE model to measure the degree of competition in segmented export markets. They started from the general case, which assumed homogenous products and a group of exporters facing a particular foreign market, and developed the residual demand function. They used annual data for U.S. Kraft linerboard paper (1973-1987) and German beer (1975-1993) to estimate this model. In the case of German beer, their empirical results indicated that "the elasticity of the residual demand curve German exporters face in each destination is closely related to the presence of the Netherlands as a competitor," (page 58) and for U.S. linerboard exports, they found "strong evidence of imperfect

competition in the case of Australia, which is a very small market where U.S. firms face almost no competition from other producers” (page 58).

Carter, et al. (1999) tested the world wheat market using the RDE model, which provided a new approach to measure market power for wheat, a key international bulk agricultural commodity market. Carter, et al. assumed that each country was a firm, and that parameters could be interpreted as share-weighted industry averages for all firms within one country. Based on Goldberg and Knetter’s RDE model, Carter, et al. directly defined a reduced form of the inverse residual demand function for U.S. wheat and used quarterly data (1970 to 1991) to estimate their model. Their results indicated that “the United States is possibly a price leader in the Japanese market for imported wheat whereas Australia and Canada form a competitive fringe” (page 9).

Poosiripinyo and Reed (2005) applied the RDE model to the Japanese chicken meat market and estimated price flexibilities of Japanese inverse residual demand for whole birds, legs with bone, and other cuts from Brazil, China, Thailand, and the United States. Their results indicated that only Brazil (in whole birds and leg with bone) and the U.S. (in other cuts) have significant market power over Japanese chicken meat importers.

The RDE model has been adopted by many researchers because of the following advantages: 1) the RDE model can measure market power with modest data requirements, which are generally lacking in domestic and international markets; 2) the RDE model can be defined in double-log form and the elasticity can be estimated directly; and 3) the RDE model can incorporate exchange rate variable in the model as an indicator of marginal cost change. However, when applying the RDE model, we must also consider the disadvantages of the RDE model, which include 1) the RDE model entails a loss of price elasticity of demand; and 2) the estimated coefficients are difficult to interpret. With these disadvantages of the RDE model, however, in cases where the Lerner Index is very difficult or infeasible to compute, the RDE model appears to be the next best alternative to evaluate market power.

Mathematic Model

Based on the RDE model, Song (2006) developed a two-country (U.S.-China) partial equilibrium soybean trade model, which incorporate the reverse residual demand function and the reverse residual supply function as well as the equilibrium condition, where the residual demand equals the residual supply in equilibrium. The specific functional form of the model follows:

$$\left. \begin{aligned}
 (1) \quad & P_{US}^{XPT} = \beta_0 + \beta RS_{US}^{CH} + \beta_1 P_{US}^{Corn} + \beta_2 INC_{US} + \beta_3 P_{US}^{Oil} + \beta_4 P_{US}^{Meal} + \beta_5 T \\
 & + \beta_6 XPT_{US}^{OTH} + \beta_7 STK_{US} + \varepsilon_{US} \\
 (2) \quad & P_{CH}^{IMP} = \alpha_0 + \alpha RD_{CH}^{US} + \alpha_1 P_{CH}^{Corn} + \alpha_2 INC_{CH} + \alpha_3 LDI_{CH} + \alpha_4 P_{CH}^{Oil} \\
 & + \alpha_5 P_{CH}^{Meal} + \alpha_6 T + \alpha_7 IMP_{CH}^{OTH} + \alpha_8 BP_{CH} + \varepsilon_{CH} \\
 (3) \quad & P_{CH}^{IMP} = \phi P_{US}^{XPT} \\
 (4) \quad & RD_{CH}^{US} = RS_{US}^{CH}
 \end{aligned} \right\}$$

Where

P_{US}^{XPT} : U.S. soybean export price to China (\$/MT)

RS_{US}^{CH} : U.S. soybean exports to China U.S. residual soybean supply to China (MT)

P_{US}^{Corn} : U.S. corn price (\$/MT)

INC_{US} : U.S. personal disposable income (\$)

P_{US}^{Oil} : U.S. soyoil price (\$/MT)

P_{US}^{Meal} : U.S. soymeal price (\$/MT)

T : Time trend variable

XPT_{US}^{OTH} : U.S. soybean exports to the other countries (MT)

STK_{US} : U.S. beginning soybean stocks (MT)

ε_{US} : Error term

P_{CH}^{IMP} : China's soybean import price from the United States (USD/MT)

RD_{CH}^{US} : China's residual demand for U.S. soybeans (MT) or China's soybean import quantity from the United States

P_{CH}^{Corn} : China's corn price (RMB/MT)

INC_{CH} : China's personal disposable income (RMB)

LDI_{CH} : China's livestock industry development index, which is the chain growth rate of China's meat production, including pork, beef, poultry, and fish

P_{CH}^{Oil} : China's soyoil price (RMB/MT)

P_{CH}^{Meal} : China's soymeal price (RMB/MT)

IMP_{CH}^{OTH} : China's soybean imports from the other countries (MT)

BP_{CH} : China's biotech policy, a dummy variable, equaling 0 before May 2001 and 1 otherwise

ε_{CH} : Error term

Equation (1) is the U.S. inverse residual soybean supply function for China, and equation (2) is the China's inverse residual demand for U.S. soybeans. Equation (3) is the equilibrium condition, where the U.S. residual soybean supply for China

equals China's residual demand for U.S. soybeans. Equation (4) captures the relationship between U.S. soybean export prices (FOB prices) and China's soybean import prices (CIF prices).

The contribution of this two-country partial equilibrium trade model compared to prior models is that this model incorporates the equilibrium condition, where residual demand equals residual supply. Assuming that in the short-run, the price flexibility of either China's inverse residual demand for U.S. soybeans or the U.S. inverse residual soybean supply for China is constant, then equations (1), (2), (3), and (4) can be estimated simultaneously using the double-log form.

Data Description

Data used in this research are monthly data from January 1999 to February 2005, 74 observations. The variables and their sources are listed in the appendix A. The Chinese livestock industry development index, LDI_{CH} , and Chinese meat products, including beef, pork, poultry, and fish, were aggregated. Finally, the chain growth rate was calculated as an index to reflect the change in feed demand because of the fast development of the Chinese livestock and fishery industries.

Empirical Estimation and Interpretation

The two-country partial equilibrium model was estimated using the SAS full information maximum likelihood (FIML) method. Estimation results are reported in table 1. For the U.S. inverse residual soybean supply function (equation (1)), six independent variables, including the U.S. soybean residual supply for China, RS_{US}^{CH} , the U.S. personal disposable income, INC_{US} , the U.S. soyoil prices, P_{US}^{Oil} , the U.S. soy meal prices, P_{US}^{Meal} , U.S. soybean exports to Mexico, XPT_{US}^{MX} , and the U.S. soybean stocks, STK_{US} , are statistically significant at the 5% significance level or better respectively as shown in table 1. The sign of the parameter for the U.S. soybean residual supply, RS_{US}^{CH} , is positive as expected. This estimated parameter, $\hat{\beta}$, for the U.S. soybean residual supply, RS_{US}^{CH} , is the price flexibility of the U.S. soybean inverse residual supply function. From another perspective, this price flexibility can be used to measure the market power of Chinese soybean importers. Its estimation result, $\hat{\beta}=0.13$, implies that the marketing margin for Chinese soybean importers (the difference between the Chinese domestic soybean price and the soybean import price from the U.S.) is 13% of the import price from the United States plus tariffs and transaction costs of Chinese soybean importers. This is a large margin for such a standardized product and is certainly evidence that the Chinese have market power.

Table 1: Estimation results of the two-country partial equilibrium model

Equation	Variable	Parameter estimate	Standard error	t value	Pr > t
U.S. reverse residual supply: $P_{US}^{XPT} = P(\dots)$	Intercept	10.6230***	3.9991	2.66	0.0103
	RS_{US}^{CH}	0.1306***	0.0405	3.23	0.0021
	P_{US}^{Corn}	-0.2770	0.1442	-1.92	0.0600
	INC_{US}	-1.1029**	0.5496	-2.01	0.0497
	P_{US}^{Oil}	0.4348***	0.0734	5.92	<.0001
	P_{US}^{Meal}	0.5027***	0.1315	3.82	0.0003
	XPT_{US}^{EU}	-0.0067	0.0052	-1.27	0.2082
	XPT_{US}^{JP}	-0.0093	0.0370	-0.25	0.8023
	XPT_{US}^{MX}	-0.0848***	0.0265	-3.19	0.0023
	STK_{US}	-0.0694***	0.0260	-2.67	0.0100
China's reverse residual demand: $P_{US}^{IMP} = P(\dots)$	Intercept	-4.2451	3.5773	-1.19	0.2405
	RD_{CH}^{US}	-0.0392***	0.0141	-2.78	0.0074
	P_{CH}^{Corn}	0.2717***	0.0914	2.97	0.0044
	INC_{CH}	0.2961	0.5201	0.57	0.5714
	LDI_{CH}	0.5782	0.8977	0.64	0.5222
	P_{CH}^{Oil}	0.4430***	0.0743	5.96	<.0001
	P_{CH}^{Meal}	0.3011***	0.0794	3.79	0.0004
	IMP_{CH}^{BR}	-0.0015	0.0010	-1.48	0.1448
	IMP_{CH}^{AR}	-0.0005	0.0009	-0.52	0.6062
BP_{CH}	-0.0692	0.0435	-1.59	0.1179	
Price relationship: $P_{US}^{IMP} = P(P_{US}^{XPT})$	Intercept	-0.5210	0.3634	-1.43	0.1566
	P_{US}^{XPT}	1.1145***	0.0676	16.48	<.0001

Note: *** 1% significance level, ** 5% significance level, * 10% significance level.

For the Chinese inverse residual demand function (equation (2)), four variables, including the Chinese soybean residual demand, RD_{CH}^{US} , the corn price in China, P_{CH}^{Corn} , the prices of soyoil and soymeal in China, P_{CH}^{Oil} and P_{CH}^{Meal} , are statistically significant at the 1% significance level. In addition, the sign of the parameter, $\hat{\alpha}$, for the Chinese soybean residual demand, RD_{CH}^{US} , is negative as expected. The estimated parameter for the Chinese soybean residual demand, RD_{CH}^{US} , is the price flexibility of the Chinese inverse residual demand function for U.S. soybeans. From another perspective, this price flexibility can be used to measure *the market power of U.S. soybean exporters*. Its estimation result, $\hat{\alpha} = -0.04$, implies that the marketing margin for U.S. soybean exporters (the difference between the U.S.

soybean export price and the U.S. farm level soybean prices plus transaction costs of U.S. soybean exporters) is 4% of the U.S. farm level price plus transaction costs. The relatively small marketing margin for US soybean exporters indicates that they have little market power.

In addition to the price flexibilities, estimation results for some other variables are also meaningful. For the Chinese inverse residual demand function (equation (2)), estimated coefficient for China's biotech policy (BP_{CH}) is not significant. It means that China's biotech policy did not impose significant impacts on U.S. soybean exports to China. This is consistent with the results found by Marchant, et al. (2002) and Marchant and Song (2005). It makes sense that given China's huge demand and insufficient domestic supply, China cannot stop importing soybeans. For U.S. soybean exporters, they do not need worry about China's biotech policy changes. It may delay soybean trade in short run, but will not stop or reduce it in the long run.

The estimated coefficients for China's imports from Brazil and Argentina are not significant, either. It means that China's imports from Brazil and Argentina did not impact U.S. exports to China. This finding is surprising because South American producers have added much more storage capacity in recent years and they can compete with the U.S. during months outside the harvest season. The results are consistent with the Chinese arranging their purchasing decisions such that their importation of South American soybeans does not impact the price they pay for U.S. soybeans. This also implies that the U.S. and South America are complementary soybean suppliers for China. The results are also contrary to our expectation in that China's income and livestock development index are not significant. Again, this might reflect very good import management on the Chinese side. They have a vested interest in managing their import levels so that they do not affect world price significantly. It appears that they have used their market power to help assure that they obtain soybeans for a relatively low price from all suppliers, using the fact that they can obtain soybeans from multiple sources as a strategy to lower the price they pay.

Summary and Conclusions

In the world soybean market, China is and will continue to be the largest soybean importer, and the U.S., Brazil, and Argentina are the top three soybean exporters. Considering that soybean import demand for other main soybean import countries are quite stable, China becomes the most important soybean market for these top three soybean export countries. As the number one soybean importer in the world, Chinese soybean importers have developed stronger market power over soybean exporters from the U.S., Brazil, and Argentina. They have used this power and the availability of soybeans from South America throughout more of the year, to

increase their import margins for soybeans. This is clearly an issue for producers and agribusinesses that are exporting soybeans from North and South America. By examining monthly data, this research conducted a competitive structure analysis of the Chinese soybean import market. Results imply that the U.S. and South America (Brazil and Argentina), three main soybean suppliers for China, are seasonal complementary soybean suppliers for China. The Chinese seem to take advantage of the differing production seasons in their purchasing behavior to assure lower prices. The empirical results of the U.S.-China two-country partial equilibrium trade model show that the price flexibility of China's residual demand, which can be used to measure *the market power of U.S. soybean exporters*, is 4% and the price flexibility of U.S. residual supply, which can be used to measure *the market power of China's soybean importers*, is 13%, indicating that China's soybean importers do have stronger market power relative to U.S. soybean exporters. The increased availability of South American soybeans throughout the marketing year seems to have allowed more market power for the Chinese.

From China's perspective, since Chinese soybean importers have stronger market power over soybean exporters from the U.S. and South America, Chinese soybean importers can exercise their monopsony power to maximize their import profits by working with both the U.S. and South America to diversify their soybean suppliers to reduce price risk. Due to Chinese soybean importers' strategic choice and the seasonal production differences for the U.S. and South America, the U.S. and South America become seasonal complementary soybean suppliers for China, with South America dominating period I (June, July, August, September, and October) and the U.S. dominating period II (November, December, January, February, March, April, and May). Yet the availability of soybeans from the U.S. and South America throughout the year seems to have allowed the Chinese to exert more market power.

This study has many implications for the U.S. soybean industry. U.S. growers and soybean marketing firms should favor increased promotion of soybeans for various uses and argue for increased market access through lower trade barriers. This will not only increase the demand for soybeans, but also diversify the destinations for soybean shipments. Yet, the marketing firms are global, so they have more interest in soybeans in general, than in U.S. soybeans in particular, because they operate in so many countries. Certainly the fast development of soybean industries in Brazil and Argentina is threatening U.S. position in the world soybean market, yet the market power of Chinese soybean importers is also a concern for all soybean exporting countries. Exporting countries and agribusiness firms need to diversify their sales and bring more dynamic importers into the market through product promotion and incentives for new uses (such as biofuels).

The U.S., Argentina, and Brazil have a common interest in developing new and expanding existing markets for soybeans to help combat this market power of the

Chinese. More market outlets for soybeans will bring new customers to compete with the Chinese for exported soybeans, reducing the reliance on Chinese imports and possibly shrinking Chinese marketing margins. Lower trade restrictions, through WTO negotiations or other means, could improve access to potential soybean importing countries and result in less Chinese market power. The use of soybeans for biofuels might also help exporters diversify their markets.

Another alternative to reduce China's market power is to have U.S. and South American firms invest directly in soybean storage and crushing capacity in China. This is already allowed and such investments are taking place (Goldsmith et al). Increased horizontal integration among firms invested in exporting countries could also combat Chinese market power through better coordination of exporting among countries. The large grain trading firms already operate throughout the world, but it appears that they have a difficult time in dealing with Chinese market power.

China's soybean market is a very dynamic market that has great implications for US agriculture. Situations in China's soybean market change quickly and it is difficult to understand all aspects of this market without much research. Further research is needed to understand how Chinese soybean imports are undertaken and how Chinese crush capacity, storage capacity, and foreign investment affect the world soybean markets. This paper has found strong market power for the Chinese and little market power for the U.S. What is the source of that power? Will this change over time? What strategies might successfully change these power relationships? These are important issues that this paper has begun to address. It is hoped that more answers will be forthcoming as time passes.

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Appendix. Data Source

Variable	Definition	Source
P_{US}^{CH}	U.S. soybean export price to China (\$/MT)	USDA-FAS, 2006b
RS_{US}^{CH}	U.S. soybean residual supply for China (MT)	The Chinese Minister of Agriculture, 2006
INC_{US}	U.S. personal disposable income (\$)	USDA-ERS, 2006
P_{US}^{Corn}	U.S. corn retail price at Chicago market (\$/MT)	USDA-ERS, 2006
P_{US}^{Oil}	U.S. soyoil price (\$/MT)	USDA-ERS, 2006
P_{US}^{Meal}	U.S. soymeal price (\$/MT)	USDA-ERS, 2006
XPT_{US}^{EU}	U.S. soybean exports to the EU (MT)	USDA-FAS, 2006b
XPT_{US}^{JP}	U.S. soybean exports to Japan (MT)	USDA-FAS, 2006b
XPT_{US}^{MX}	U.S. soybean exports to Mexico (MT)	USDA-FAS, 2006b
STK_{US}	U.S. soybean beginning stocks (MT)	USDA-ERS, 2006
P_{CH}^{IMP}	Chinese soybean import price from the United States (RMB/MT)	The Chinese Minister of Agriculture, 2006
RD_{CH}^{US}	Chinese residual demand for U.S. soybeans (MT)	The Chinese Minister of Agriculture, 2006
P_{CH}^{Corn}	Chinese corn price at Dalian Port (RMB/MT)	Shanghai JC Intelligence Co., Ltd. 2006
INC_{CH}	Chinese personal disposable income (RMB)	USDA-ERS, 2006
LDI_{CH}	Chinese livestock industry development index	Chinese Statistics Yearbook (1999-2005)
P_{CH}^{Oil}	Chinese soyoil prices (RMB/MT)	Shanghai JC Intelligence Co., Ltd. 2006
P_{CH}^{Meal}	Chinese soymeal prices (RMB/MT)	Shanghai JC Intelligence Co., Ltd 2006
IMP_{CH}^{BR}	Chinese soybean imports from Brazil (MT)	The Chinese Minister of Agriculture, 2006
IMP_{CH}^{AR}	Chinese soybean imports from Argentina (MT)	The Chinese Minister of Agriculture, 2006



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Efficiency and Productivity Changes in the Indian Food Processing Industry: Determinants and Policy Implications

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Abstract

This paper analyses efficiency and productivity changes in 12 broad segments of food manufacturing industries during pre and post liberalisation periods, covering a period of two decades, from 1980-1981 to 2001-2002. The nonparametric Data Envelopment Analysis (DEA) approach is used to compute the Malmquist Total Factor Productivity (TFP) change, which has been further decomposed into efficiency and technical change. This paper also evaluates the performance of major inputs used in the food processing industry and identifies the causes of inefficiency across various segments. Based on the findings, the paper gives suggestions that can be used by policy makers and food processors in making decisions regarding various technical and managerial aspects to improve productivity and efficiency.

Keywords: Technical Efficiency, Total Factor Productivity (TFP), Food Processing, Data Envelopment Analysis (DEA), India.

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Introduction

The food and agricultural sectors in developing countries have been significantly transformed in the way food is produced, processed, marketed and consumed (Busch and Bain 2004; Deshingkar et al. 2003; Henson and Reardon 2005; Pinstrup-Andersen 2000; Reardon et al. 2001; Swinnen and Maertens 2007). Consumers have also been responding to changes in quality of food intake and are becoming more conscious regarding nutrition, health, and food safety issues (FAO 2003; Deininger and Sur 2007). Historically, Indian consumers have preferred fresh and unprocessed food over processed and packaged food; however, the recent changes in consumption patterns, particularly in middle and high income groups, show ample opportunity for processed food segments in the country (Bhalla and Hazell 1998; Bhalla, Hazell, and Kerr 1999; Chand 2003; Chenggapa et al 2005; Deininger and Sur 2007; Kumar 1998; Mukherjee and Patel 2005). Rising income, increased urbanization, changing lifestyle, greater willingness to experiment with new products and flavours, desire for convenience and an increase in the number of working women have led to a strong growth in consumption of packaged and processed food products (Goyal and Singh 2007).

The process of economic liberalisation in India has been on its way since the late 1970s and early 1980s, but at a slow and halting pace (Gulati and Chadha 1993). The first comprehensive economic reform policy statement was formulated for India in July 1991 in the form of industrial and trade sector liberalisation (Ganguly-Scrase and Scrase 2001). The economic reforms of the 1990s, which strengthened the process of liberalisation, privatisation and globalisation in the country, have brought new opportunities and challenges before food processors through a competitive market environment. To meet the emerging demand for processed food products, both national and multinational food processing organizations have been trying to capture the huge and exponentially growing food market by adopting sophisticated technologies to facilitate innovations in food product development and packaging for competitive success and survival within the consumer market across the world (Bogue 2001; Stewart-Knox and Mitchell 2003 Wells, Farley, and Armstrong 2007). The capital investment in the food processing sector has significantly increased after the economic reforms of 1991 in the country. The government has also relaxed the restrictions on technology imports and private foreign direct investment to strengthen the manufacturing sector, including food processing (Goyal 1994; Vachani 1997; Bowonder 1998; Gandhi, Kumar, and Marsh 2001; Athreye and Kapur 2001; Das 2003; Mani 2004). Rodrik and Subramanian (2004) categorise the reforms of 1980s and 1990s as “pro-business” and “pro-market”, respectively. The eighties’ reforms focused on increasing the profitability of existing firms by easing capacity restrictions and reducing corporate taxes, while the reforms of the nineties allowed more competition and increased provisions for the entry of new domestic firms and multi-national companies (MNCs) in the Indian manufacturing sector. Therefore, analysing productivity and efficiency changes

across the manufacturing sector during pre and post reform periods becomes essential for providing strategic inputs to the producers, the government and other stakeholders.

Market liberalisation is expected to have a favourable impact on productivity growth in the manufacturing sector due to several reasons. Krishina and Mitra (1998) argue that trade can spur innovation by enhancing industrial learning, exchange of technical information, sharing of global research and elimination of duplication in research and development. Goldar and Kumari (2003) have listed several expected impacts of import liberalisation on productivity and efficiency of manufacturing sector: (i) import liberalisation will provide the industrial firms with greater and cheaper access to imported capital goods and intermediate goods; (ii) greater availability of imported capital and intermediate goods will enable the firms to enhance the productivity and efficiency in a better way; (iii) the increased competition among manufacturing units will enforce better utilisation of resources; (iv) the increased competitive pressure coupled with expanded opportunities for importing technology and capital goods will bring greater technological dynamism in industrial firms; (v) since competitive business environment forces inefficient firms to close down, the average level of efficiency of various industries should improve; and (vi) greater access to imported inputs and a more realistic exchange rate associated with a liberalized trade regime would enable manufacturing firms to compete more effectively in export markets. Similarly, other researchers emphasise that trade reforms lead to increased international competition which brings about a reduction in input slacks and greater access to a variety of specialised inputs for enhancing production efficiency (Chand and Sen 2002; Horn, Lang, and Lundgren 1996). Pattanayak and Thangavelu (2005) indicate that key elements of the New Industrial Policy (NIP) of 1991 aim at enhancing productivity and efficiency in the Indian manufacturing sector by increasing competition, creating a level playing field among public, private and foreign businesses, and generating a conducive environment for technological growth through abolition of licensing, reducing the reserved list for public sector undertakings, increasing foreign equity ownership and investment, promoting private investment in infrastructure, allowing free import of capital goods, reducing tariffs for consumer goods and deregulating small scale units. However, there are contrasting views as well on the linkage of market liberalisation with productivity and efficiency growth. The traditional infant industry argument, which has greater relevance to the Indian food processing sector, emphasises that the removal of protection through market liberalisation may force the majority of small and medium firms to close down their business (Driffield and Kambhampatti 2003).

There are very few empirical evidences regarding the contribution of technology to the growth of the food processing industry at the disaggregated level. However, evidences from the food industry as a whole during different periods of time indicate varied contributions of technology to the growth of the food processing industry. The

average growth of Total Factor Productivity (TFP) in Indian manufacturing was sluggish during 1951-1979 and the relative contribution of TFPG to output growth was meagre (Goldar 1986). There was negative TFP growth in Indian food processing during 1959-1986 (Ahluwalia 1991). Mitra, Varoudakis, and Vegarzones (1998) analysed the impact of available infrastructural facilities on Total Factor Productivity Growth (TFPG) and Technical Efficiency (TE) in Indian manufacturing and estimated positive TFPG in food processing during 1976-1992. Other empirical analysis also show mixed TFPG in organized food processing sector (Balakrishnan and Pushpangadan 1994; Mitra 1999; Trivedi, Parkash, and Sinate 2000; Goldar and Kumari 2002; Pattnayak and Thangavelu 2005).

Several empirical studies have also analysed the relationship of India's economic reforms and market liberalisation initiated in the year 1991 with competition and productivity growth in the manufacturing sector (Srivastava 1996; Joshi and Little 1997; Krishna and Mitra 1998; Forbes 2001; Hasan 2002; Rani and Unni 2004). Empirical evidences show that the economic liberalisation has positively promoted total factor productivity in the Indian manufacturing sector (Goldar 1986; Ahluwalia 1991; Chand and Sen 2002; Driffield and Kambhampatti 2003; Milner, Vencapa, and Wright 2007). Some studies also indicate a negative impact of liberalisation on productivity growth in various manufacturing sub-sectors (Balakrishnan, Pushpangadan, and Babu 2000; Singh, Coelli, and Fleming 2000; Srivastava 2001; Das 2003).

The food processing sector in India covers a wide range of food items such as meat and meat products, fish and fish products, fruits and vegetables, vegetable oils and fats, milk and milk products, grain milling, animal feed, confectionery products, bakery products, sugar processing, among others. The level and structure of the Indian food processing industry reflects that food production is mainly constrained due to lack of productivity augmenting technologies. To meet the emerging challenges, there is an urgent need to bring efficiency to the production process, either through maximizing the output or minimizing the cost. Therefore, technology is the key to improvement in the growth and efficiency of the food processing sector. This study evaluates the performance of various segments of the food processing industry in India in terms of TFP and efficiency change over the period of 1980-1981 to 2001-2002, to analyze pre and post market liberalisation situations. Using the Malmquist productivity index, this study decomposes the TFP change in the disaggregated food processing sector into technical and efficiency changes. The study empirically analyses the determinants of productivity change and reasons for inefficiency in the production process, which consequently indicate practical policy directions for strengthening and accelerating the growth of various sub-segments of the industry. In particular, the study intends to find the answers to the following questions and compare the pre and post market liberalisation periods:

- Are there structural changes across the food processing sector with respect to number of manufacturing units, employment generation, capital investment and gross value added (GVA)?
- Has the performance of the food processing industry in India improved since the market liberalisation of the 1990s in terms of productivity and efficiency changes?
- What are the major factors causing production inefficiencies, and what are the possible solutions for addressing these issues across the food processing sector?

This study expects to identify the emerging segments of the food processing sector during post market liberalisation period, which may become potential investment avenues for food processors. The structural change in food consumption patterns towards high-value products such as fruits, vegetables, milk, meat and eggs may provide greater opportunity to these units for growth and development. It is expected that these segments will invite and encourage more entrants and investments during the market liberalisation period to meet the growing demand. Because of this, capital investment in high-value food segment is expected to increase at a higher rate than others. The efficiency and productivity changes are expected to be low due to the long gestation of capital investment, which should increase in the years to come. The study also expects to analyze the factors causing inefficiency and low productivity across the food processing sector, which will provide implications for food processors as well as policy makers in addressing critical issues to strengthen sustainable growth and development. This will also facilitate in deciding the optimal mix of factor inputs and modernisation of production process for better efficiency and productivity.

Data and Methodology

The data on input and output related to registered/organized food manufacturing units has been compiled for the period of 1980-1981 to 2001-2002 from the Annual Survey of Industries published by the Central Statistical Organization (CSO), Ministry of Statistics and Programme Implementation, Government of India. The data on value of output and inputs of food processing units has been converted into constant prices, considering 1993-1994 as the base year by using the appropriate price indices of the respective commodity groups and inputs. All units with 50 or more workers operating with power, and units having 100 or more workers operating without power were covered under the CSO database. A brief definition of variables used for estimating TFP and efficiency change is given in Box 1. The Data Envelopment Analysis (DEA) Approach is used for measuring productivity change and efficiency in the Indian food processing industry over the period of 1980-1981 to 2001-2002, with categorisation of data into pre reform period (1980-1981 to 1990-1991) and post reform period (1991-1992 to 2001-2002). About two decadal panel data has been used to capture the fairly long-term effects of the pre and post market

liberalisation periods on productivity and efficiency, and also to assess the structural changes in the food processing industry. As the major economic reforms in the country took place during the 1990s, a comparison of productivity and efficiency between pre and post reform periods across the food processing sector provides practical insights on technical and managerial issues for policy makers, food processors and researchers in the changing market environment. Data Envelopment Analysis (DEA) is the most commonly used nonparametric method across the world for estimating relative efficiency with reference to best practice frontier (Cooper, Sinha, and Sullivan 1996; Jayanthi, Kocha, and Sinha, 1999; Emrouznejad, Parker, and Tavares 2008). The advantage of using the DEA-based Malmquist index is that the estimation of the production frontier requires fewer observations and assumptions as compared to parametric methods such as stochastic frontier estimation (Mao and Koo, 1997; Zheng, Liu, and Bigsten 2003). This method does not require specification of the underlying technology and has an advantage in dealing with disaggregated input and output variables. However, the parametric methods were questioned by many economists because of the limitation of chosen functional forms, biased estimates in the presence of measurement error, lack of statistical fit and dependency on the choice of variables (Arnade 1994; Mao and Koo 1997; Donthu, Hershberger, and Osmonbekov 2005; Ruggiero 2007).

Box 1: Variable Definitions

Output: Gross output is defined as the ex-factory value of products and by-products manufactured during the accounting year.

Cost of Capital: User's cost of capital; i.e., a sum of depreciation, interest payment and rent is used to estimate the capital use in food processing industry

Labour: The annual survey of the industry provides two categories of labour employment in the food processing industry, i.e., employees and workers. The data available on number and payment to employees and workers is used in the study.

Raw Material: Raw material is the major input used in food processing, basically constituting raw agricultural produce of respective food unit, like food, spices, edible oils, vegetables, chemicals, ice and packing materials, etc.

Energy Used: Values/costs of different types of energy; mainly includes electricity, diesel and petrol used in food processing units.

The DEA methodology was initiated by Charnes, Cooper, and Rhodes (1978) whose work was largely based on the frontier concept pioneered by Farrell (1957). Thus, the DEA is a methodology directed to frontiers rather than central tendencies

(Seiford and Thrall 1990). This method attempts to measure the efficiency of Decision Making Units (DMUs)/firms through linear programming techniques which “envelop” observed input–output vectors as tightly as possible (Boussofiane, Dyson, and Thanassoulis 1991). The original model developed by Charnes, Cooper and Rhodes (CCR model) was applicable when technologies were characterized by constant returns to scale (CRS) and all firms operated at an optimal scale (Coelli, Prasada, and Battese 1998). But, imperfect competition may cause a DMU not to operate at optimal scale (Coelli 1996). Therefore, an input-oriented variable return to scale (VRS) Data Envelopment Analysis Model extended by Banker, Charnes, and Cooper (BCC Model) in 1984 has been used for measuring technical and scale efficiency.

For estimating the TFP change in the Indian food processing industry, the Malmquist productivity index is used. The Malmquist productivity index was introduced by Caves, Christensen, and Diewert (1982) based on the distance functions developed by Malmquist, which is defined as the ratio of two output distance functions. In other words, the Malmquist TFP index measures the TFP change between two data points by calculating the ratio of the distances of each data point relative to a common technology. The input-output variables used in this study include cost of capital, labor, raw material consumed, energy used and gross value of output. The Malmquist TFP index and efficiency scores have been obtained by using the Data Envelopment Analysis Program (DEAP) software (version 2.1) developed by Coelli (1996).

Results and Discussion

Performance of Food Processing in India

Food processing is an emerging sector of Indian economy and is growing at a rate of more than 10 percent per annum. The majority of the food processing units in the country are unorganized and are facing various kinds of challenges in the fast changing global scenario. The analysis of structural changes in food processing units suggest that in terms of number of units, the change in composition is significantly visible in the case of grain milling, which has increased from 13.3 percent during the pre-liberalisation period to 20.0 percent during the post liberalisation period (Table 1). The share of all other types of food processing units, in terms of number of units, has increased over time, except sugar & jaggery and vegetable oils. Processing units under these categories have closed down due to unfavorable policy environment and increased competition after market liberalisation. The food processing units summarized in the “Other Food Items” category constitute 30.4 percent of total units, which include manufacturing of macaroni, noodles and similar products; processing and blending of tea; coffee curing, roasting, grinding and blending; processing of edible nuts; manufacturing of malted foods; grinding and processing of spices; manufacturing of *papads*, appalam and similar products; and manufacturing of vitaminised high protein food products and other semi-processed, processed or instant foods not included below.

Table 1: Structural Composition of Indian Food Processing Industry (%)

Group	Number of Factories			Employment (No.)			Gross Value Added (Rs. Lakh)		
	1980-1982	1991-1992	1999-2001	1980-1982	1990-1992	1999-2001	1980-1982	1990-1992	1999-2001
Meat / Meat Products	0.3	0.3	0.5	0.8	0.6	0.7	0.7	0.6	1.2
Fish / Fish Products	0.9	1.5	2.5	1.1	1.2	2.1	1.4	1.6	2.8
Fruits / Vegetables	0.9	1.3	2.0	1.0	1.1	1.7	0.7	0.9	2.1
Vegetable Oils	8.1	9.1	7.9	10.3	9.6	7.5	24.8	28.8	20.3
Dairy / Dairy Products	2.4	4.4	5.7	8.2	11.3	13.8	10.4	11.1	13.5
Grain Milling	13.3	20.0	23.4	12.5	10.5	11.6	10.0	13.4	18.8
Starches / Starch Products	0.7	1.0	1.4	1.0	0.9	1.6	3.4	3.1	4.3
Animal Feeds	0.4	0.9	1.5	0.8	1.4	2.1	0.7	1.3	2.3
Bakery Products	1.6	2.9	3.5	3.6	4.3	4.5	2.9	3.5	4.2
Sugar	44.3	29.6	20.1	42.4	45.1	37.4	21.7	17.2	10.9
Indigenous / Refined Confectionery	0.3	0.7	1.0	0.5	0.9	1.9	0.4	0.8	1.6
Other Food Items	26.9	28.2	30.4	17.7	13.1	15.2	23.1	17.8	18.1
Food Industry	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Source: Annual Survey of Industries (various issues), CSO, New Delhi

Food processing is an important employment generating segment within the agriculture sector in India and has a vast scope for its development (Gupta 2002; Rani and Unni 2004). The distribution of employment in different types of food processing units shows that sugar & jaggery employs 37.4 percent persons out of the total employed (Table 1), followed by dairy and dairy products (13.8%) and grain milling (11.6%). Per unit labour absorption capacity of sugar & jaggery segment is high, which employed 258 persons in 1999-2001 (Table 2). Animal based industries such as meat, dairy and fishery processing units are also labour intensive, employing 112, 111 and 109 persons, respectively, per unit on an average during the same period.

The composition of the gross value added (GVA) shows that vegetable oil units constitute the major share (20.3%), followed by grain milling (18.8%), dairy and dairy products (13.5%), and sugar and jaggery (10.9%). Gross value added per unit is highest in sugar and jaggery units followed by meat and meat products, dairy products, and confectionery (Table 2). Moreover, capital investment has increased positively in all segments of the food processing industry but is comparatively high in case of sugar & jaggery and meat & meat products. Per unit capital investment in sugar and jaggery units has drastically increased in recent years for making these units more viable and sustainable through productivity & efficiency improvement and increased utilisation of the by-products. The capital investment in meat and meat products has also increased to meet the emerging export demand (Table 2).

Table 2: Employment, Capital and Gross Value Added in Indian Food Processing (Per Unit)

Group	Number of Person Employed			Cost of Capital Rs. lakhs			Gross Value Added Rs. lakhs		
	1980- 1982	1990- 1992	1999- 2001	1980- 1982	1990- 1992	1999- 2001	1980- 1982	1990- 1992	1999- 2001
Meat / Meat Products	139	109	112	14.19	34.51	107.14	34.0	94.7	208.3
Fish / Fish Products	50	81	109	4.60	17.58	42.43	8.8	54.2	72.4
Fruits / Vegetables	71	68	54	4.01	10.21	26.09	7.3	21.1	49.8
Vegetable Oils	32	33	37	2.69	10.29	19.71	7.6	21.9	44.7
Dairy / Dairy Products	142	131	111	11.96	28.27	53.12	34.4	76.7	182.7
Grain Milling	23	22	25	1.08	2.74	5.67	2.6	5.6	12.5
Starches / Starch Products	25	31	25	2.41	7.45	15.75	6.6	13.0	29.6
Animal Feeds	37	43	45	3.20	7.15	17.29	11.4	29.4	46.3
Bakery Products	39	44	47	1.82	5.28	9.03	9.3	24.3	48.6
Sugar Indigenous / Refined	247	259	258	13.02	65.11	228.42	23.7	108.9	323.3
Confectionery	40	62	52	2.53	14.21	29.17	9.2	45.8	115.3
Other Food Items	108	89	94	2.23	6.59	12.47	11.4	34.5	48.5
Food Industry	73	56	54	3.54	10.05	22.77	8.9	23.8	48.7

Source: Annual Survey of Industries (various issues), CSO, New Delhi

The annual growth performance of the food processing industry in terms of number of units, employment and the gross value added (GVA) during the pre and post reform periods is given in Table 3. It is clear from the table that the high value segments, such as meat and meat products, fish and fish products, fruits and vegetables, milk and milk products, starches and starch products and confectionery, have significantly gained in terms of number of units, employment, investment and output growth during the post-reform period. Maximum growth in number of units during the post-liberalisation period has been experienced by starches and starch products followed by fruits and vegetables. The number of persons employed in food processing units has also increased positively across the sector during the post-liberalisation period. There has been positive growth in employment during the post-liberalisation period as compared to negative growth during the pre-market liberalisation situation.

Value addition across the food processing industry in the country has been growing at a very significant rate over the last two decades (Table 3). The rate of growth in the gross value added of the food processing industry was 11.74 percent during 1980-1990 (pre reform period), which has slightly declined during 1990-2001 (post reform period) but is still higher at 9.23 percent. However, the growth in value addition increased during the 1990s for most of the high-value food processing

Table 3: Growth Performance of Food Processing Units in India, 1980-2001 (%)

Group	Number of Units			Number of Person Employed			GVA (Rs. in lakhs at 1993-94 prices)		
	1980-1990	1990-2001	1980-2001	1980-1990	1990-2001	1980-2001	1980-1990	1990-2001	1980-2001
Meat / Meat Products	1.42	3.94	3.01	-1.36	4.96	2.76	7.40	15.51	16.78
Fish / Fish Products	-2.67	4.06	1.96	0.17	8.49	6.71	9.87	8.85	14.67
Fruits / Vegetables	3.04	7.93	4.93	2.67	5.85	4.11	12.05	18.51	13.64
Vegetable Oils	-0.68	-1.35	-0.03	-0.44	0.09	0.48	9.88	6.61	9.69
Dairy / Dairy Products	5.18	6.10	5.87	4.78	3.52	4.25	17.92	15.88	14.35
Grain Milling	2.90	1.89	2.47	2.87	3.40	2.96	10.53	9.93	10.57
Starches and Starch Products	-0.99	8.13	3.69	0.09	4.95	3.21	3.45	14.33	10.18
Animal Feeds	4.98	5.80	6.48	7.00	7.62	7.91	13.30	11.85	13.85
Bakery Products	3.83	2.76	3.11	5.32	3.56	3.91	14.40	10.17	11.71
Sugar	-5.97	-2.44	-4.30	-6.39	-2.49	-2.61	11.57	8.70	10.00
Indigenous / Refined Confectionery	5.46	5.72	5.44	8.08	4.78	7.21	18.87	15.99	18.25
Other Food Items	0.51	1.56	1.46	-2.61	2.03	1.27	12.00	5.56	8.53
Total Food Products	0.91	1.64	1.58	-2.31	1.43	0.71	11.74	9.23	10.51

Note: Annual Compound Growth Rates are calculated using exponential growth model

Source: Annual Survey of Industries (various issues), CSO, New Delhi

segments, such as meat and meat products, fruits and vegetables, grain processing, starches and starch products, animal feed, and bakery products. The growth in output for meat and meat products and fruits and vegetables has almost doubled during the last two decades. These growth trends in gross value added (GVA) for various food products suggest that there is vast scope for promoting high-value segments in the post liberalisation period.

Productivity Change in Food Processing Industry

Table 4 shows the cost composition of the food processing industry in India, which would definitely help in formulating effective strategies for the development of various food segments. The major constraint in the development of the food processing industry is timely and quality procurement of raw material, i.e., agricultural produce for processing, which accounts for about 85-90 percent of the total input cost. The absence of assured electric supply coupled with lack of other infrastructural facilities such as road, transport, storage etc., are other constraints that hinder the growth of the food processing industry. Though the cost composition in various types of food processing units varies, raw material consumption constitutes the major share.

Table 4 also clearly illustrates that economic liberalisation has increased the capital intensity in the Indian food processing industry, as the share of capital cost has

Table 4: Cost Composition of Food Processing Industry in India (%)

Group	Wages & Salaries			Cost of Capital			Material Consumed			Energy Used		
	1980-1982	1990-1992	1999-2001	1980-1982	1990-1992	1999-2001	1980-1982	1990-1992	1999-2001	1980-1982	1990-1992	1999-2001
Meat / Meat Products	9.45	7.66	4.74	6.93	8.81	8.79	78.40	78.04	81.03	5.22	5.49	5.44
Fish / Fish Products	2.95	2.41	3.37	4.29	4.24	5.22	90.43	91.06	88.15	2.33	2.29	3.25
Fruits / Vegetables	8.32	10.99	8.19	8.22	13.45	15.68	79.70	69.42	68.54	3.76	6.14	7.59
Vegetable Oils	1.76	1.53	1.79	2.38	3.17	3.61	93.17	92.16	91.02	2.69	3.14	3.58
Dairy / Dairy Products	4.88	4.93	4.90	2.97	3.43	3.99	88.22	88.32	87.60	3.93	3.31	3.50
Grain Milling	3.24	2.43	2.43	3.09	3.61	3.56	92.02	91.82	91.13	1.65	2.15	2.88
Starches / Starch Products	6.21	6.16	6.41	7.75	10.09	11.38	72.36	69.16	69.56	13.68	14.59	12.65
Animal Feeds	3.77	3.08	3.26	3.26	2.58	3.40	91.02	92.33	90.67	1.95	2.01	2.67
Bakery Products	8.93	9.00	9.25	3.73	4.82	4.65	82.76	81.15	79.71	4.58	5.03	6.39
Sugar Indigenous / Refined	9.55	9.51	8.66	10.88	10.88	15.15	76.46	77.11	74.33	3.11	2.49	1.85
Confectionery	7.99	7.93	8.98	5.15	10.32	9.65	83.20	76.82	75.61	3.66	4.94	5.76
Other Food Items	6.74	5.52	6.84	3.71	5.05	5.30	83.95	84.29	81.84	5.60	5.14	6.01
Food Industry	5.03	4.57	4.79	4.82	5.36	6.59	86.95	86.93	85.10	3.20	3.15	3.52

Source: Calculated from Annual Survey of Industries Data, CSO, New Delhi

increased during the post-liberalisation period. Pattnayak and Thangavelu (2005) argue that the capital-using technical change has significant policy implications in terms of capital accumulation and increasing total factor productivity in the Indian manufacturing industry.

Table 5: Average Technical and Scale Efficiency in Indian Food Processing Industry

Group	1980-90			1990-2001			1980-2001		
	CRSTE	VRSTE	SCALE	CRSTE	VRSTE	SCALE	CRSTE	VRSTE	SCALE
Meat / Meat Products	0.417	0.918	0.460	0.764	0.882	0.852	0.606	0.911	0.665
Fish / Fish Products	0.687	0.955	0.719	0.833	0.863	0.960	0.764	0.907	0.847
Fruits / Vegetables	0.823	0.829	0.993	0.803	0.868	0.912	0.792	0.895	0.880
Vegetable Oils / Fats	0.872	0.978	0.892	0.856	0.939	0.909	0.862	0.956	0.900
Dairy / Dairy Products	0.709	0.894	0.793	0.804	0.837	0.955	0.758	0.866	0.875
Grain Milling	0.768	0.901	0.852	0.866	0.900	0.960	0.821	0.903	0.909
Starches / Starch Products	0.713	0.941	0.759	0.752	0.862	0.867	0.737	0.902	0.818
Animal Feeds	0.768	0.835	0.927	0.807	0.833	0.949	0.790	0.838	0.936
Bakery Products	0.858	0.912	0.941	0.923	0.925	0.997	0.892	0.921	0.969
Sugar	0.788	0.978	0.805	0.850	0.937	0.903	0.829	0.959	0.863
Indigenous Refined Confectionery	0.657	0.838	0.793	0.689	0.733	0.926	0.671	0.785	0.858
Others	0.851	0.999	0.851	0.953	0.968	0.984	0.900	0.982	0.917
Food Processing	0.743	0.915	0.815	0.825	0.879	0.931	0.785	0.902	0.870

Source: Calculated from Annual Survey of Industries Data, CSO, New Delhi

Note: CRSTE=Technical Efficiency from CRS DEA
 VRSTE= Technical Efficiency from VRS DEA
 SCALE= Scale Efficiency

The performance of the Indian food processing industry is measured in terms of technical and scale efficiency (Table 5). The technical efficiency is the product of its scale efficiency and pure technical efficiency estimated under the assumption of constant returns to scale. The values of efficiency indices equal to unity implies that the industry is on best-practice frontier, while values below unity show that the industry is below the frontier or technically inefficient. Analysis of this study shows that the average technical efficiency score is estimated to be 0.785 under the CRS model and 0.902 under the VRS model. The average scale efficiency in Indian food processing units for the entire period is estimated to be 0.870. This implies that the average technical inefficiency could be reduced by 10 percent by improving scale efficiency and eliminating pure technical inefficiencies. The efficiency scores in the food processing industry vary significantly across various types of food processing units and over time. It is also evident that the average technical efficiency scores for the food processing industry as a whole have experienced declining trends during

the post-liberalisation period (1990s) over the pre-liberalisation period (1980s). The decline in technical efficiency during the post-liberalisation period may be because of high gestation lag in capital investment. However, the scale efficiency has improved from 0.815 during 1980-1990 to 0.931 during 1990-2001. This implies that market liberalisation has facilitated the enhanced investment in capital goods leading to greater capacity utilization.

Based on a literature survey, Golany and Yu (1997) argue productivity improvements in five different scenarios, which include (a) producing the same output while consuming less resources; (b) producing more output without changing the level of resource usage; (c) producing more output with fewer inputs; (d) a large increase in the output for an increase in input; and (e) a smaller reduction in the output for an increase in input consumption. Out of these five scenarios, the first three are associated with technical efficiency while the remaining are associated with scale efficiency. Input-oriented variable returns to scale (VRS) Data Envelopment Analysis Model known as BCC Model identifies the decision making units (DMUs), operating in three regions: (i) a region of increasing returns to scale (IRS), (ii) a region of declining returns to scale (DRS), or (iii) a region of constant returns to scale (CRS). Banker, Charnes, and Cooper (1984) refers to the region of constant returns to scale as the “most productive scale size” (MPSS).

The relevance of returns to scale analysis in business decision-making is a well researched area (Kang and Kwon 1993; Segoura 1998; Butler and Li 2005). The analysis provides information for decision-makers to examine their production performance and to determine the effectiveness of resource utilization. Table 6 indicates that most of the sub-sectors of the food processing industry were operating under increasing returns to scale during the pre-liberalisation period (1980-1990);

Table 6: Returns to Scale in Indian Food Processing Industry

Group	1980 - 1990	1990 - 2001	1980 - 2001
Meat / Meat products	IRS	IRS	CRS
Fish / Fish products	IRS	IRS	DRS
Fruits / Vegetables	IRS	IRS	IRS
Vegetable Oils / Fats	IRS	CRS	DRS
Dairy / Dairy Products	IRS	DRS	DRS
Grain Milling	IRS	DRS	DRS
Starches / Starch Products	IRS	IRS	CRS
Animal Feeds	IRS	CRS	CRS
Bakery Products	CRS	CRS	DRS
Sugar Indigenous / Refined	CRS	CRS	CRS
Confectionery	DRS	CRS	CRS
Others	IRS	CRS	CRS

Source: Calculated from Annual Survey of Industries Data, CSO, New Delhi

Note: CRS=Constant Returns to Scale
 IRS=Increasing Returns to Scale
 DRS= Decreasing Returns to Scale

except for bakery products and sugar, which had constant returns to scale, and confectionery which had decreasing returns to scale. However, the majority of the segments of the industry have moved towards constant and decreasing returns to scale during the post-liberalisation period (1990-2001), except for meat and meat products, fish and fish products, fruits and vegetables, and starches and starch products. These results clearly indicate that after market liberalisation the capital investments across the food processing industry had significantly increased, after having not been fully utilized in most of the food processing segments in the initial years.

Table 7 shows the estimated average annual rate of productivity and efficiency change in the Indian food processing industry during the last two decades. The Malmquist TFP index measures the productivity change over period t to period t+1. This output-based index explains the change in productivity level in given level of inputs. The TFP change in a firm occurs either due to technological progress (i.e., shift in the production frontier), or due to efficiency improvements in the firm (Hossain and Bhuyan 2000). A productivity value index larger than one indicates a productivity improvement and a value less than one indicates productivity decline.

Table 7: Efficiency Change, Technological Progress and TFP Change in Indian Food Processing Sector

Group	1980-1990			1990-2001			1980-2001		
	EFFCH	TECHCH	TFPCH	EFFCH	TECHCH	TFPCH	EFFCH	TECHCH	TFPCH
Meat / Meat Products	1.009	1.091	1.089	1.007	1.146	1.166	1.018	1.119	1.140
Fish / Fish Products	1.011	1.068	1.081	0.992	1.086	1.031	1.005	1.081	1.060
Fruits / Vegetables	1.038	1.058	1.100	1.130	1.072	1.151	1.068	1.071	1.112
Vegetable Oils	1.094	1.157	1.179	1.019	1.162	1.102	1.030	1.174	1.128
Dairy / Dairy Products	1.074	1.113	1.192	0.999	1.114	1.055	1.040	1.127	1.135
Grain Milling	1.020	1.014	1.011	0.998	1.038	1.018	0.999	1.033	1.012
Starches / Starch Products	0.955	1.078	1.022	1.091	1.095	1.078	1.029	1.080	1.041
Animal Feeds	1.002	1.075	1.074	1.177	1.068	1.258	1.095	1.076	1.177
Bakery Products	1.004	1.097	1.105	0.994	1.026	1.006	0.998	1.061	1.054
Sugar / Jaggery	1.001	1.055	1.054	1.002	1.030	1.027	1.002	1.057	1.055
Confectionery	1.003	1.085	1.083	1.094	1.113	1.218	1.055	1.098	1.157
Other Food Items	1.002	1.065	1.063	0.979	1.009	0.957	0.989	1.040	1.010
Food Industry	0.999	1.072	1.064	0.989	1.069	1.031	0.982	1.060	1.041

Source: Calculated from Annual Survey of Industries Data, CSO, New Delhi

Note: EFFCH=Efficiency Change
 TECHCH= Technical Change
 TFPCH= Total Factor Productivity Change

During the last two decades, all segments of the food processing industry experienced positive change in TFP with varied magnitude. The TFP gain is basically due to change in technological progress, and the contribution of efficiency change in TFP is small.

The overall TFP change in the Indian food processing industry declined from 1.064 during the pre-liberalisation period (1980-1990) to 1.031 during the post-liberalisation period (1990-2001). However, some of the segments have gained significantly in terms of TFP change during the post-market liberalisation period, such as animal feed (1.258), confectionery (1.218), meat and meat products (1.166), fruits and vegetables (1.151), and grain milling (1.018). A close look at the TFP results indicate that the food segments with high scope of value additions have shown positive TFP changes during the post-liberalisation period. This provides an interesting and practical relevance to policy makers and food processors for enhancing investment in these segments of the food processing sector. Similarly, a total of 6 out of 12 food processing segments have experienced declining TFP change during the post-market liberalisation period. The contribution of technological progress and efficiency change in various types of food processing shows mixed trends.

Table 8: Average Slacks in Input use in Indian Food Processing Industry

Group	1980-90			1990-2001			1980-2001		
	Energy Rs. lakh	Material Rs.lakh	Cost of Capital Rs.lakh	Energy Rs.lakh	Material Rs. lakh	Cost of Capital Rs. lakh	Energy Rs. lakh	Material Rs. lakh	Cost of Capital Rs. lakh
Meat / Meat Products	702	20060	1000	182	7496	732	401	12912	850
Fish /Fish Products	111	3022	176	13	333	36	63	1681	108
Fruits / Vegetables	159	4444	287	13	637	62	86	2550	177
Vegetable Oils / Fats	1	62	0	0	25	0	1	45	0
Dairy / Dairy Products	119	3180	178	11	391	30	66	1789	106
Grain Milling	0	9	0	1	18	3	1	14	2
Starches / Starch Products	76	1786	80	10	282	0	44	1033	40
Animal Feeds	303	7535	542	29	811	26	166	4161	284
Bakery Products	4	127	4	5	156	7	5	135	6
Sugar	5	161	6	5	157	9	5	159	8
Indigenous / Refined Confectionery	159	4765	243	24	672	57	91	2635	148
Others	7	200	11	2	32	0	4	111	5
Food Processing	137	3779	210	25	918	80	78	2269	144

Source: Calculated from Annual Survey of Industries Data, CSO, New Delhi

Table 8 provides results on target inputs and the estimated slack inputs in the Indian food processing industry. Target inputs refer to what a particular DMU ought to have consumed if it was on the efficient frontier. The slack inputs are excess inputs. The slack is calculated as the difference between actual inputs

consumed minus the target input a DMU ought to have consumed. An efficient DMU will have zero input-output slack. In absolute terms, major input slack per unit was recorded in case of raw material use (Rs. 2269 lakhs) followed by cost of capital (Rs. 144 lakhs) and energy (Rs. 78 lakhs) during 1980-1981 to 2001-2002. It is interesting to note that the input slacks have comparatively declined during the post-liberalisation period as compared to the pre-liberalisation period. This may be because of modernization of production technologies to enhance resource use efficiency, as capital investment shows increasing trends across the food processing segments during the recent years.

Implications of the Study

The study provides empirical evidence on efficiency and productivity changes for each segment of the food processing industry over a period of two decades, which clearly maps the performance of food processing units at disaggregated level. It also identifies the causes of inefficiency and low productivity by analysing the input slacks. The results of the study have great managerial relevance in a number of ways. It provides a direction to new entrants into the food processing sector about the potential avenues of investment. Food segments with higher efficiency and productivity seem to be more attractive sub-sectors. Findings clearly indicate that higher efficiency and productivity changes have been experienced within the high value sub-sectors of food processing industry, which also follow the changing demand pattern towards high-value products, such as fruits, vegetables, milk, meat and confectionery. Firm managers can also consider efficiency and productivity scores as their performance indicators and, can accordingly take corrective measures after identifying the sources of inefficiency. Based on the slacks, the managers can adjust the combination of factor inputs or modernize the production process to improve the efficiency and productivity levels of their firms.

The study also suggests policy directions for the Indian food processing industry. As value addition through food processing is meagre, there is a need to have a focused approach in promoting this sector. Therefore, this sector requires policy inputs at the disaggregated level so that appropriate measures can be taken for each segment as per the requirement. High-value segments may require different levels of government interventions as compared to other segments. For example, high-value products may require more technological advancements at processing and sourcing levels to meet the customer need in an efficient manner. Similarly, the government may plan a relief package for inefficient units to enhance their performance. Findings of the study clearly indicate that maximum inefficiency comes from inefficient use of raw material, which is the major cost component of the food processing units. Government intervention in raw material sourcing for food processing units is quite critical, and necessitates policy reforms to allow direct private participation of food processors in procuring their raw material from the farmers.

Conclusions

Food processing in India has immense potential in terms of income and employment generation through value addition due to the availability of resources, labour, technology, the huge market and a favourable business environment. The level of food processing in the country is at the infancy stage and only a meagre quantity of agricultural produce is processed. The growth in the Indian food processing industry is mainly constrained due to lack of productivity augmenting technologies and limited resource utilization. Therefore, technology is the key to enhancing growth and efficiency in the food processing sector.

The analysis suggests that the food processing industry in the country is growing at a rate of about 10 percent per annum. The growth in output is largely driven by the incremental use of input doses. The average technical efficiency score is estimated to be 0.902 under the VRS model, with an average scale efficiency score of 0.870. This implies that the average technical inefficiency could be reduced by 10 percent by improving scale efficiency and eliminating pure technical inefficiencies. The technical efficiency scores for the food processing industry have declined during the post-liberalisation period (1990s) as compared to the pre-liberalisation period (1980s). The analysis of returns to scale in the food processing sector suggests that most of the sub-sectors have moved from increasing returns to scale towards constant and decreasing returns to scale during the last two decades, except for meat and meat products, fish and fish products, fruits and vegetables, and starches and starch products. This result clearly indicates that additional investment in the food processing segments with increasing and constant returns to scale will give encouraging and profitable output, whereas food segments with decreasing returns to scale need significant reorientation and modernization of the production process.

The food industry has experienced positive change in TFP with varied magnitude across sub-sectors during the pre and post liberalisation periods. The positive gain in TFP is basically due to change in technological process, i.e., shift in production frontier due to increased doses of capital input. The contribution of efficiency to TFP change is very small and needs attention for sustainable growth of the food processing sector. The variability in efficiency and TFP results across food processing sectors clearly indicate that high-value addition segments such as confectionery, meat and meat products and fruits and vegetables have shown a positive growth during the post liberalisation period. This implies that there have been structural changes in the food processing sector towards high-value segments following the changes in consumption patterns in the domestic markets. These findings also suggest that food processing segments with high-value addition opportunities have greater for investment attraction.

The reasons for inefficiency and low TFP change have been empirically analyzed in terms of input slacks. The analysis of input slacks in the food processing industry suggests that the industry is labour intensive and that the effects of the expansion

of the food industry on labour employment and productivity appear to be favourable. Analysis further shows that the food processing industry has been scale inefficient, mainly due to slacks in raw material, capital and energy use, implying that these inputs were excessively used. Policy makers and food processors may use these findings to improve productivity and efficiency in the Indian food processing industry and may work out the optimal levels of input mix by rationalizing the process of acquisition and usage of these inputs. Results indicate that the industry needs to modernize its production system to improve the capacity utilization of factor inputs, mainly of raw material, capital and energy. As raw material constitutes about 85 percent of production cost, proper methods of sourcing quality raw material for food production should be adopted by shortening the procurement process of the food processing industry. This initially requires reforms in domestic food and agricultural markets for strengthening backward linkages of food processors with the farmers through the provision of direct procurement.

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Market Segmentation Practices of Retail Crop Input Firms

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Abstract

The farmers targeted by crop input retailers may be divided into distinct groups or segments, but retail crop input firms vary in their ability to implement strategies to serve individual segments. In this study, segmentation practices among cooperatives and independently owned crop input retailers were explored. Addressing gaps between Best's seven-step market segmentation framework and retailer practices will help practitioners serve evolving farmer-customers.

Keywords: market segmentation, target marketing, crop inputs, distribution channel, retailer.

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Introduction

The crop input retailer is the business entity which traditionally has served as the final link between the farmer and the manufacturer of crop inputs. Traditional crop input retailers provide fertilizer, crop protection chemicals, and seed to farmers. In addition, most crop input retailers provide a host of complementary information and application services for these products. The crop input retailer's customers (farmers) continue to consolidate, creating fewer and larger farms. Retailers increasingly work with a larger, more sophisticated, and more demanding customer (Akridge, et al. 2004). At the same time, crop input manufacturers continue to merge, creating ever larger, typically multi-national, organizations. Fewer, larger suppliers reduce the retailer's bargaining power in the purchasing relationship (Thompson and Strickland 2001). In addition, competition from new intermediaries such as consultants, brokers, wholesalers and large growers has also emerged as a formidable threat to the traditional crop input retailer (Joshua 2004). Marketplace changes force any firm to re-examine its business model, and reconsider how they go about creating and communicating value. As intermediaries, retailers of crop inputs must consider value as defined by their grower/customer and their manufacturer/suppliers. As the needs of farmers evolve, firms must adjust their marketing strategies. For example, Alexander, Wilson, and Foley (2005) point out that needs of large farmers differ in terms of service requirements. As farms grow, the service offerings of suppliers will need to match their needs for service.

Market segmentation, frequently employed in larger organizations, is the practice of dividing a total market into separate groups of prospects and customers which have homogenous preferences within the groups, but heterogeneous preferences between groups. (Stern, El-Ansary and Coughlan 1996). Demographic and psychographic characteristics of buyers are common factors used to identify segments. Needs-based market segmentation is a marketing strategy aimed at aligning an organization's resources with the varied needs of its targeted customers (Wind 1978).

While market segmentation and the associated idea of target marketing (approaching each segment with a unique marketing mix – product/service/information bundle, price, promotion, place, people) is not new, there are questions about how the strategy of market segmentation and target marketing is being used in retail crop input firms. Previous research has demonstrated that distinct groups of farmers/customers exist (Mwangi; Gloy and Akridge 1991; Alexander, Wilson, and Foley 2005). However, retail crop input firms tend to be of modest size (annual agronomy sales under \$100 million) and are geographically bound (the economics of the logistics of their products and services force these firms to serve a specific geographic market). Both lack of resources and

being limited to a specific geographic market present challenges for successful implementation of a market segmentation/target marketing strategy (Stolp 1998).

The purpose of this study is to:

1. Identify needs-based market segmentation strategies currently employed by crop input retailers and compare them with needs-based market segmentation strategies suggested in the small business and marketing research streams; and
2. Determine where market segmentation/target marketing is not widely employed by crop input retailers and identify the reasons for not pursuing this practice and the barriers to its successful implementation.

Market Segmentation

Segmentation factors may be grouped into buyer characteristics and buyer behaviors (Kotler and Keller 2006). Buyer characteristics include the geography or physical location of customers; demographics like gender and age, or in the case of businesses, company revenues or numbers of employees; or psychographics, like lifestyles or values. Behavioral segmentation factors may include potential customer responses, perceptions of product or service benefits, or product usage. Characteristic or behavioral definitions alone are typically not adequate for identifying segments. Some means of evaluating differences between segment member's reactions to offers is typical of segmentation practices. These may vary from simple survey analysis to more complex statistical testing (Wind 1978).

Segments of farm customers who buy crop inputs have been identified according to their buying preferences (Alexander, Wilson and Foley 2005). In this case, segmentation was accomplished according to specific responses from farmers about their decision making process and were categorized into convenience, price, performance, service, and a balanced segment for whom no specific factor was significant. This segmentation model was then evaluated for its predictiveness and the preferences of segment members were considered

As a marketing strategy, segmentation benefits companies who target specific segments by allowing them to tailor a unique marketing mix to each segment. Strong positions in targeted segments create more total sales than undifferentiated marketing across all segments (Armstrong and Kotler 2007). However, segmentation can be costly for firms to implement. Segmentation requires obtaining data and analysis. Rapid movement between segments requires more frequent sampling. To counter this, some firms may use need-based segmentation, which provides the benefit of more stable customer groupings over time as compared to segmentation based on reactions to price (Wind 1978). This may be a

benefit to smaller firms with correspondingly smaller market research budgets than their large firm counterparts.

A Framework for Needs-Based Segmentation

Roger Best proposes a framework for implementing a market segmentation strategy. He suggests a set of sequential steps to be taken in a needs-based segmentation process (Table 1). The primary benefit of needs-based segmentation is that segments are created around specific benefits that customers require. The goal is to determine what observable demographics and behaviors differentiate one segment from another in order to make a needs-based market segmentation actionable (Best 2004). This framework provides a useful guide for exploring segmentation practices in the retail crop input industry.

Table 1: Key Steps in a Needs-Based Market Segmentation Process

Steps in Segmentation Process	Description
1 Needs-Based Segmentation	Group customers into segments based on similar needs and benefits sought by customer in solving a particular consumption problem.
2 Segment Identification	For each needs-based segment, determine which demographics, lifestyles, and usage behaviors make the segment distinct and identifiable (actionable).
3 Assess Segment Attractiveness	Using predetermined segment attractiveness criteria, determine the overall attractiveness of each segment.
4 Evaluate Segment Profitability	Determine segment profitability (net marketing contribution).
5 Segment Positioning	For each segment, create a "value proposition" and product-price positioning strategy based on that segment's unique customer needs and characteristics.
6 Segment "Acid Test"	Test the attractiveness of each segment's tailored value proposition to the targeted segment.
7 Marketing-Mix Strategy	Develop marketing mix: product, price, promotion, place, and people targeted to individual segments.

Source: Best, Roger J. *Market-Based Management*. 3rd ed, 2004.

In practice, few detailed accounts of market segmentation strategies are found in the trade press for the crop input industry, and there is virtually no published academic work. Since January 2005, some material dealing with market segmentation has appeared in the trade press focused on the crop input retailer

(Ruen 2005, Schrimpf 2005, Schrimpf 2006). In September 2005 an article in *Agrimarketing* emphasized the importance of local crop input retailers' influence over growers' input buying decisions. Because of this strong local retailer influence, manufacturers of crop inputs have focused their energy on marketing to segments. Rob Neill of Syngenta, a major manufacturer of crop inputs, commented, "We realize more and more that segmenting the market is key to success. The more segmenting we do, however, the more complex the marketing and sales job becomes" (Grooms 2005). A market segmentation strategy could serve to direct the retailer's role as a conduit for products, technologies and support; all important elements of the retailer's role (Joshua 2004). At question is whether such strategies are employed by firms that sell crop inputs to farmers, and if so, how they are executed.

Data Collection and Methods

This research compares and contrasts market segmentation practices between two groups: independently owned crop input retail businesses, and diversified agricultural cooperatives. Individuals from these firms with primary responsibility for marketing crop inputs and agronomic services were chosen to participate in this study. Participants' experiences with market segmentation strategy were examined through a two-part process: first with a survey administered through Zoomerang Survey (<http://info.zoomerang.com>) online; and second with a succeeding telephone interview. The sample design was structured around *CropLife's* Top 100 ranking of crop input retailers (Sfiligoj 2003; Sfiligoj 2006). The 20 participants were selected first based upon a previous working relationship with Purdue's Center for Food and Agricultural Business (CAB), and secondly on their status as a current Top 100 rank holder. While this method limits the generalizability of findings, particularly beyond the Top 100, the interview approach allows the interviewer "to uncover underlying motivations, beliefs, attitudes and feelings on a topic" (Malhotra, 2003, 147).

The web-based survey was designed to gather demographics, general market information and address preliminary issues in the market segmentation process to set the tone for the follow-up telephone interview. The web-based survey instrument is presented in Appendix C.

The telephone interview was designed to examine in a detailed manner the specific elements, methods, effects and outcomes of adopting a market segmentation strategy. The phone interview survey instrument is presented in Appendix D. Questions were structured upon an adapted version of Best's steps for a needs-based market segmentation process. By structuring the questionnaire so that at least one question addressed each of the steps, gaps or breakdowns in the market segmentation process could be assessed, and then related back to a difference in

organizational type, size, market environment descriptor, implementation challenge, or participant's survey responses.

Statistical analysis included simple descriptive characteristics. Cross tabulations and associated Chi-squared statistics were completed to evaluate differences in firm type. Statistical significance of mean responses between the categories of firm type for each variable were calculated using an F-test. Digitally recorded telephone interviews were transcribed in Microsoft Word, highlighting key points and statements from individuals' responses. Once all interviews had been transcribed, responses were sorted by question and a synopsis of each set of qualitative responses was compiled. This procedure was previously used successfully by Stolp in 1998 to collect data on market planning practices of retail crop input firms. These data were collected in March and early April 2007.

Results

An overview of the sample demographics is first presented. Second, a descriptive statistical analysis is reported for the survey questions concerning market segmentation strategy, specifically for key accounts. Last, results from the interviews with individuals who have primary responsibility for marketing crop inputs and agronomic services at the respondent firms are presented.

Sample Demographics

The responding sample was 55% (11) agricultural cooperatives, 40% (8) privately owned, independent retailers, and 5% (1) publicly owned retailer for a total sample of 20. For the purpose of comparative analysis between firm types, the public firm's responses were aggregated with those of independents. While publicly traded, the firm's retail operations were of modest size and the firm's overarching goals were similar to those of independently-owned retail operations. Detail on the sample is presented in Attachment C.

Primary Results of Web-Based Survey

Market Segmentation

Participants were asked to respond to the following definition and question:

A market segment is a specific group of customers who share unique needs, desires and identifying characteristics. Target marketing involves identifying these groups of customers and then selecting segments to target with a marketing program tailored to each segment's unique needs. Do you segment customers in your firm's marketing strategy?

Seventeen of the twenty (85%) crop input retailers responded 'yes' to this definition/question. The three retailers (15%) who responded 'no' included one independent and two farmer-owned cooperatives. The succeeding discussion of survey questions hinges on the assumption that a market segmentation strategy was employed. Therefore, responses for the retailers who answered 'yes' to segmenting their customers were analyzed separately from those who answered 'no.'

Database Support

Market segmentation is an activity that requires extensive data on customers and/or prospects. Participants were asked to rate the effectiveness of their electronic database on its ability to support their market segmentation strategy on a scale of 1 (ineffective) to 5 (highly effective), or 6 (not applicable). For those retailers who segmented customers (17), the mean effectiveness of their electronic databases as a support tool was 2.38 on average. The most frequent response was an effectiveness rating of 2 on the five-point scale.

The relatively low mean effectiveness rating of these retailers' electronic databases could have several explanations. It may imply that the retailers' electronic databases are less effective (mean < 3.00) at supporting a market segmentation strategy because:

- They do not contain pertinent information useful for supporting a market segmentation strategy.
- The information tracked in the electronic databases would be useful in supporting a market segmentation strategy, but the firm lacks the expertise/experience to put this information to work, and therefore the database is found less effective as a support tool.
- They track the data in some non-electronic form.

Retailers' responses regarding information tracked on key accounts support the first explanation. Customer information such as profitability per account, customer specific business goals and information on use of competitors' products/services were electronically tracked for low proportions of key accounts relative to traditional categories such as name, address, and phone number, custom application acres and customer specific sales/purchase history.

Challenges to Market Segmentation

Retailers were asked to rate a series of 11 challenges that could contribute to a breakdown in the implementation of a market segmentation strategy (Table 2). The challenges were rated on a scale of 1 (was an easily surmounted challenge;

insignificant challenge) to 5 (challenge served as a significant barrier to implementation; very significant challenge), or 6 (not applicable). These challenges were grouped into four sub-categories: knowledge/information/data challenges (K/I/Dc); staff/human capital challenges (Sc); market challenges (Mc); and general challenges (Gc).

Table 2: Challenges to Implementation of Market Segmentation Strategy

Challenge	Sub-category	Overall Mean	Independent	Co-op	F-test	Chi-squared	Number
Lack of practical guidance on what elements are necessary for a successful market segmentation strategy	K/I/Dc	3.56	4.14	3.11	3.31*	5.16	16
Lack of evaluation criterion for market segmentation strategy (no way to determine effectiveness, measure benefits, or success)	K/I/Dc	3.13	3.50	2.89	0.72	2.50	15
Obtaining data, or data quality (customers resistant to share information)	K/I/Dc	2.94	2.57	3.22	1.10	2.32	16
Expensive and/or time consuming	Gc	3.25	3.29	3.22	0.01	0.97	16
Benefits to a market segmentation strategy are unclear/not proven	Gc	2.71	2.63	2.78	0.05	0.94	17
Inability to tailor bundles to fit individual market segments	Sc	3.19	4.14	2.44	8.33**	7.53	16
Limited access to marketing expertise to develop and/or execute a market segmentation strategy	Sc	3.13	3.86	2.56	5.47**	6.33	16
Inexperienced managers (lack expertise incorporating market segmentation strategy into the firm's marketing/strategic plan)	Sc	3.06	2.43	3.56	5.02**	7.33	16
Resistance to change (sales staff and sales managers)	Sc	2.94	3.00	2.89	0.05	2.82	17
Too much variation across market for any market segmentation strategy to work	Mc	2.81	3.29	2.44	1.41	2.59	16
Rapidly changing market environment (market segments become obsolete quickly)	Mc	2.67	2.50	2.78	0.17	1.67	15

* Differences statistically significant at 90% confidence level

** Differences statistically significant at 95% confidence level

Cooperatives rated the implementation challenges much differently than did the independents (Table 2). Their highest mean rated challenge was inexperienced managers (lack expertise incorporating market segmentation strategy into the

firm's marketing/strategic plan) (Sc); the independents' lowest mean rated challenge. Interestingly the cooperatives highest mean rated challenge was 3.56, with seven of the challenges rated at 3.00 or less on average. Because cooperatives' rated seven of the challenges lower on average than those of independents, the results suggest that cooperatives in this sample have/had a less challenging experience implementing a market segmentation strategy relative to independents. None of the highest (top 3) mean rated challenges were shared by cooperatives and independents alike.

Benefits to Market Segmentation

The final question of the web-based survey addressed the benefits of a market segmentation strategy (Table 3). In the same fashion as with the challenges, retailers were asked to rate a list of nine benefits on a scale of 1 (realized little or insignificant gain) to 5 (realized significant gain), or 6 (not applicable), or 7 (don't know).

Table 3: Mean Ratings for Benefits of Market Segmentation

Benefit	Overall Mean	Independent	Co-op	F-test	Chi-squared	Number
Identification of highest value market segments	4.25	4.57	4.00	3.15*	2.96	16
Increased sales/ market share	4.00	4.13	3.89	0.16	2.76	17
Improved efficiency when serving customers (resource allocation, cost savings)	3.94	3.86	4.00	0.08	0.09	16
Improved competitive position	3.88	3.86	3.89	0.00	4.26	16
Increased cross-selling opportunities	3.82	4.00	3.67	0.21	2.45	17
Improved firm profitability	3.81	4.43	3.33	5.64**	6.81*	16
Insights into new product/service offerings	3.71	3.63	3.78	0.05	5.30	17
Elimination of products/services which do not create customer value	3.29	3.50	3.11	0.39	2.68	17
More accurate forecasts (future market trends)	3.27	3.00	3.44	0.76	5.63	15

* Differences statistically significant at 90% confidence level

** Differences statistically significant at 95% confidence level

Independents considered identification of highest value market segments, improved firm profitability, increased sales/market share and increased cross-selling opportunities to be benefits of increased importance (mean ≥ 4.00). Among these same four benefits, cooperatives found only identification of highest value market segments to be of increased importance (mean ≥ 4.00). Elimination of products/services that do not create customer value was rated as the least important benefit on average by cooperatives. Independents shared a similar opinion, rating this benefit second to least important.

Primary Themes of Telephone Interviews

Step 1: Market Segmentation Identification

Overall, 17 (85%) retailers identified market segments within their respective market areas. Retailers recognized a variety of characteristics that uniquely defined their market segments. Many of these characteristics were also acknowledged by Kotler and Keller as “major [market] segmentation variables.” Major market segmentation variables reflected throughout retailer interviews included geographics (e.g. by location/outlet); demographics such as age, occupation (e.g. off-farm job), and generation (e.g. father and son within same operation); psychographics, or personality traits (e.g. innovative/progressive, traditional, loyal, professional); and behaviors such as user status (e.g. custom application versus farmer applied crop inputs), usage rate (e.g. proportion of business done by crop input category: fertilizer, crop protection chemicals, seed), and loyalty (e.g. high level of loyalty evaluated by consecutive years of retailer/farmer relationship). No single unifying set of characteristics (demographics, psychographics, behaviors) was used across the sample of retailers to segment their markets. Rather, various combinations of geographics, demographics, psychographics and behaviors were used by these retailers to define unique market segments. Market segments based on acreage operated had no consistent size across the retailers’ different market areas.

A second tier of market segments (sub-segments) were identified by seven retailers. Bases for sub-segmentation include: service level required; off-farm employment and; transactional differences, like where the product was purchased, bulk quantities, or shipment details; and buying behavior. Sub-segmenting does not imply increased effectiveness of the market segmentation process; it simply indicates another level of complexity and illustrates the types of sub-segments formally acknowledged during the interview process by retailers in this sample.

The most consistently recognized segment, regardless of whether business was transacted with that segment, was a price/economic buyer segment. Every interviewee expressed the price/economic buying behavior as a characteristic of a market segment (e.g. no-service, mega grower, cash and carry).

Other commonly identified market segments included a “relationship segment” (7), a “business segment” (4), and a “technology segment” (4). An aggregate description from the retailers who identified these segments is transcribed:

“Relationship: Long-time customers, loyalty transcends salesman, less price sensitive than other segments, desires more traditional product/service offering.

Business: Analytical, must show added value that service provides, prefer sales appointments, more price sensitive than a relationship customer, conversations revolve around specific business topics only.

Technology: Desires efficiency, desires precision services like VRT fertilizer application, data management of yield data, desires latest seed technologies/traits, lack labor (time and expertise) to support these services, more opportunities relative to other segments to provide services.”

Two of the three firms which did not segment their markets were cooperatives. The most formal set of market segments belonged to an independent whose segments were first identified by acreage, and then sub-segmented based on price, business or relationship buying behavior. A tertiary level technology segment was identified within the mid-sized relationship buyer sub-segment.

Step 2: Market Segment Attractiveness

Market growth, competitive intensity and market access are measurable and/or observable across most markets (Best 2004). Best suggests these commonly observed market characteristics be used to evaluate a particular market segment’s attractiveness, arguing that a market segment assessment using these measures combined with an evaluation of segment profitability will determine which segments a firm should pursue with a tailored offering and positioning strategy. This framework encourages the firm to place a priority on market segments meeting and/or excelling with respect to these measures.

In contrast, market growth, competitive intensity and market access were rarely cited as ways in which retailers prioritized their market segments. Three of 17 retailers said that they did not prioritize their market segments, while an additional pair of retailers admitted that prioritizing market segments based on attractiveness was an area of weakness for them.

Analysis of the retailers’ ways of measuring segment attractiveness and prioritization revealed an important gap in the market segmentation process. While attractiveness measures including market growth (future customer growth through acquisition) (3) and market access (organizational fit) (2) were cited,

competitive intensity was never cited as a measure used to prioritize market segments. Interestingly, retailers in this sample are aware of competitive intensity in their respective market areas, responding most frequently that retail capacity to provide agronomy products and services was somewhere between 1% to 50% greater than farmers' needs in their respective market areas.

Although market growth rate was not cited by retailers as a segment attractiveness measure, it was considered in the context of which customers will continue becoming larger through acquisition, and therefore operating a greater number of acres. One retailer stated:

"I can say all kinds of things like, [market segmentation is] going to lead to a deeper long term partnership, I think its going to create this -- going to create that, but the reality is [prioritization] still comes back generally to business growth."

An important gap between theory and practice appears to be evaluating segment attractiveness with a multi-faceted (market size, market growth rate, and market growth potential concurrently) approach and then determining which segments to target based on these measures.

Step 3: Market Segment Profitability

Best states that "although market attractiveness of a segment may be acceptable, a business may elect not to pursue that segment if it does not offer a desired level of profit potential." Therefore, retailers were asked if they determined the potential profitability of each of their market segments, and if so how they measured that profit. The most common response was that firms do not determine each market segment's profitability (14). Of retailers who responded this way, 2 acknowledged the desire to become more sophisticated in this area as illustrated by the following quotation:

"I'd like to tell you we've got a great information system that dices these customers up for us and tells us exactly how much we are making on each one and what segment they bucket into. Unfortunately, I feel we've got a weakness in being able to specifically track some of the activities of these customers. I think the reality of it is that it's more of a generality that we do see the revenues being driven, or the margins we are able to capture by being able to tie up that customer with the services of a salesperson as compared to what margins are out there when you talk about purely a price conscious buyer."

One retailer supplemented his response indicating that instead of measuring potential market segment profitability his firm focused on determining individual customer profitability of their key accounts (20% of customer base that comprises

80% of business). The remaining retailers (3) responded yes to the question of measuring segment profitability. As mentioned previously two retailers expressed that their attempts to measure potential segment profitability were a work in progress. Only one retailer provided a precise explanation of how, and what measurements/tools were used to determine potential segment profitability within his firm. A description of the measurements and tools used by this respondent follow:

The Profit Calculator: Microsoft Excel spreadsheet developed in conjunction with an outside consultant that determines profitability per customer.

Lifetime value number: takes into account the customer's remaining active years in farming and then relates a profitability figure over that time period.

A proprietary customer information database management system supported through a supplier that tracks sales by individual customers per input category. including:

- Services (e.g. custom application)
- Micronutrients
- Crop nutrients (N-P-K)
- Crop protection chemicals
- Seed

As evidenced through interview responses, it appears that the information and accounting systems to track market segment profitability have not reached an adequate sophistication level in at least two of these firms. This might be attributed to the size of the firm and subsequent available resources. Again, this sample of crop input retailers struggled to successfully complete this step in the market segmentation process. Eighty-two percent of the retailers who segmented their markets did not evaluate the potential profitability per market segment. This illustrates an important area for improvement within this group of retailers.

Step 4: Segment Positioning

The next step in the market segmentation process is positioning, which involves creating a value proposition and positioning strategy for each target segment. A value proposition ideally, "should be built around the needs/desires by a target customer" (Best 2004). The second element is creating a product-price positioning strategy based on the segment's unique needs and characteristics (geographics, demographics, psychographics, behaviors)" (Best 2004). This step was addressed with the question: How do you create a tailored offering for each market segment?

Seven retailers described creating tailored offerings based on the needs of their customers in all identified market segments. An additional 8 retailers cited ways in

which their offerings could vary (product price breaks on volume purchased, product price terms based on mode of shipment, service level, financing, etc.), but did not relate a specific tailored offering to any particular market segment. The remaining retailers (2) did not create a tailored offering for their market segments as evidenced by this quotation:

“I can’t say as there is any segment that is tailored [to]. Our number one concern would be treating everybody equal. Every customer no matter how much they farm is important to our business.”

Only seven retailers created a tailored offering and then developed a product-price positioning strategy directed at each of their market segments. This finding points to another gap in the market segmentation process. Fifty-nine percent of the retailers who segmented their markets in this sample could improve upon execution of their tailored offering product-price positioning strategy. This finding is consistent with the way in which retailers rated the challenges to implementation of a market segmentation strategy in their survey responses. Inability to tailor bundles to fit individual market segments was rated as being an important overall (mean = 3.19) challenge to implementation of a market segmentation strategy.

Step 5: Segment “Acid Test”

The segment “acid test” proposed by Best hinges on the idea of presenting a set of tailored offerings in association with their respective product-price positioning strategies to a small sample of potential customers in the market. If the strategy (i.e. tailored offering in conjunction with positioning strategy) is successful, the majority of the test customers will select the tailored offering/positioning strategy created for them (Best 2004). Because this method represents only one of many ways to gauge acceptance of a tailored offering/positioning strategy from the market, an open question was asked of retailers: Do you have a formal way of gauging the receptiveness of a tailored offering before its introduction into the market?

Seven retailers had no formal way to gauge the receptiveness of a tailored offering before its introduction to the market. Methods used to assess this by the remaining retailers included: a test market by location/outlet, or by a small group of target customers (4), presenting the offering to a small group of target customers individually (4), and talking with a small group of target customers in a round table format collectively (2).

This lack of fulfillment could be directly related to the performance of the previous step which involved creating a price-product positioning strategy for each market segment. The inability to tailor bundles to fit individual market segments,

indicated with a mean response of 3.19, could partly explain this breakdown in the market segmentation process.

Step 6: Marketing-Mix Strategy

“A major cause of failure is ineffectively executing the market segmentation strategy. To be successful, the market segmentation strategy needs to be expanded to include all elements of the marketing mix, including place (sales strategies) and promotion (communications)” (Best 2004).

Retailers were asked to explain steps taken to communicate a new tailored offering to sales staff, and then articulate how its intended implementation was ensured through sales staff. Retailers responded to this question in a variety of ways, but common themes were noted among responses. These common themes included: general sales staff meetings occurring on a regular basis (weekly, monthly) (5); involving the sales staff from ground zero in development of a new tailored offering through sales/administrative staff meetings (4); a third party and/or internal sales training effort (3); and general sales staff meetings occurring on an as-needed basis (2). Three retailers reported doing little in the way of communicating new tailored offerings to sales staff.

Of the 17 retailers who segmented their markets, 6 cited specific ways in which they ensured implementation of marketing strategies by sales staff. Common responses included: established a special resource team comprised of senior level agronomists/sales management/general management and made sales calls as a team with junior salesman to monitor progress (2); sales management specifically follows-up with individual salesman (2); aligned sales staff with the segment/customer their capabilities allowed them to best serve (1); and management delivered a consistent message to sales staff so that marketing strategies were presented in the same fashion from location to location (1). Two retailers admittedly said that they were not sure how to ensure implementation, noting that implementation of marketing strategies was flexible per location. One of these retailers stated:

“That’s the million dollar question! We have always allowed quite a bit of autonomy to our lead field people in terms of adapting their style to their marketplace, to their customers’ personalities, etc. ... We don’t have a way to sit down on top of people and say ‘you will follow this exactly’. That’s just not been our style and culture inside the business. So, we’ve tended to let people take this to market. What happens then is that the personality of the individual presenting the program takes over, and in many cases the offering takes on the shape and form of how that individual views it.”

In order to evaluate if retailers' market segmentation strategies encompassed the complete marketing-mix, a final question was asked regarding communication strategy. Retailers were asked if and how the communication strategy varied between market segments.

Eleven retailers responded that their communication strategy did vary between their respective market segments, while 6 did not. Common ways in which communication strategies varied was by: length of time spent personally communicating with a customer of a particular market segment (5); type of communication (direct mail, email, web-site) used with market segments (2); type of personal conversation conducted between salesman and customer of a particular market segment (e.g. more professional, or required prior preparation to prove value to customer) (3); a combination of time spent, products/services offered and type of communication (direct mail, email, web-site) used with market segments (1).

Step 7: Progress with Segments

The final step of the market segmentation process is to measure progress within the segments through customer satisfaction and/or broader measures of success.

Retailers were asked if their market segmentation strategy had a way to measure customer satisfaction within segments. None of the retailers reported having a way to measure customer satisfaction by market segment.

Retailers in the sample rated lack of evaluation criterion (no way to determine effectiveness, measure benefits, or success) for a market segmentation strategy as a challenge to implementation (mean = 3.13). This could explain the overwhelming lack of fulfillment of this step by retailers.

Challenges to Implementation of a Market Segmentation Strategy

Retailers that segmented their markets were asked to comment on significant, overarching challenges to implementing a market segmentation strategy within their respective businesses. Commonly cited challenges are compared and contrasted with mean importance ratings (refer to Table 1) from the web-based survey instrument for the respective challenges. .

Lack of practical guidance on what elements are necessary for a successful market segmentation strategy: One independent and 2 cooperatives expressed this challenge as an important barrier their firm had encountered through the process of incorporating a market segmentation strategy into their strategic plan. Accordingly, it was cited as an important (mean = 3.56) challenge by this group of retailers overall.

“You start with numbers (sales, volume, acreage) and you try to slice and dice your customer base and fit them into segments. That works somewhat, but the numbers don’t tell the whole story.”

Expensive and/or time consuming: Two independents and 2 cooperatives expressed this challenge as an important barrier their firm had encountered through the process of incorporating a market segmentation strategy into their strategic plan. Accordingly, it was cited as an important (mean = 3.25) challenge by this group of retailers overall.

“First and foremost time, and time with your sales people as a group, the time to implement something. Time is so limiting in this business.”

Inability to tailor bundles to fit individual market segments: Two independents and 1 cooperative expressed this challenge as an important barrier their firm had encountered through the process of incorporating a market segmentation strategy into their strategic plan. Accordingly, this was rated as an important (mean = 3.19) challenge by this group of retailers overall.

“Being able to create the offers that are distinguishably different and change the offers as needed. It gets really difficult to react in the marketplace very quickly when you have a broad [geography to cover].”

Limited access to marketing expertise to develop and/or execute a market segmentation strategy: Two cooperatives expressed this challenge as an important barrier their firm had encountered through the process of incorporating a market segmentation strategy into their strategic plan. This was rated an important (mean = 3.25) challenge by this group of retailers overall. Interestingly, this was rated as an important (mean = 3.86) challenge by independents, yet none of the independents’ interview responses reflected this particular challenge. Conversely, cooperatives rated this challenge as unimportant (mean = 2.56), yet one clearly reflected this challenge through the quotation below.

“The first challenge is discipline. Our structure has been one that we can charge a higher price and provide very high levels of service but we haven’t been as good at charging a lower price and then providing the appropriate lower level of service. The guys want to fall back into that ‘we’ll give you a pump and meter because we love you’ kind of thing.”

Resistance to change from sales staff and sales managers: Two independents and 4 cooperatives expressed this challenge as an important barrier their firm encountered through the process of incorporating a market segmentation strategy into their strategic plan. Overall, this was rated as an unimportant (mean = 2.94)

challenge by this group of retailers. Unexpectedly, the challenge was reflected in retailers' responses most frequently (6) out of all other challenges.

“More important [than any other challenge] is the culture of your company and how you've approached servicing customers and managing relationships for years and years. People that have always done it, and fundamentally believe there is a right way to do it, and have done it that way for a long time are difficult to move to a different mindset.”

Rapidly changing market environments (market segments become obsolete quickly):

Three independents and 2 cooperatives expressed this challenge as an important barrier their firm had encountered through the process of incorporating a market segmentation strategy into their strategic plan. Overall, this was rated as an unimportant (mean = 2.67) challenge by this sample of retailers. This challenge was also rated least important, yet was illustrated by the second highest frequency (5) of retailers' quotations from interview responses.

“The dynamics of our marketplace are changing so quickly that it gets really hard and cumbersome to spend the amount of time it takes to get [market segmentation] done with the multiple roles that most of us play.”

Information systems to manage data for market segmentation strategy support:

Three cooperatives expressed this challenge as an important barrier their firm had encountered through the process of incorporating a market segmentation strategy into their strategic plan. This represents a challenge not captured by the web-based survey instrument. It highlights a barrier to the successful implementation of a market segmentation strategy experienced by 3 retailers that segmented their respective markets.

“Trying to manage multiple offerings and manage the information; to blend [tailored offering information] into our accounting systems. It's difficult when you are doing different things for different customers at different times. To keep your arms around all those different offerings [is challenging].”

Customer resistance to change (alienate customers who do not participate): Two independents and one cooperative acknowledged this challenge as an important barrier their firm had encountered through the process of incorporating a market segmentation strategy into their strategic plan. Although closely related to the implementation challenge regarding resistance to change found in the survey, the resistance here is on the customer's behalf rather than the retailer's sales staff. This highlights a barrier to the implementation of a market segmentation strategy experienced by 3 retailers that segmented their markets.

“One of the most significant things we encountered to start with is that you are beginning to do something your customers have never seen before. Because it’s different, and depending on how you are segmenting out there, you are going to have a percentage of your customers that don’t like it. It’s not the way it has always been done. And that puts some [customer] relationships at risk.”

Four of the 6 highest mean rated challenges on the survey were expressed in retailers’ interview responses, while 2 were never mentioned. Lower mean rated challenges from the survey that were reflected in retailers’ responses included resistance to change by sales staff and sales managers, and rapidly changing market environments (market segments become obsolete quickly).

Benefits Resulting from a Market Segmentation Strategy

Similar to implementation challenges, retailers were asked to comment on important overarching benefits that they believed their firm had realized as a result of implementing a market segmentation strategy. Commonly cited benefits are compared and contrasted with mean importance ratings (refer to Table 2) from the web-based survey for similar benefits.

Overarching benefits from a market segmentation strategy cited by retailers who segmented their markets included improved profitability (6) and increased sales/market share (6). These were the only benefits from the survey that were directly reflected in retailers’ interview responses.

The following quotations from responses to the benefits resulting from adoption of a market segmentation strategy illustrate one or more of the additional benefits not identified specifically through the survey instrument:

“I don’t think there’s any doubt if you don’t address the needs of each [market segment] then it’s pretty hard to sustain or grow your business. We’ve recognized what the needs and desires are of each one of those segments, or we wouldn’t continue to sell that particular customer grouping.”

“We have less price issues with [our] customers as we are showing the value [of our offerings], so I believe bottom-line performance is affected. And then, when you start to build a better relationship with [customers] you also get the opportunity to talk about other [sales opportunities]. I think we spend more valued time with customers through this whole process. It allows us to prioritize our time spent with customers and it’s probably not to the full extent that I’d like it to be done, but I see that process continue to evolve, improve.”

Based on survey results, the overall mean ratings for the benefits resulting from adopting a market segmentation strategy were all important (mean > 3.00).

Retailers directly cited two of these benefits in their interview responses: improved profitability and increased sales/market share.

A host of other specific benefits commonly cited by retailers included: identification of customers' needs/desires; stronger/deeper customer relationships; improved job quality of the sales position; improved pricing discipline by sales staff; helped sales staff establish priorities (e.g. time allocation); and identification of which customers not to serve (fire a customer). Identification of highest value market segments was the highest mean rated benefit based on survey responses. While never directly cited during retailers' interviews, direct quotations from responses to other questions of the telephone interview support this survey finding.

Summary and Conclusions

The results of this study may not be generalizable to all retailers. However, the observations and conversations with this group of twenty independent and cooperative retailers taken from the list of Top 100 retailers in the U.S. provide insight into some of the challenges of segmentation faced by retailers today. Table 3 (see Appendix A) maps the 17 firms who segmented their markets against the seven key steps of a market segmentation strategy as suggested by Best. Firm type is denoted by a 'C' for cooperative and an 'I' for independent. Steps which the firm executed are marked with an 'X.' Execution was evaluated based on telephone interview responses to questions that were specifically mapped against each of Best's descriptions of the seven key steps in a market segmentation process. Among the twenty retailers examined, two natural breaks in market segmentation strategy sophistication levels appear, leading to three distinct groups. Those characterized by successfully executing at least four of the seven steps were deemed to have a sophisticated/complete approach to their market segmentation strategy and are described as Full Strategy. Those that executed exactly three steps are considered to be of mid-level sophistication with their market segmentation strategies and are described as Partial Strategy. Lastly, those executing less than three steps had less sophisticated/incomplete market segmentation strategies and are described as Aware Only.

Table 4 (see Appendix B) summarizes the common themes from interview responses for each of the key steps, highlighting the similarities and differences among sophistication/ completeness levels. The sample is divided into three sophistication/completeness levels as described previously in the discussion of Table 3. The high-level group consisted of two cooperatives and one independent. The mid-level group was comprised of three cooperatives and two independents. The low-level group contained five independents and four cooperatives.

Implications for Agribusiness

The key gaps identified in these retailers' market segmentation strategies reveal opportunities to improve current market segmentation strategy execution. While these results may not be generalizable to all firms, other small to mid-sized crop input retail firms may share similar challenges.

Implementing a successful market segmentation strategy begins with identifying segments. Based on a definition of farmer segments as a specific group of customers who share unique needs, desires and identifying characteristics, most retailers in this study indicate that segmentation strategy plays a role in their marketing efforts. . In recognizing the specific needs of segments, the full strategy implementers in this study may have the ability not only to identify commonalities, but differences in needs that allow for clearer positioning. Those who merely identified segments based on demographic characteristics may lack clarity necessary to complete additional steps in the segmentation process.

To address the gap in evaluation of market segment attractiveness and profitability, information systems need to be developed/utilized which have the ability to account for complex and diverse tailored offerings. Because these retailers cited difficulty in tracking activities (costs) associated with providing these services, small to mid-sized crop input retailers require solutions to assign costs to these activities. Subsequently, this would aid in retailers' ability to track profitability by market segment.

Sales training programs for sales management and sales staff alike must be developed to emphasize the importance of market segmentation/target marketing strategy in practical application. Acquiring employee buy-in from all levels of the organization, especially from sales staff would help to ensure consistent, intended sales strategy implementation. Evaluation of a market segmentation strategy's success relies on this consistency. Training programs should also include guidance on adapting non-personal forms of communication to various market segments. This could help close the execution gap for those retailers who do not successfully execute on adapting the marketing-mix to their segment positioning strategy. Such training programs must be highly pragmatic – the issue is not a lack of intuitive understanding of market segmentation, the issue is translating this understanding into specific actions given the market realities faced by crop input retailers.

Finally, other tangible measures by which to track progress within market segments must be identified to provide retailers with a set of benchmarks by which to evaluate the success of their market segmentation/target marketing strategies. While customer satisfaction within market segments is generic, specific quantifiable measures such as acreage enrolled, acreage retained, or new acreage enrolled under a specific tailored offering may need to be tracked in order to effectively assess the

success of a new tailored offering. Additionally, if profitability per market segment were tracked accurately, it could be utilized to measure progress within market segments.

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Appendix A.

Table 4: Successfully Executed Key Steps in a Market Segmentation Strategy

Type	1. Segment Identification	2. Segment Attractiveness	3. Segment Profitability	4. Segment Positioning	5. Segment Acid Test	6. Marketing Mix		7. Segment Progress	Total
						Sales	Communication		
C	X	X	X	X	X	X	X		6
I	X	X		X		X	X		4
C	X	X			X	X	X		4
I	X			X	X		X		3
C	X	X		X			X		3
C	X			X	X		X		3
I	X			X	X				3
C	X				X	X	X		3
I	X			X			X		2
C	X	X				X			2
I	X				X*				2
I	X				X*				2
C	X				X*				2
C	X				X*				2
I	X						X		1
C	X					X			1
I	X								1
Total	17	5	1	7	10	6	9	0	

*Firm which did not create tailored offerings, but described a way in which an ‘acid test’ on generic offerings was performed prior to widespread market introduction.

Appendix B.

Table 5: Comparison of Market Segmentation Strategy Sophistication/Completeness Levels

Key Steps	Sophistication/Completeness Level		
	Low – Aware Only	Mid – Partial Strategy	High – Full Strategy
1 Segment Identification	<ul style="list-style-type: none"> Demographics, personality traits and behaviors Tend to have 3 or fewer segments 	<ul style="list-style-type: none"> Identify on buying behavior, personality traits, or services needed 	<ul style="list-style-type: none"> Identify on buying behavior or services needed Sub-segments identified
2 Segment Attractiveness	<ul style="list-style-type: none"> Do very little segment attractiveness evaluation, if any Priorities based on level of retailer loyalty 	<ul style="list-style-type: none"> Tend to evaluate based on market share of input expenditure (volume of sales) or profitability 	<ul style="list-style-type: none"> Evaluate segments based on market growth and market access factors
3 Segment Profitability	<ul style="list-style-type: none"> Profitability by segment is not evaluated 	<ul style="list-style-type: none"> Evaluation is an intuitive exercise, emphasizing service revenues generating higher margins than product sales 	<ul style="list-style-type: none"> Evaluation is limited in general, an intuitive exercise emphasizing level of service revenues When done more formally, externally developed tools such as spreadsheets and customer sales databases are used
4 Segment Positioning	<ul style="list-style-type: none"> Tailored offerings are rarely created Positioning relies heavily on product instead of price Equal treatment of customers is emphasized 	<ul style="list-style-type: none"> Tailored offerings created and positioned with product/service bundle and price differentiation to all identified segments Difficulty expressed around price positioning; jeopardizing customer relationships because of price differentiation is generally a concern 	<ul style="list-style-type: none"> Tailored offerings created and positioned with product/service bundle and price differentiation to all identified segments

Table 5: Comparison of Market Segmentation Strategy Sophistication/Completeness Levels (Continued)

Key Steps	Sophistication/Completeness Level		
	Low – Aware Only	Mid – Partial Strategy	High – Full Strategy
5 Segment Acid Test	<ul style="list-style-type: none"> • Methods to evaluate the receptiveness of an offering exist within these firms • Because tailored offerings are not created, the tendency is to not perform the acid test 	<ul style="list-style-type: none"> • Typically test tailored offerings • Methods of personal communication with small groups of target customers and test market by location used equally among group 	<ul style="list-style-type: none"> • All but one firm tested tailored offerings • Personal communication with a small group of target customers collectively is the method used
6 Marketing Mix			
<i>Sales</i>	<ul style="list-style-type: none"> • Sales strategy is communicated to sales staff • Sales training is an emerging focus for this group • Rarely was a way to ensure intended implementation cited 	<ul style="list-style-type: none"> • Sales strategy is communicated to sales staff • Sales staff are formally trained • Rarely was a way to ensure intended implementation cited. 	<ul style="list-style-type: none"> • Sales strategy is communicated to sales staff • Sales staff are formally trained • Intended implementation of the sales strategy is ensured through periodic follow-up by sales managers and/or team selling
<i>Non-Personal Communication</i>	<ul style="list-style-type: none"> • Varying communication strategy from segment to segment rarely occurred within this group 	<ul style="list-style-type: none"> • Communication strategy differs between segments • Common differences in strategy were time spent personally communicating and type of conversation that took place • Some use different non-personal communication approaches 	<ul style="list-style-type: none"> • Communication strategy differs from segment to segment • Common differences include time spent personally communicating, type of communication, and information services provided • Some use segment-specific non-personal communication approaches
7 Segment Progress	<ul style="list-style-type: none"> • No ways to measure progress within segments 	<ul style="list-style-type: none"> • No ways to measure progress within segments • Some use of surveys to measure customer satisfaction 	<ul style="list-style-type: none"> • No ways to measure progress within segments • Some use of surveys to measure customer satisfaction

Appendix C. Zoomerang Web-Based Survey

Market Segmentation Practices of Crop Input Retailers (Questions marked with an asterisk (*) are mandatory.)

1. *What is your primary position/area of responsibility within your firm?
(check one)

- Owner/general manager
- Branch/location manager
- Departmental manager (agronomy, marketing, etc.)
- Precision/application manager
- Technical consultant/agronomist
- Sales/sales management
- Other, please specify

2. *Is your firm a: (check one)

- Privately-owned (non-cooperative, independent) retailer
- Cooperative retailer
- Retail joint venture of a private/public firm and a cooperative
- Other, please specify

3. *Approximately how many TOTAL retail crop input locations does your firm operate? (enter TOTAL number of RETAIL locations)

_____ Number of locations open year round

_____ Number of ADDITIONAL locations open only part of the year

4. *What is the geographic scope of your total firm's RETAIL crop input market territory? (check appropriate response)

- Regional (multi-state)
- Within a single state (indicate state here)

5. If you selected REGIONAL (MULTI-STATE) in the previous question, please check all the regions in which your firm operates.

- Northeast (CT, DE, ME, MD, MA, NH, NJ, NY, PA, RI, VT)
- Appalachian (KY, NC, TN, VA, WV)
- Southeast (AL, FL, GA, SC)
- Delta States (AR, MS, LA)
- Lake States (MI, MN, WI)
- Corn Belt (IL, IN, IA, MO, OH)

- Northern Plains (KS, NE, SD, ND)
 - Pacific (WA, OR, CA)
 - Southern Plains (OK, TX)
 - Mountain (CO, WY, UT, ID, MT)
 - Southwest (AZ, NV, NM)
6. *What were the total retail sales of crop inputs (fertilizer, crop protection chemicals, seed, and services) sold directly to farmers for your TOTAL FIRM in fiscal 2006? (check one)
- None
 - Under \$15 million
 - \$15 – under \$25 million
 - \$25 – under \$50 million
 - \$50 – under \$100 million
 - \$100 million - \$1 billion
 - Over \$1 billion
7. *Your firm's lines of business (es) are: (check all that apply)
- Petroleum (fuel, lubricants, etc.)
 - Grain merchandising (storage, marketing, etc.)
 - Feed/animal nutrition products
 - Agronomy (crop protection chemicals, fertilizer, seed, agronomic services)
 - Other, please specify
8. *Does your firm provide custom application of fertilizer or crop protection chemicals or custom seeding?
- No → go to Question 12
 - Yes → continue with Question 9
9. *In fiscal 2006, approximately how many TOTAL ACRES did your firm custom apply for its growers (fertilizer, chemicals, seeding – TOTAL ACRES including multiple applications)? _____
10. *In fiscal 2006, approximately what proportion of your firm's TOTAL fertilizer sales were custom applied by your firm? _____
11. *In fiscal 2006, approximately what proportion of your firm's TOTAL herbicide/pesticide/fungicide sales were custom applied by your firm? _____
12. *In which of the following ways does your firm use precision (site-specific) technology? (check all that apply)

- Soil sampling with GPS
- Soil electrical conductivity (Veris) mapping
- Field mapping with GIS
- Yield monitor data analysis
- MANUAL controlled GPS (light bar), STANDARD RATE application of fertilizer, lime and/or chemicals
- CONTROLLER-driven GPS (auto-steer), STANDARD RATE application of fertilizer, lime and/or chemicals
- Controller-driven GPS, SINGLE NUTRIENT VARIABLE RATE application (fertilizer, lime, and/or chemicals)
- Controller-driven GPS, MULTIPLE NUTRIENT VARIABLE RATE application (fertilizer, lime, and/or chemicals)
- Satellite/aerial imagery for internal firm purposes
- Agronomic recommendations based on GPS/GIS data
- Don't use precision technology

13. *In your opinion, how much (if any) 'excess capacity' currently exists in your firm's market area? When you consider the total crop input needs of all farmers in your market area (tons of product, application needs, etc.), what is your perception of the total amount of retail dealer capacity (your firm and all competitors) available: (check one)

- Capacity not adequate to serve farmers' needs
- Capacity about equal to farmers' needs
- Slightly more capacity than required (1% - 50%) to serve farmers' needs
- Considerably more capacity than required (51% - 100%) to serve farmers' needs
- More than double the capacity required (100% or more) to serve farmers' needs

14. *From your perspective, how would you rate your firm's performance in each of the following areas relative to the 'average' or 'typical' competitor in your market? Please rate your performance in each area on a scale of 1 (far below the average/typical competitor in your market) to 4 (about equal to the average/ typical competitor in your market) to 7 (far superior to the average/typical competitor in your market).

- Product prices
- Providing grower access to latest products and technologies
- Service prices
- Site-specific technology and service offerings
- Overall cost of doing business
- Customer relationships (individual attention, trust, loyalty, etc.)

- Convenience (hours of operation, location, ease of doing business, etc.)
 - Frequency of introduction of new services to growers
 - Sales force (technical knowledge, business savvy, communications skills, etc.)
15. *KEY accounts are customers of strategic importance due to their size or influence. Consider your KEY accounts to be those accounts that comprise 80% of your firm's TOTAL sales revenue. What is the (approximate) average acreage farmed (size) of your KEY accounts as defined here? _____
16. *What percentage of your TOTAL accounts make up 80% of your TOTAL sales volume (TOTAL sales and service revenue)? _____
17. *Based on the definition of KEY accounts above, for what percentage of your KEY accounts do you track the following customer data electronically?
- Name, address, phone number
 - Additional descriptive information (farm size, crop rotation, 1 and rented vs. owned, etc.)
 - Customer-specific sales/ purchase history
 - Soil test results
 - Application acres
 - Up-to-date email addresses
 - Customer-specific complaint history
 - Customer-specific sales calls/ personal contacts
 - Gross margins by account
 - Profitability by account
 - Customer specific business and/or personal goals
 - Information on use of competitor products, services
18. *A market segment is a specific group of customers who share unique needs, desires and identifying characteristics. Target marketing involves identifying these groups of customers and then selecting segments to target with a marketing program tailored to each segment's unique needs. Do you segment customers in your firm's marketing strategy? _____
19. *How effective is your ELECTRONIC database in supporting your market segmentation strategy? Please indicate the appropriate rating on a scale of 1 (ineffective) to 5 (highly effective), or select 6 (N/A=not applicable). _____
20. *What are the primary challenges/obstacles your firm has encountered in developing its market segmentation strategy? Please rate the following on a scale of 1 (was an easily surmounted challenge/obstacle) to 5 (challenge/obstacle served as a significant barrier to implementation), or select 6 (N/A=not applicable).

- Resistance to change (sales staff and sales managers)
- Expensive and/or time consuming
- Inexperienced managers (lack expertise incorporating market segmentation strategy into the firm's marketing/strategic plan)
- Rapidly changing market environment (market segments become obsolete quickly)
- Obtaining data or data quality (customers resistant to share information)
- Limited access to marketing expertise to develop and/or execute a market segmentation strategy
- Lack of practical guidance on what elements are necessary for a successful market segmentation strategy
- Inability to tailor bundles to fit individual market segments
- Too much variation across market for any market segmentation strategy to work
- Lack of evaluation criterion for market segmentation strategy (no way to determine effectiveness, measure benefits, or success)
- Benefits to a market segmentation strategy are unclear/not proven

21. *What are the primary benefits you feel your firm has realized as a result of implementing a market segmentation strategy? Please indicate the appropriate rating for the following benefits on a scale of 1 (realized little or insignificant gain) to 5 (realized significant gain), or select 6 (N/A=not applicable) or 7 (Don't Know).

- Identification of highest value market segments
- Improved firm profitability
- Improved efficiency when serving customers (resource allocation, cost savings).
- More accurate forecasts (future market trends)
- Insights into new product/service offerings
- Elimination of products/services which do not create customer value
- Improved competitive position
- Increased cross-selling opportunities
- Increased sales/market share

Appendix D. Telephone Interview Questionnaire

1. Describe the key customer segments that your organization has identified (key characteristics, needs/preferences). How is market (customer) segmentation done within your organization?
2. How do you prioritize key segments? Do you determine each segment's potential profitability? If so, how do you measure segment profitability?
3. How do you create a tailored offering for each segment?
4. Do you have a way of gauging the receptiveness of the tailored offering before its introduction into the market?
5. What steps do you take to communicate a new marketing strategy (tailored offering) to sales staff and then ensure its intended implementation through sales staff? How specifically do you train your sales staff to communicate new offerings to customer segments? Does the communication strategy vary between segments?
6. How has your market segmentation program affected sales management practices?
7. How has your market segmentation program benefited your organization?
8. Does your market segmentation program include a means to measure customer satisfaction within segments? What measures or methods are used?
9. What are the most significant challenges your organization has encountered (or continues to deal with) through the process of incorporating a market segmentation program into your marketing plan?

Appendix E. Detail on Sample

Independent Retailers: Common to all of the independent retailers were retail agronomy sales under \$1 billion. Non-diversified firms, those not offering products and services other than crop inputs (i.e. grain merchandising services) (4) ranged from under \$15 million to \$1 billion in retail agronomy sales with 75% (3) of non-diversified firms doing between \$15 million and \$50 million in annual retail agronomy sales. Those firms with lines of business in addition to agronomy (5) had retail agronomy sales from under \$15 million to \$100 million. Diversification within these four firms included grain merchandising (3), feed/animal nutrition products (3), micronutrients (1), propane/LP sales (1), ethanol production (1), turf and/or lawn care (1), rail car leasing and services (1), warehousing and distribution (1), and retail sales (hardware, plumbing, electrical, building supplies, unique specialty food, housewares, automotive supplies, pet supplies) (1). Market territories for these independent retailers were confined by a single state's bounds (5), a region (1) and multiple regions (2). Regions operated in included the Northeast (CT, DE, ME, MD, MA, NH, NJ, NY, PA, RI, VT), Appalachian (KY, NC, TN, VA, WV), Lake States (MI, MN, WI), Corn Belt (IL, IN, IA, MO, OH) and Pacific (WA, OR, CA). Crop input retail locations varied from 2 to 40 outlets. Titles of individuals interviewed included: owner/general manager (6), departmental (agronomy, marketing, etc.) manager (1), sales management (1) and regional business manager of retail operations (1).

Cooperative Retailers: Cooperatives shared the uniqueness of being owned by the farm customers they serve, their grower customers. Unlike the independents, every cooperative was diversified into at least one line of business in addition to agronomy. These lines of additional business included petroleum (fuel, lubricants, etc.) (8), grain merchandising (11), feed/animal nutrition products (9), propane/LP sales (1), turf and/or lawn care (1), precision-ag technology equipment (1), and crop insurance (1). Agronomy sales among these cooperatives ranged from under \$15 million to \$1 billion. Market territories for these cooperative retailers were confined by a single state's bounds (6), a region (4) and multiple regions (1). Regions operated in included the Lake States (MI, MN, WI), Corn Belt (IL, IN, IA, MO, OH) and Northern Plains (KS, NE, SD, ND). Crop input retail locations varied from 2 to 46 outlets. Titles of individuals interviewed included: owner/general manager (3), departmental (agronomy, marketing, etc.) manager (7), and account manager (1).



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Greene Gardens

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Abstract

The case describes the 2006 *E. coli* outbreak in the California spinach industry. The case unfolds over a period of about one month, with four separate eventful days described in detail. At the end of the narrative for each day, the reader is asked to decide how he or she would respond to the events and justify his or her decision.

Keywords: business ethics, communication, crisis management, spinach

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IAMA Agribusiness Case 12.1

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Greene Garden¹

(A) First Reports - Day 1

Sam Greene sat in front of his computer and read with alarm a news story indicating that the Food and Drug Administration (FDA) had issued a warning to consumers to avoid eating fresh bagged spinach. The report indicated that an outbreak of *E. coli* in eight states had resulted in the death of one person and the illness of 49 others (U.S. Food and Drug Administration, 2006a). The outbreak involved *E. coli* 0157:H7, a virulent strain that may lead to bloody diarrhea, dehydration, kidney failure, and, in rare instances, death. See exhibit 1 for additional information on *E. coli* 0157:H7.

Greene was a large grower of fresh vegetables headquartered in California's Salinas Valley. His company, Greene Gardens, produced broccoli, cauliflower, Brussels sprouts, cabbage, lettuce, and spinach on several ranches. He was a contract grower for a large processor, GRT Salads, which harvested about 80% of the product grown on his ranches and marketed the product under many labels. He sold the remainder of his produce to a smaller processor, Tossed Fresh, under a similar arrangement.

The Salinas Valley, located in Monterey County, is the largest producing area in the U.S. for fresh spinach. There were several major processors of fresh leafy vegetables located in Salinas Valley. GRT was one of the larger processors. It sourced product from several producers, with about 20% of its production coming from Greene Gardens. See exhibit 2 for a map detailing the location of the production areas and the reported illnesses.

The news story went on to report that the first reported case had occurred three weeks earlier. However, only recently did health officials determine that spinach was the likely problem. When patients are diagnosed with food poisoning, they are routinely interviewed to determine what they have eaten. The only food eaten in common by all of the patients affected by the recent *E. coli* outbreak was bagged fresh spinach. While tests on the product would be needed to determine if spinach was in fact the cause, no other products had been implicated. When asked whether consumers should avoid bagged salads, an FDA health official said that there was no information at this time to indicate that bagged salad was contaminated. Exhibit 3 provides information on food quality assurance in California and the U.S.

¹ The scenarios in this case are realistic and based on factual accounts. Although, the facts related to the *E. coli* outbreak in spinach mirror the actual outbreak and press releases, the firms discussed in the case are fictitious.

Questions

1. If you were Sam Greene, how would you respond to the first reports of contaminated spinach? Be specific as to the actions you would take.
2. What factors would you consider and how would you make your decision? To whom are your primary obligations?

(B) The Search Narrows – Day 9

Greene sat again at his computer and read an update from the FDA. The total number of cases of E. coli infection had risen to 166 people in 25 states (U.S. Food and Drug Administration, 2006b). See exhibit 4 for an updated map of the reported illnesses. The FDA was working closely with the Centers for Disease Control and Prevention (CDC) and the State of California to isolate the source of the outbreak. Information collected to date implicated fresh bagged spinach grown in three California counties, Monterey, San Benito, and Santa Clara. The statement went on to indicate that spinach grown in the rest of the U.S. had not been implicated. Furthermore, other produce grown in the three California counties had not been implicated. Health investigators were continuing to work to further narrow the source of the contamination.

To date, three companies had voluntarily recalled products containing fresh spinach, including GRT Salads. Because of the uncertainty surrounding the E. coli contamination in spinach, sales of bagged spinach throughout North America had virtually stopped.

Questions

3. How would you respond to this new information? Be specific as to the actions you would take.
4. What actions would you take regarding the spinach products you market through Tossed Fresh?
5. What actions would you take in regard to the other crops you produce?

(C) Processor Identified – Day 16

It was now 15 days since the first announcement by the FDA of contaminated spinach. Greene had become accustomed to checking his computer more frequently than was usual for him as he awaited the almost daily FDA update on the unfolding spinach crisis. Most of the statements simply updated the number of cases of E. coli contamination caused by fresh bagged spinach. However, today's statement was different. The FDA announced that all of the spinach implicated in this recent outbreak had been traced back to one processor (U.S. Food and Drug

Administration, 2006c), GRT Salads, the processor that bagged and marketed 80% of all of the vegetables grown by Greene Gardens.

The FDA made this determination based on laboratory findings of product samples. The analysis of 10 product samples in 8 states had confirmed the presence of a strain of *E. coli* O157:H7 (U.S. Food and Drug Administration, 2006c). All of these product samples had been processed by GRT Salads.

A total of 187 cases of *E. coli* O157:H7 infection due to fresh bagged spinach had been reported in 26 states and Canada. The contamination had been linked to one death (U.S. Food and Drug Administration, 2006c). See exhibit 5 for an updated map of the reported illnesses.

Although Greene was troubled that the FDA had pinpointed GRT Salads as the source of all of the contaminated spinach, he knew that they (GRT Salads) sourced product from many different growers. Furthermore, the FDA also indicated that the source of the *E. coli* contamination had not been traced to a specific field.

The latest statement said that “there has been a long history of *E. coli* O157:H7 outbreaks involving leafy greens from the central California region.” The statement went on to state that “... FDA and the State of California expect the industry to develop a comprehensive plan which is designed to minimize the risk of another outbreak due to *E. coli* O157:H7 in spinach grown in central California. While this plan is under development, FDA and the State of California reiterate our previous concerns and advise firms to review their current operations in light of the agency’s guidance for minimizing microbial food safety hazards,” (U.S. Food and Drug Administration, 2006c).

Questions

6. How would you respond to this new information? Be specific as to the actions you would take.
7. Given the increasing likelihood that the source of the contamination may be from Greene Gardens’ spinach, what would you do in regard to the other products you grow and to the fresh bagged spinach marketed through Tossed Fresh?

(D) Source Identified – Day 29

Today, Greene did not have to check his computer for an update on the spinach outbreak. He received a late morning call from an official at the FDA informing him that samples collected by California officials from a field on one of his ranches had tested positive for the strain of *E. coli* O157:H7 responsible for the recent outbreak.

The FDA suspected that cattle feces might be the cause of the contamination, but contaminated feces had not been found in Greene's field .

In a statement issued later that day, the FDA announced that they and the State of California were reporting laboratory results indicating that the strain of *E. coli* O157:H7 found in contaminated spinach had been found in four different fields on four ranches in Monterey and San Benito counties. The statement went on to say that "Samples of cattle feces on one of the implicated ranches tested positive based on matching genetic fingerprints for the same strain of *E. coli* that sickened 199 people," U.S. Food and Drug Administration, 2006d).

Questions

8. What actions would you take in response to the FDA and State of California findings?
9. How would you respond to the FDA and State of California statement that the industry should develop a plan to minimize the risk of another *E. coli* O157:H7 outbreak? What should be done to ensure the safety of processed produce in the future?

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processors have to ensure that the products they produce are safe is the reputation of their firms and brands, as well as the legal and financial liability they incur when they sell contaminated products.

Exhibit 4.

Map of Production Locations and Timeline of Reported Outbreaks, Day 9.

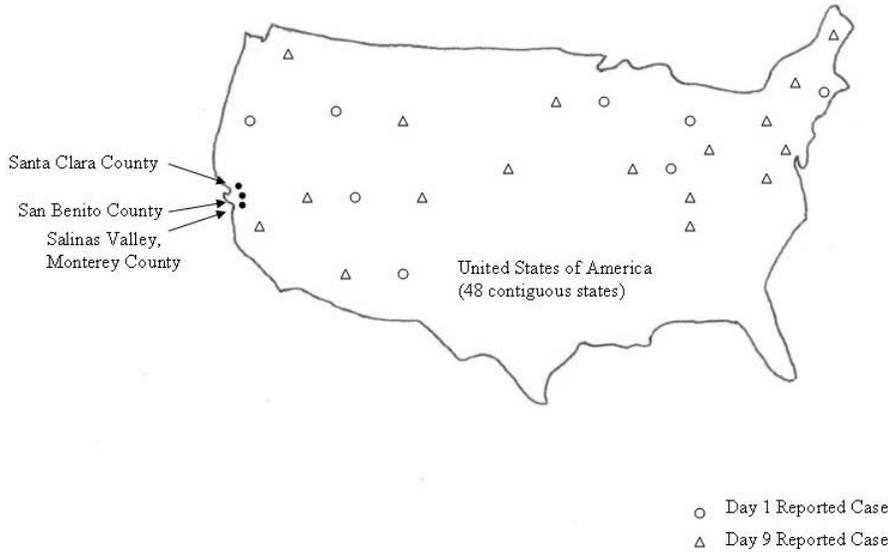


Exhibit 5.

Map of Production Locations and Timeline of Reported Outbreaks, Day 16.

