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THE POTATO SUPPLY CHAIN TO PEPSICO'S FRITO LAY

India

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SUMMARY

This study presents the supply chain developed by Pepsico's Frito Lay so as to purchase potatoes that are suitable for processing into crisps. Frito Lay in India supplies potatoes from small landholders. Because the quality requirements of Frito Lay for process-grade potatoes are very strict, the company has set up a network of agronomists and partnerships with other public and private service providers to help smallholder farmers produce potatoes that are suitable for processing. The service network that Frito Lay has organized for its suppliers contributes to reducing the risks faced by farmers. The production margins of potato farmers under contract with Frito Lay are also higher than those of farmers selling their potatoes to the traditional market. These are elements that contribute to retaining farmers from defaulting on their supply contract with Frito Lay despite the lack of enforcement mechanism for these contracts. This case study is also an organizational model of a private-public partnership to allow small farmers to link sustainably with a large agribusiness.

1. INTRODUCTION

Horticultural produce in India is largely marketed through traditional channels. A typical marketing chain for fresh produce consists of several players as shown in Figure 1. Typically, in the traditional supply chain where the produce of several farmers is aggregated, there is no premium for quality produce. Hence the farmer is not motivated to focus on quality issues. In recent years, with high private sector investment in processing, exports and retailing of horticultural produce, there is increasing emphasis on developing supply chains for quality produce. Quality specifications are important to meet the requirements for processing and export markets. Thus, companies have to be closely involved with farmers to ensure compliance with quality.

Figure 1: Traditional marketing chain for horticultural produce in India

Farmer → Consolidator → Wholesaler → Semi-wholesaler → Retailer

The objective of this study is to compare a group of farmers linked with a company, or organization producing high quality produce with a group of farmers operating through the traditional market, where both groups are producing the same agricultural commodity. Key aspects of the comparison between the two groups are:

- Quality of output;
- Productivity levels;
- Accessibility of inputs and production technology;
- Quality of inputs used;
- Price of output; and
- Price and production risks.

This paper studies the PepsiCo supply chain for manufacturing Frito Lay potato crisps through contract farming for potatoes in India. PepsiCo is one of the pioneers of contract farming in India since 2001. Their experience in contract farming has covered many crops: potato, basmati rice, tomato, chili, peanut, oranges and more recently sea weed. PepsiCo's operations in India started in the region of Punjab in collaboration with the State Government. PepsiCo India's project with the Punjab Agro Industries Corporation and Punjab Agriculture University remains one of the most ambitious contract farming projects in the country. The programme focuses on evolving agricultural practices to help Punjab farmers produce crops that would make Indian products internationally competitive (Commodity Online Special, 2007). Over the years the company has initiated contract farming in several states. The model for contract farming has also evolved over the years with experience and ground level interactions with farmers. Potato is the largest crop under contract farming to produce potato crisps for Frito Lay. The company is currently procuring potatoes from several states to meet its processing requirements.

Because PepsiCo was one of the first companies to introduce contract farming in India, much has been written about their experience with contract farming. Mostly these discussions have focused on the impact of contract farming on farmers. In this paper the approach is to look at the entire supply chain and to see how small farmers in India are involved in meeting international quality standards, and how this modern value chain differs from the traditional supply chain for the same crop.

The key input for this study was provided by direct interactions with company executives at various levels and interaction with contract farmers working with the company. Other sources of information include media press reports, secondary data and internet information. The rest of the paper is organized as follows. The next section gives an overview of the potato sector in India including production, consumption and exports. Before conducting a detailed supply chain analysis, a background of PepsiCo operations in India is presented in Section 3. Section 4 describes in detail the supply chain of potato crisps with a focus on food safety and quality issues. Section 5 presents a comparative analysis of gross margins and risks faced by PepsiCo contract farmers and farmers selling to the traditional market. Section 6 concludes with insights into the company's perspective on contract farming and lessons learned from this experience.

2. OVERVIEW OF THE POTATO SECTOR IN INDIA

India is placed third in the list of major potato producing countries of the world. It produces around 25 million tonnes of potatoes which contribute to approximately 8 percent of the world's total production. This crop is grown on 1.5 million hectares of land in India ranking fourth among the countries having a maximum area cultivated for potatoes. The yield rate per hectare in India is quite low, about 19 tonnes per hectare as compared with the productivity in the European countries which ranges between 30 and 40 tonnes per hectare.

Average yearly potato production in India ranges between 24 and 26 million tonnes. Three of the major producing regions are Uttar Pradesh, West Bengal and Bihar, accounting for about 72 percent of the national production (cf. Table 1). Other major producing states are Punjab, Gujarat, Madhya Pradesh, Assam and Karnataka. About 80 percent of the potatoes in India is grown in winter months (*Rabi* crop). In some states such as Karnataka, Maharashtra, Himachal Pradesh, and Jammu and Kashmir, the potato is planted during the monsoon season.

Table 1: Potato area and production in India

STATE	Area	Production	Yield
	('000 ha)	('000 tonnes)	(tonnes/ha)
Uttar Pradesh	440	9 822	22
West Bengal	321	7 107	22
Bihar	318	5 657	18
Punjab	73	1 470	20
Gujarat	43	978	23
Madhya Pradesh	52	783	15
Karnataka	60	603	10
Assam	73	589	8
Uttaranchal	22	448	20
Haryana	18	442	24
Orrisa	13	165	13
Maharashtra	17	163	9
Himachal Pradesh	14	152	11
Meghalaya	18	149	8
Chatishgarh	13	130	10
Jammu and Kashmir	7	117	17
Other	39	413	10
TOTAL	1 542	29 189	19

Source: Kumar et al, 2006

Regarding the consumption pattern, given the country's population size, most of the potato produced is consumed within the country. As a result, there is a very small quantity of the potatoes left for exports making India's share in world exports insignificant and inconsistent. India exports only around 0.5 percent of all the potatoes on the global market, equivalent to 72 000 tonnes. The importing countries are Sri Lanka, Nepal, Mauritius, Singapore, the United Arab Emirates and Japan. The imports of this crop into the country are negligible. Furthermore, the level of processing is also very low, since most of the potatoes are used as table potatoes.

Processors involved in crisp making and other forms of processing have to work closely with farmers to ensure specific variety and other requirements for satisfactory processing.

3. PEPSICO INDIA OPERATIONS

3.1. Overview of company activities

This section draws from the details about the company available online (www.pepsiindia.co.in). PepsiCo entered India in 1989 and is currently one of the largest food and beverage companies in the country. Export is a major part of PepsiCo's operations in India. At the time of entry into India, the company was obliged to earn at least 50 percent of its revenue from exports. The export obligation expired in 1993–1994; however, exports have continued to increase significantly over the years.

PepsiCo India's product range includes iconic refreshment beverages such as Pepsi, 7Up, Mirinda and Mountain Dew; low calorie options such as Diet Pepsi and 7Up Light; hydrating and nutritional beverages such as Aquafina drinking water, isotonic sports drinks like Gatorade, and fruit juices and juice-based drinks like Tropicana, Tropicana Twister and Slice. In the drinks segment, the brands specific to India include Lehar Everess Soda, Dukes Lemonade and Mangola.

PepsiCo's snack food company, Frito Lay, is the leader in the branded potato crisp market. It manufactures Lay's Potato Chips, Cheetos extruded snacks, Uncle Chipps and traditional snacks under the Kurkure and Lehar brands. The health food segment includes Quaker Oats and Lehar Lites, a low fat and roasted snack option. The health emphasis also extends to other Frito Lay core products; indeed, Kurkure, Uncle Chipps and Cheetos are cooked in rice bran oil to reduce saturated fats significantly.

3.2. PepsiCo's agricultural operations in India

Currently, about 26 percent of Pepsi's export turnover comes from processed agricultural products including basmati rice, peanut butter, tomato, chilly, garlic and ginger pastes. The company has been working with farmers in Punjab since the 1980s, initially pulping tomatoes in return for obtaining government permission to produce and sell its drinks in India. Pepsi introduced new varieties that have helped boost the state's tomato crop from 18 000 tonnes in 1988 to 300 000 tonnes in recent years.

Although no longer involved in tomatoes, PepsiCo had a five-year programme with the Punjab government to provide several hundred farmers with four million sweet orange trees for its Tropicana juices by 2008. It is also developing a seaweed crop for a food gelling agent on 4 000 rafts off the South Indian coast. The company has introduced Punjab farmers to high-yielding varieties of other crops such as basmati rice, mango, potato, chilli, peanut, and barley, which it uses for its Frito Lay snacks or sells to domestic and international buyers.

3.3. PepsiCo potato operations

PepsiCo has three potato processing plants in India located in Punjab (Sangrur), West Bengal (Sankrail near Kolkata) and Ranjangaon near Pune in Maharashtra. The production capacity at these three plants is approximately 10 000 tonnes for Channo in Punjab, 18 000 tonnes for Pune and 7 500 tonnes for Kolkata. Potatoes are currently procured from Punjab, Uttar Pradesh and West Bengal during the winter season and from Karnataka and Maharashtra during the summer months. The quantity of potatoes sourced under contract farming has risen from 2 920 tonnes in 2002 to 57 000 tonnes in 2007. Potatoes sourced under contract farming account roughly 55–58 percent of PepsiCo's total requirement (Bhattacharya, 2004). The company is currently working on extending the land area under potato in Jharkhand and Bihar.

In this study, the potato production site in West Bengal was explored because it is a traditional potato growing area, and it is interesting to see the difference between the traditional potato growers and PepsiCo contract growers.

The company has different models to link with farmers in different regions, depending on the socio-economic conditions of the particular location. The models used are working through co-operatives, NGOs or working directly with farmers. In West Bengal, the vendor model has been used. The vendor is the local person hired by the company as a liaison person between farmers and company. The vendor is accessible to the farmer as he stays in the vicinity. Farmers can approach him or her directly in case of any problem. The vendor in turn communicates the issue to the company experts. The vendor also ensures the availability of seeds and other inputs at the farm level and is involved in monitoring the crop along with the company agronomists. The West Bengal operations were initiated in 2003. This region has *Rabi* crop. The company currently undertakes contract farming with 1 800 farmers over 648 ha in West Bengal, procuring about 12 000 tonnes of potatoes. By 2010, the company intends to procure about 30 000 tonnes of potatoes from the state for Fritolay (Financial Express, 2008).

3.4. Potato crisp supply chain: food quality and safety issues

3.4.1. Processing and quality requirements

The quality parameters set in place through the chain are driven by the buyer requirements and specific requirements for processing. Potatoes grown in India for traditional use have high sugar content and fewer solids. Processing requires potatoes with no sugar content and high solids (between 15 and 20 percent). Apart from these requirements, the company is HACCP- and ISO-certified, which requires stringent quality control at all levels in the chain. Specific requirements are met by ensuring quality compliance at every stage, research and development, farming, storing, processing, and packaging. This section describes in detail the steps taken to ensure quality at every stage in the chain.

3.4.2. Research and development thrust areas

As mentioned above, potatoes required for making crisps, French fries and other fried products must have low sugar content to avoid browning of the finished product. The sugar content of potatoes is determined by the genotype and several pre- and post-harvest factors. The major preharvest factors affecting sugar content are crop maturity, temperature during growth, mineral nutrition and irrigation, while important post-harvest factors are mechanical stresses and storage conditions. Each genotype requires an ideal pre- and post-harvest treatment to maintain low sugar levels; any kind of stress results in sugar accumulations.

As most of the potatoes in India are used as cooking potatoes the most common variety grown in West Bengal is Kufri Jyoti, another major variety is Kufri Chandramukhi. Chipsona I, Chipsona II and Atlantic with low sugar and high solid contents have been introduced for processing purposes. Before introducing the varieties to the farmers, extensive trials of various varieties were undertaken. A package of agronomic practices suitable to the local agroclimatic conditions has also been developed in collaboration with the Central Potato Research Institute (CPRI). The package of practices developed includes specific fertilizer requirements and a spraying schedule.

3.4.3. Farm inputs

The company ensures the availability of inputs to farmers working in the area under contract. The vendor in the region ensures that the farmers falling under his or her supervision have all the

required inputs at the right time. In the case of Pune, farmers working with the company are given an input kit. Initially the kit is made available free of charge. In West Bengal, the company advises on the use of quality inputs. If the company provides inputs then the cost is deducted when potatoes are purchased from farmers. Seed potatoes of specific varieties for processing are provided by the company.

Apart from providing inputs, the company had also introduced crop insurance by the Agricultural Insurance Company (AIC) and weather insurance from ICICI Lombard. Generally, the transaction cost of insurance companies is high when dealing with many individual farmers. If the farmers are linked with a company, the transaction costs are significantly lowered. Hence the company was able to negotiate special premium rates with AIC for its contract farmers. Furthermore, clearance of claims is also much faster because of the company's involvement instead of each individual farmer dealing with the insurance company. The special premium rates negotiated with AIC are no longer available, but the company is exploring options with other insurance companies. Similarly, in Karnataka PepsiCo also created an institutional setup with the Shimla-based Central Potato Research Institute (CPRI), agro-chemical giant Du Pont and it provided weather insurance from ICICI Lombard General Insurance (Economic Times, 2007).

3.4.4. Farm production

In order to produce a specific variety of potato and to enhance productivity PepsiCo is very closely involved with its potato contract farmers. The company has employed a team of agricultural graduates, who work with the farmers to provide technical input and to monitor the production of the farmers in their specified area. One technical expert deals with approximately 100 farmers. The farmers reported that because of the technical information provided by company agronomists the use of chemicals and fertilizers is much more timely and effective.

A change from traditional practices of production management is crop spacing. In the traditional method row spacing is 46–51 cm and plant spacing is 10–13 cm but in the case of Frito Lay the distances between rows and plants are respectively 66 and 20 cm. This increased spacing helps to increase yield, reduce greening of potatoes, and reduces the share of undersized potatoes which cannot be used for crisp making.

The agronomists regularly monitor the fields at the time of planting, spraying, harvesting, etc. If there is expectation of an outbreak of any disease or pest, they inform the farmers about timely spraying. Any major problems are attended to in priority, with inputs from the company researchers if necessary. Regular scouting helps early identification of infestation by pests and diseases. This significantly helps to reduce crop loss. It is not only the PepsiCo contract farmers but all potato growers who benefit from early detection of diseases, which can be considered as a positive externality of the company's operations.

The general practice in West Bengal is to grow the potato crop after paddy. Early planting of potatoes leads to early harvesting of the produce, which fetches a higher price. To produce potatoes early, farmers are recommended to go for short duration paddy so that land is available for early potato cropping.

3.4.5. Harvesting and packaging

"Handle potatoes like eggs, not like stones" was the message the company agronomists were giving farmers. This statement conveys the care taken through the post-harvest management

process. Traditionally, jute bags have been used for packaging potatoes. Instead of jute bags, the company has propagated the use of plastic bags for packaging as it ensures better storage.

3.4.6. Grading and sorting

At the company's unloading dock, the potatoes are mechanically graded for size. Potatoes that are too small for processing are separated. There is also visual inspection for damaged potatoes. Test for sugar content is undertaken by frying a small sample from this lot. Potatoes with high starch content will turn red on frying. Sample tests are also undertaken for solid content. Potatoes that do not meet the requirements are rejected.

3.4.7. Storage

Critical factors in successful storage include variety, methods of culture, harvest, field curing, temperature and humidity control, storage and sprouting inhibition. Potatoes are stored at 12°C to control conversion of starch into sugar. At this temperature potatoes can be stored up to four months. Potatoes are also treated to limit sprouting.

3.4.8. Processing centre

The selected produce is taken to the processing plant and is subjected to washing and peeling. Peeled potatoes are subject to metal detection and inspection for physical damages and discolouration. Following this, the potatoes are run through rotating slicers and are subjected to deep frying.

The fried crisps undergo optical testing for colour. As mentioned earlier, rice bran oil is used for frying which significantly reduces saturated fat content. At the last stage the crisps are mixed with spices and packed. Thorough testing of inputs and packaging materials is also conducted. The plant has a well equipped quality testing lab.

3.5. Comparative analysis: PepsiCo contract farmers versus farmers selling to the traditional market

3.5.1. Gross margin analysis

Detailed information regarding production costs and value of output is presented in Table 2. Based on this, the gross margins for both the groups are calculated. The cost of production for PepsiCo farmers is INR74 574 per hectare whereas the same for farmers selling to the traditional market is INR62 466¹. The major difference in the production costs comes from the seed cost. In the case of traditional farming, the seed rate is lower as smaller tubers can also be used for planting. In the case of contract farmers the seed cost is higher because of the size of the seed potatoes and specific variety used. Finally the cost for agrochemicals is also higher for farmers under contract with PepsiCo.

The potato yield for contract farmers and non-contract farmers is 25–30 tonnes per hectare. For contract farmers 20–25 tonnes of the production can go as crisp grade, the rest is sold to the open market. PepsiCo announces prices before the beginning of the season. Different prices are announced for early crop, peak season and ending crop. In some cases where the farmers have closely followed the production practices of the company agronomists, the yields were as high as 44 tonnes/ha. The corresponding gross margins in this case can range from INR28 218 to 110 749 assuming 35 tonnes of crisp grade.

¹ At the time of study, US\$1 ≈ INR40

Table 2: Margin per hectare of potato for PepsiCo contract farmers and farmers selling to the traditional market

Cost of production (INR)	Crisp-grade potatoes	Potatoes for traditional market
Seed tubers (ATL)	39 535	29 652
Land Preparation	988	988
Fertilizer-NPK (100:60:80)	7 660	7 907
Irrigation	2 224	2 224
Labour	11 119	11 119
Agrochemicals	7 413	4 942
Gunny bags	3 163	3 163
Organic manure-FYM (1 tonne)	2 471	2 471
Total cost of cultivation per hectare	74 574	62 466
Yield (tonnes)	25–30	25–30
Yield for crisp grade (tonnes)	20–25	--
Market price INR/kg	3.6–6.4	2.8–5.5
Value of output (yield 25 tonnes and crisp grade 20 tonnes)	85 001–153 694	69 187–135 903
Value of output (yield 30 tonnes and crisp grade 25 tonnes)	101 310–185 322	83 024–163 084
Gross margin (yield 25 tonnes)	10 427–79 120	6 721–73 437
Gross margin (yield 30 tonnes)	28 218–110 749	20 558–100 618

It is obvious from the data in Table 2 above that gross margins for contract farming are higher than those of farmers selling to traditional markets. Further, in calculating costs, the loss of income due to lack of transparency in weighing and commission paid to the agents at the markets has not been considered here although these are factors which affect the income of non-contract farmers. Finally, several farmers would have borrowed money from traders to purchase their inputs. They often have to sell at a price lower than market price as an interest on the loan by the trader. In the case of Pepsico farmers, the company has a tie-up at national level with the State Bank of India to provide credit. These factors also have to be considered in assessing the impact of contract farming.

Table 3: Risk analysis of PepsiCo contract farmers and farmers selling to traditional markets

	PepsiCo contract farmers	Comparison of risk: increased (↑) minimized (↓) same (↔)	Farmers selling to traditional market
Weather- or drought-related risks	This risk is minimized as the company's extension agents are in touch with the farmers. In case of expected storm outbreak or weather change, they inform the farmers to take the necessary action. But in reality this is also a problem as this is a natural calamity, some losses do occur.	↓	The farmers themselves have to decide what to do in a critical situation
Risk from short-term commodity price fluctuation	This risk is also minimized as a minimum guaranteed price is fixed for the contract farmers.	↓	Farmers selling to the spot market have to bear the brunt of fluctuating market prices.
Risk from long-term price fluctuation	NA	↔	NA
Asset risks	There is no provision for asset risk management in the contract	NA	--
Financial risks (loans and credit)	The company can be involved in arranging the loans between the financing company and farmers. These farmers will probably have more leeway in the case of a default.	↓	--
Exchange rate risks	NA	NA	--
Risks of poor or deficient information	This risk is minimized as the company extension workers inform the farmers if a disease outbreak is expected.	↓	--
Biological risks	These risks are also minimized as the company extension agents are scouting the fields regularly	↓	--
Legal and governmental risks	Currently, there are no regulations in the country. Consequently the risks from defaulting and legal implications are not very high.	↔	--
Farm management risks (impact on technical production systems)	Company extension agents are also providing information on these issues.	↓	--
Personal risks	NA	NA	--

Note: NA = Not applicable

3.5.2. Risk analysis

Table 3 shows the risk analysis between PepsiCo contract farmers and farmers selling to the open market. The third column shows whether the risk for the contract farmers is higher, lower or same as that of the farmers in the traditional market. It is evident that on no account is the risk for the contract farmers higher than the farmers selling to the traditional market. Risks related to weather and biological pests are reduced in the case of contract farmers, as the company agronomists are very actively scouting the area for pests and diseases. Incidentally, this also has a positive impact for other farmers who are not working with the company because they are also informed of disease onslaught in advance by their neighbours.

Financial risks are reduced in the case of the farmers working with the company as they have support on this front. The credit required for inputs can be better managed as the company is involved in ensuring availability of inputs. As discussed above, risks from price fluctuation are minimized as the prices are announced ahead of time. Personal risks remain the same as there is no provision for these in the contract. Finally, the repercussions for legal risks could be higher in the case of contract farmers if the company should decide to retaliate on defaulting farmers. However, currently there are no regulations in place for enforcing contracts. Thus, this risk currently is not very high; but it could become important when these regulations are put in place. Finally the production risk due to vagaries of weather is also significantly reduced for contract farmers thanks to the weather insurance policy arranged by the company.

4. CONCLUSION

This case study of the potato crisp supply chain to PepsiCo's Frito Lay is a good example of how international quality requirements are met by small farmers in India. A very strong extension network by the company helps to monitor and maintain quality at every level. Evidently the farmers working as contract growers benefit on several fronts: there is extensive training and education of farmers for proper timing and method of sowing, harvesting and other field operations; farmers' overall management capabilities are enhanced by meetings and visits by agricultural experts from time to time. Gross margins for contract farmers are higher. Furthermore, because the company announces prices ahead of the production season, they are sure of covering at least their production costs and can invest in agrochemicals and other inputs, which in turn leads to enhanced productivity. Other risks from crop infestation and weather changes are also minimized as the company's extension agents are constantly working with the farmers to give timely input on these issues. Finally, weather insurance is also available for the company contract farmers, which further minimizes risks.

The obvious advantage for the company is getting an assured quantity and quality for crisp making to enable utilization of the processing plant at optimal capacity. Direct involvement with farmers enables good communication to ensure availability of produce which meets the specific quality requirements for processing and indicators for the company's HACCP and ISO certification.

In the absence of a legal framework, and even if there were a regulatory mechanism, trust between both parties is important for success in contract farming. The company field officers have close interactions with farmers to discuss issues and problems in potato production. This has enabled them to develop trust in the company overtime. The company announces prices for potatoes in advance, which is a critical factor in maintaining farmer loyalty. However, there is always a risk of farmers selling to the open market when market prices are high. This issue can be addressed in time by developing a long-term relationship with farmers. Furthermore, the company encourages farmers to plant part of their crop for processing and a part for selling to the open market, so farmers can capitalize on the rise of open market prices.

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