International Food and Agribusiness Management Review
Volume 16, Issue 1, 2013

Supply Chain Re-engineering in the Fresh Produce Industry: A Case Study of Adani Agrifresh

Mukesh Pandey[a], Gregory A. Baker[ⓘb] and Deepali Tewari Pandey[c]

[a] *Associate Professor of Agribusiness, GBPUAT, Pantnagar, India*

[b] *Professor of Management and Director of the Food and Agribusiness Institute, Leavey School of Business, Santa Clara University, California, USA*

[c] *Subject Matter Specialist (Horticulture) at GBPUAT, Pantnagar, India*

Abstract

Srinivasa Ramanujam, the Chief Operating Officer of Adani Agrifresh, faces important decisions regarding his apple business in India. In 2005, Agrifresh saw a business opportunity and set up a Controlled Atmosphere Storage (CAS) facility when the state of Himachal Pradesh adopted the amended APMC Act, which deregulated the marketing of fresh produce. Following this change in the legal environment, Ramanujam reengineered the apple supply chain, which had previously operated very inefficiently. He achieved some degree of initial success in an agribusiness environment where long chains of intermediaries dominated produce marketing despite adding little value. The case describes the challenges faced by Agrifresh including securing supplies from farmers, capacity utilization, and product portfolio issues. The case is intended to be used in teaching a variety of management topics to students at the undergraduate, graduate, and executive levels, including agribusiness, strategy, and supply chain management, particularly as they apply to emerging markets.

Keywords: agribusiness, supply chain management, produce, apples, controlled atmosphere storage

ⓘCorresponding author: Tel: + 1 408.554.5172
Email: G. A. Baker: gbaker@scu.edu

IFAMA Agribusiness Case 16.1 B

Adani Enterprises in India

Adani Enterprises, a US$6 billion Indian business group, has interests in edible oil, ports, logistics, special economic zones, power, oil exploration, coal, mining, and gas distribution. In 2006, through its wholly owned subsidiary, "Adani Agrifresh Limited," the conglomerate set up integrated storage, handling, and transportation infrastructure for fresh produce in the state of Himachal Pradesh.

In 2008, Ram joined Adani Agrifresh to lead its operations as COO. Being an agribusiness veteran with an excellent record of accomplishments across several vertical agribusiness chains, he saw much opportunity for the company. Ram was keen on significantly expanding the business by integrating its operations from farm to consumer and to emerge as the undisputed leader of India's fresh produce sector.

Apple Production and Marketing in India

The domestic Indian apple market was valued at approximately US$4.1 billion in 2010 (Dei Rosi 2010). India's three mountain states, Himachal Pradesh, Jammu & Kashmir, and Uttarakhand, produce nearly all of the apples grown in the country. Two apple varieties, Red Delicious and Golden Delicious are the dominant varieties grown and consumed in India. Indian consumers prefer apples that are red, sweet, crunchy, and uniform in shape (Venkataraman 2011). The lead apple producing state, Jammu & Kashmir, accounts for over two-thirds of the apple production. Additionally, its yield per hectare is almost twice that of the next largest producing state, Himachal Pradesh (exhibit 1). In 2009, India produced 1.98 million metric tons of apples on 274.4 thousand hectares (Indian Horticulture Database-2010 2010), one of the lowest yields amongst the world's apple producers (exhibit 2). Explanations for this low yield include mountainous terrain, monsoon dependence, and use of century-old "Delicious" variety cultivars. Apples are a fruit best suited to a temperate climate; therefore, colder temperatures are required for the trees to bear fruit and mature. As a result, the apple-harvesting season in India ranges from July to November, when the domestic supply of apples is at its peak, causing prices to decrease sharply (exhibit 3).

In India, the great majority of fresh produce is sold through informal retailers, including roadside and neighborhood stalls, kiosks, and doorstep delivery by hand carts. Organized fresh food retailing through supermarkets is still in the nascent stage and largely confined to a few big cities. In the current, supply-driven market, buyers face great variability of supply in terms of quality, quantity, specifications, and yield. For this reason, most buyers, including food processors and retailers, do not know in advance what to expect from the supply lot (Minton et al. 2009).

Diversification of Dietary Patterns in India

Compared to other apple producing countries, India's per capita apple consumption of about 1.35 kgs. per year is quite low. Turkey has the highest per capita apple consumption, approximately 36.8 kgs., followed by France, China, and the US, with 16.2, 14.0, and 9.7 kgs., respectively

(Rawat 2009a). With its rapid forecasted growth, India is predicted to be one of the world's largest economies by 2050 (Knight Frank 2012). This may portend changes in consumption patterns as fruits such as apples become mainstream commodities in Indian markets.

The size of India's workforce is expected to increase from 775 million in 2008 to 950 million by 2026. As incomes rise, Indian consumers are diversifying their diets to include a broader array of foods. With this diversification, dietary patterns that mirror global trends are beginning to emerge. Since the early 1990s, non-staple foods including dairy products, meats, edible oils, fruits, and vegetables have been the fastest growing food categories in India. The increased consumption of foods in these categories is due in large part to the rise in dual-income families, rising income levels, and globalization (Pingali and Khwaja 2004). With a burgeoning organized retail infrastructure, growing consumer awareness about healthy eating, and established perceptions about apples as a healthy and flavorful fruit, the Indian market for apples has huge growth potential. Furthermore, the potential expansion of distribution networks to medium-sized cities offers another untapped opportunity. To meet this rapidly growing demand through domestic supply, India must either increase its area under apple cultivation or improve yields by adopting improved cultivation systems.

Fresh Fruit Imports in India

Fresh fruit imports in India grew nearly 7 percent between 2005 to 2010 (exhibit 4). Between April 2009 and March 2010, India imported approximately 140,000 tons of fresh fruit valued at more than US$120 million (Narayanan 2010). Apples account for over 58 percent of these imports despite the high import tariff rate of 50 percent (exhibit 5). In comparison to the import duties on other fresh fruits in both developed and developing countries, India's customs duty on apples is high. A notable exception is Turkey, with an import duty of 60.3 percent. Besides apples, India also imports citrus, kiwifruit, grapes, pears, plums, and limited quantities of peaches and nectarines as shown in exhibit 6 (Brusco 2011).

Through surveys and discussions with various fruit retailers, the authors found that the Red Delicious variety constitutes approximately 90% of the apples imported into India. The remaining 10% includes varieties such as Fuji, Royal Gala, and Granny Smith. The authors also found that imported apples are generally priced approximately 25 to 50 percent higher than domestically produced apples. This may be explained by the high import tariff as well as the high margins charged by importers. Channel margins account for over 50% of the consumer price (exhibit 7). Risk and uncertainty faced by importers, particularly regarding enforcement of nontariff import regulations, may contribute to importers' demands for higher margins. Although India eliminated quantitative restrictions on apple imports in 1999, it imposed nontariff measures, including phytosanitary, pesticide residue, and food safety regulations, in addition to the 50 percent import tariff. Some of India's requirements for apple imports, such as those pertaining to waxing and chemical residues, differ from US and international standards. Although these regulations appear to have had little effect on India's apple trade so far, uncertainties regarding the rules and their enforcement have the potential to be disruptive and costly for traders (Landes 2006).

Until 2008, the majority of apples imported into India came from the US. However, in the last two to three years, Chinese apples, imported mostly from Shaanxi province, have flooded Delhi's fruit markets, giving Indian apple growers tough competition. As of 2010, China and the US have approximately equal shares of the Indian apple market (exhibit 8). A prominent fruit vendor, when interviewed in Delhi, said, "The strange thing about Chinese apples is that they taste the same all year round. Though Chinese apples can at times, cost Rs 20 to Rs 40 more than the Indian varieties, Indians buy them because they look more tempting with their bright red, gleaming surface. They look the same all the time unlike Indian apples." Indian growers have made little effort to improve quality and yields to better compete with imported apples. The high price of both domestic and imported apples, relative to other Indian fruits, has limited apple consumption largely to higher income families (Rawat 2009a). This is in contrast to many industrialized countries where apple prices are relatively low and apples are widely-consumed across all income categories.

APMC Act and Its Amendment

The marketing of agricultural products in India has traditionally been controlled by the state and regulated by the Agricultural Products Marketing Committee (APMC) Act, which states use to develop their own APMC Act. These acts require all agricultural produce to be sold only in government-regulated markets (called "mandis"), which have poor infrastructure, and are typically characterized by a long chain of intermediaries (exhibit 9). These intermediaries cause long marketing delays and charge exorbitant margins in an arbitrary manner. They pay scant attention to grading, sorting, and storage, and take little care in handling the product during loading, unloading, and transport (Pandey, Sudhir, and Tewari 2010). The licensing of traders in these regulated APMC markets generates buyer power for the traders and serves to limit the income of small and unsophisticated farmers. It is a major entry barrier for entrepreneurial traders (Coulter 2004). Industry estimated losses due to poor post-harvest management are approximately 30 percent of the value of Indian fruit and vegetable production or almost US$3 billion (Pulamte 2008).

India's Ministry of Agriculture, being acutely aware of the limitations of the APMC Act, amended the act in 2003 and removed some of its principal rigidities (exhibit 10). The amended APMC Act, which has been adopted by a majority of India's states, introduced the concepts of parallel private markets and contract farming, and assigned new roles for cooperatives (Marketing Infrastructure & Agricultural Marketing Reforms 2003).

Himachal Pradesh's Business Environment after the AMPC Act Amendment

Himachal Pradesh adopted the amended APMC Act in 2005. Since then many private business have actively worked to design business models under the new regulatory environment. Under the amended APMC Act in Himachal Pradesh, private players are allowed to open and operate agricultural markets where farmers may sell their produce. Farmers need not bring their produce to the APMC market now as they have the option of selling their produce directly to private parties, food chains, and retailers. Under the amended act, food processors and retailers may also sign contracts with farmers to obtain the desired quantity and quality of produce. During the last

five years, various players like CONCOR, Reliance Fresh, Field Fresh, Mahindra Shubh Labh, and Adani Agrifresh have started procuring apples directly from farmers without going through the APMC (exhibit 11). To capitalize on the untapped horticultural business opportunities resulting from the APMC reforms, Adani Enterprises entered Himachal Pradesh aggressively and set up an extensive cold chain infrastructure.

In Himachal Pradesh, the major apple producing areas are Shimla, Kullu, Sirmour, Mandi, Chamba and Kinnaur (exhibit 12). The majority of farms in these areas are small (exhibit 13) and farmers must cope with poor roads, little or no cold storage facilities, nonexistent farm credit, little market information, and poor market infrastructure. These small apple farmers lack the ability to invest in modern agricultural practices and farm machinery, resulting in low productivity. As a result, their output is very low and they are "price takers". The Indian domestic market is characterized by an oversupply of apples in the peak season and shortages in the off-season, resulting in off-season prices that are often three to four times peak-season prices. The lack of appropriate storage and logistics infrastructure ultimately results in high prices for low-quality apples during non-peak periods.

When interviewed in 2011, Mr. Pranav Adani, Chairman of Adani Group, said "Adani group has been at the forefront of setting up infrastructure projects that significantly impact the growth of the Indian economy, be it port, power, mining, or grain storage. When the port sector was opened up to the private sector, we set up the first private sector port at Mundra in Gujarat on the west coast of India. When the Food Corporation of India invited offers to set up modern bulk silo storage facilities, we set up facilities to store, handle and transport 550,000 metric tons of grains in bulk, significantly saving a great amount of grain, which was otherwise going to waste due to inadequate storage facilities and poor handling. When we saw an opportunity to leverage our strength to contribute to reducing the wastage in the horticulture sector, we decided to set up 'Adani Agrifresh' to create an integrated cold supply chain."

At present, three different business models are practiced for the procurement and distribution of apples in Himachal Pradesh.

1. **Commission agents in traditional APMC markets:** After harvesting their crop, the farmers of Himachal Pradesh pack their apples in cardboard boxes and transport them by small trucks to the mandis, traveling an average of about 20 kilometers from their farm. A commission agent on the mandi works with the farmers by acting as a liaison between the farmers and buyers. There are major inefficiencies in this supply chain model. From the grower's perspective the major disadvantage is that he or she does not know beforehand the prevailing price of apples at the mandi. Word-of-mouth and/or cell phone communication are the only means of price discovery for the farmer. This information is often unreliable and insufficient for determining where, when, and at what price to sell the product. Once the farmer arrives at the mandi with the produce, he or she discovers the price. In most cases, the farmer must sell at whatever price the apples get at auction by the commission agent. Farmers are left with few options for two principal reasons. First, storage opportunities are not available due to the absence of cold chain infrastructure. This means that farmers must sell their fruit immediately following harvest. Second, farmers lack financial training and do not understand that transporting their apples to the mandi and incurring the transportation costs generally

puts them at the mercy of whatever price the commission agent offers. Farmers simply cannot afford to pay the cost of transportation more than once. Before the APMC Act reforms, farmers were not only dependent on commission agents to sell their apples but also to get loans in the absence of a formal credit mechanism. Reliance on a commission agent makes the entire transaction very asymmetric where the farmer has very little power relative to the commission agent. With little power in the hands of farmers, cheating in the weighing of the apples has become standard practice and farmers are not in a position to demand otherwise.

2. **Semi-direct company buyers:** Retail companies such as Reliance, Mahindra and Mahindra, and Spencers have hired their own agents in Himachal Pradesh. These agents buy from farmers on behalf of their company and compete aggressively in the field for larger volumes of good quality apples. Since most of the growers produce small quantities of apples, the purchasing company needs many buyers to handle the large volume of purchases. Moreover, since the packing and grading of apples is not standardized, a great deal of time is spent finalizing the deal with farmers. This makes it difficult to monitor and control the entire operation of apple procurement. Semi-direct company buyers purchase approximately 30% of overall apple production.

3. **Direct company buyers:** At present, the direct company buyers include Adani Agrifresh and Fresh & Healthy Enterprise Limited of the Container Corporation of India (CONCOR, Ministry of Railways, India). Unlike commission agents and semi-direct company buyers, direct company buyers work throughout the year to train farmers in scientific cultivation practices and post-harvest management. These training sessions are organized by company personnel, who send experts hired by the company to periodically visit villages and invite farmers to participate in training sessions free of charge. Both Adani Agrifresh and Fresh & Healthy own CAS facilities, which are technically far superior to conventional cold storage, as the former controls the entire atmosphere and not just the temperature.

Adani Agrifresh's Operations in Himachal Pradesh

Adani Agrifresh started investing in Himachal Pradesh after the APMC Act was amended. Their business strategy was to concentrate on marketing those fruits that are produced far from major consumption centers, are seasonal in nature, and are amenable to increased storage life using modern, integrated CAS facilities. Apples were chosen for three reasons: (a) although the two mountainous states in northern India produce most of the apples, the fruit is consumed across India; (b) in India, apples are considered a product for the "classes" rather than the "masses," and consumers' price sensitivity for apples is much less than for other commonly consumed fruits; and (c) apples can be stored for as long as seven months in a properly controlled atmosphere.

Ram remarked, "We set up the controlled atmosphere storage units in Himachal Pradesh to handle apples to start with. We are very happy that our intervention has brought about welcome changes in the way apples are handled from farm to retail, benefitting both the apple farmers and consumers." Using modern CAS facilities with sorting and packing lines, the plan is to buy, store, and market apples focusing on high quality and constant supply throughout the year.

Volume is a critical factor for Agrifresh given that the level of investment is high and margins are low.

Agrifresh realized that the prevailing market system did not incentivize growers to follow the best harvest and post-harvest practices, especially practices related to proper harvest timing and method, product handling, and packing. Agrifresh ruled out the option of buying from the mandis as they discovered that the quality of apples sold at the mandis is not high enough to build a brand at the retail level. Agrifresh researched the reasons underlying the poor quality of apples and analyzed the logistical inefficiencies that occurred when growers supplied apples through APMC markets. They found that most growers who sell through APMC markets overpacked the boxes, with some growers packing close to 30 kgs. in a box designed to hold only 20 kgs. of apples. The desire to save on costly packing adversely affected the quality of the apples. In the subsequent stage, transporters frequently loaded 25% more apple boxes on their trucks than recommended, resulting in additional damage in transit. Moreover, during the peak production months, India's largest mandi in Delhi's Azadpur market would receive more than 800 trucks of apples per day, although it was designed to handle only 400 trucks each day. As a result, apples spent hours under the hot sun in non-refrigerated trucks prior to being unloaded. The apples were further damaged at APMC markets as the boxes were unloaded, opened, and reloaded manually for further transportation to various consumer markets.

Armed with this research, Adani Agrifresh decided to design an entirely new system for handling and distributing apples. They started their operations in Himachal Pradesh in 2006 by contacting farmers directly and clearly communicating the required quality specifications. Unlike APMC mandis, Agrifresh announced its procurement price of different grades of apples for the entire week, thus enabling growers to make an informed choice. To ensure quality, Agrifresh subjected each apple to firmness and maturity tests prior to purchase. Procurement officers of Agrifresh visit farmers every two weeks in their fields to ascertain the quality and yield of their apple orchards. Agrifresh buys only those apples that meet its criteria after doing preliminary grading in the farmers' fields. The remaining apples are rejected and farmers are free to supply these apples to the APMC market. Agrifresh also invested in sturdy, reusable plastic crates and issued them to farmers who produce an adequate quantity of good quality apples. Agrifresh asked farmers to transport their apples to its CAS facilities in these crates thus eliminating the quality deterioration due to over-packing and overloading the fruit. Crop experts at Agrifresh also trained growers in scientific cropping and post-harvest practices with the aim of building a preferred-buyer relationship. This is one way that Agrifresh hopes to build loyalty among farmers.

Agrifresh maintains a concentration of 0 to 20 percent carbon dioxide and less than two percent oxygen concentration level inside its CAS. The temperature and relative humidity are maintained at -2 degrees Celsius and 90-95 percent, respectively. This modified atmosphere retards the rate of apple respiration, thereby preserving critical attributes such as texture, flavor, and appearance for up to seven months. Agrifresh also installed imported, computerized apple graders at its CAS facilities to sort apples according to their color, shape, and weight. This mechanism also helped Agrifresh to develop a transparent payment system wherein it compensates farmers based on the quality, grade, and weight of their apples. Because of this strict quality control regimen,

Agrifresh's apples conform to international codes, quality, and safety standards such as CODEX, and HACCP, and EU standards.

Adani Agrifresh sells apples through an extensive network of dealers spread across India. The company also sells apples directly to modern supermarkets countrywide and through large fruit and vegetable retailers that operate in most large cities. By investing in CAS facilities, Agrifresh is able to store apples in the peak production season and sell them to consumers during the off-season at higher prices. This strategy enables Agrifresh to leverage its logistical strength and arbitrage the price differential between the peak and off-peak seasons.

Hub Operators: the Logistical Backbone Behind Agrifresh

Agrifresh signed contracts with approximately 150 hub operators in Himachal Pradesh who in turn serve around 4000 farmers. Agrifresh delivers crates to these hub operators, who further distribute them to those growers who are interested in supplying to Agrifresh and have good quality apples available. Upon receipt at Agrifresh's CAS, apples undergo quality tests and are sorted and graded according to quality and color. Since 2010, Adani has started accepting some B grade apples that it does not store in its CAS facility but supplies directly to the smaller price-sensitive markets. Once the apples are accepted for quality, size, maturity, and color, the hub operator's account is credited based on the price declared in advance for the week. The A grade apples are then put into the CAS facility. This process continues until the procurement season is over. Agrifresh also uses this network of hub operators to sell agricultural inputs to farmers and to arrange regular meetings with growers.

The crates serve as an incentive to farmers who supply Agrifresh, as the farmers do not have to bear the costs of cardboard packing boxes, transportation to the APMC markets, and commissions, and market fees. Moreover, grading and packing apples in cardboard boxes, unlike packing in plastic crates, requires skilled labor, which is often in short supply during the peak harvest season. Furthermore, selling to Agrifresh reduces the risk of damage or weight loss that growers often experience when delivering product to the APMC markets. Exhibits 14a and 14b indicate the extent to which farmers obtain an increased share of the wholesale price. The higher revenue gives farmers the financial means to plan for future investments and purchase the latest technological innovations.

Farmpik Shoppe

The unreliable supply of agricultural inputs is a major problem in Indian horticulture. In order to supply genuine quality inputs and extension services, Agrifresh has established three agricultural input stores, called "Farmpik Shoppe," where growers may purchase inputs. These stores supply pesticides, seed, fertilizers, and other agri-inputs from reputable companies such as BASF, Bayer, and PI Industries. Representatives of these companies and technical experts from local agricultural universities also provide technical advice on cultivation and post-harvest management to farmers through village meetings. Because of these stores, farmers receive genuine, quality agricultural inputs at reasonable prices.

Farm-Pik Consumer Brand

With access to a consistent quality of fruits and vegetables throughout the year, Agrifresh now plans to set up distribution centers across India. In addition to apples, Agrifresh markets Indian pomegranate, table grapes, bananas, cherries, lychees, grapefruit, and oranges under the brand name "Farm-Pik." Exhibit 15 provides production and consumption figures for a variety of fruits grown in India. The company also imports and markets apples, pears, and kiwis from China, the US, New Zealand, and Chile using its distribution network. Agrifresh has distributors in all major cities across India selling their Farm-Pik produce. They have utilized promotional activities including dealer boards, umbrellas, posters, danglers, carry bags and have promoted their brand at retail stores, trade fairs, and other trade events.

Future Challenges

Ram is very optimistic about the future of the re-engineered apple supply chain that he and his team have developed. He is also very concerned about the scalability and profitability of Agrifresh's operations. Some of the key challenges that Ram believes Agrifresh will face are:

Challenge 1: Agrifresh buys only grade A apples (the best quality and suitable for storage) from growers whereas APMC mandi-based commission agents buy all grades, namely, grades A, B, and C. Around 60% of the apples produced in Himachal are grade A, with the rest being inferior grades B and C. Although 95% of Himachal Pradesh farms are small, a few dozen farmers own large apple plantations. Despite the financial incentives farmers receive from Agrifresh, larger farms prefer to transact with commission agents in APMC mandis as they buy their entire crop and give them personalized services. These large growers are not only well educated, but also have better managed orchards, follow scientific horticultural practices, and produce superior quality apples. Without servicing the large-scale farmers, Agrifresh's transaction costs are high due to the large number of small-scale farmers delivering small loads of average quality. How can Agrifresh secure the commitment of large-scale farms to build and nurture a long-term, sustainable relationship that will reduce its per unit transaction costs?

Challenge 2: Most apple orchards in Himachal Pradesh are over 30 years old, have declining yields, and lack uniformity in terms of the shape, size and color of the fruit. Moreover, "Royal Delicious" and "Rich Red" varieties constitute most of the apples produced. Although more than 700 international apple varieties have been tried and tested during last 50 years, the "Delicious" cultivar group still accounts for 83 percent of production. How can production and post-harvest technologies be transferred rapidly and efficiently to such a large number of small farmers across several geographical territories?

Challenge 3: Over 95% of fruits in India are sold through makeshift, non-permanent shops, push-cart sellers, and pavement and roadside vendors. These vendors sell fruit at ambient conditions in extreme heat, humidity, dust, and unsanitary conditions. The lack of integrated cold chains in India poses a serious threat to fruit quality and consequent sales, especially during the hot April to August period. While deciding on the location of its CAS infrastructure, Agrifresh had two choices: either to invest in facilities that are close to the production area of apples in

Himachal Pradesh or to locate facilities close to the big consumption centers near Delhi, Mumbai, Chennai, Bangalore, or Calcutta. Agrifresh decided that getting the apples to cold storage within 12 hours of harvest would better preserve the quality of the fruit and better serve the market. The success of Agrifresh's Farm-Pik apples is an indication that consumers acknowledge the superior quality of this fruit. However, there is a flip side to the decision to invest in CAS at Himachal Pradesh – capacity utilization and a costly infrastructure. In Himachal Pradesh, nearly 75 percent of the apples procured and stored by Agrifresh from the August to mid-October harvest are sold to domestic markets by December. Moreover, there is an ever-present threat of apple imports from countries like the US and China. Furthermore, from April onwards, mango production dominates the Indian market. The mango is considered a "fruit for the masses" as well as an exotic fruit. India is the largest producer of mangoes in the world and when mangoes flood the market between April and August, all other fruits take a back seat. How can Agrifresh best recover its large investment made in the cold atmosphere storage and logistics infrastructure in a business environment vulnerable to price and climate risks and farmers who may renege on contracts when offered higher prices elsewhere?

Challenge 4: Due to the difficulty of standardization, scalability, sourcing of quality fruits in large quantities, and consumer resistance to paying a premium for a well-handled product, Agrifresh's prior entry into the mango, orange, and kinnow supply chain was not very successful. Wanting to leverage its distribution network, Agrifresh has planned to import fruits, including apples, pears, oranges, kiwis, and grapes from the US, China, New Zealand, Italy, and South Africa. With the nutrition recommendation of five daily servings of fruits and vegetables gaining an increasing number of followers in urban Indian households, the outlook is bright for fresh fruit and vegetable sales. However, Ram believes that sales of imported fruit will be limited because the number of Indian households with the financial means to purchase fresh imported fruits is generally low. Furthermore, the structure of the fruit trade in India is very fragmented, limiting mass distribution through supermarkets. At present, over 90% of Agrifresh's business comes from apples. Ram is evaluating whether Agrifresh's operations can be profitably sustained while handling primarily apples. He has identified the following product portfolio options:

Option 1: A wide product portfolio of fruits targeted at the entire Indian market.

Option 2: A narrow product portfolio of niche-market exotic fruits.

Option 3: Off-season cultivation of exotic vegetables, which growers in Himachal have started producing on a fairly large scale. Ram's only concern with this option is whether these vegetables can be priced to cover the cost associated with storing them in CAS.

How might these portfolio options contribute to a more successful business model for Agrifresh?

Challenge 5: What incentives can Agrifresh give hub operators to ensure that they act as front-line personnel by keeping track of competitor activities and ensuring a flow of good quality apples? Can hub operators be used by Agrifresh to assist with farmer training in the areas of scientific cultivation, pest management, and post-harvest management practices?

Acknowledgements

We express our gratitude to Mr. Srinivasa Ramanujam, Chief Operating Officer (COO) and Mr. Basant Nayak, General Manager of Sales & Marketing, both of Adani Agrifresh. In addition to providing access to proprietary information and excellent logistical support, they also provided invaluable insights into complex issues. We thank the marketing and supply chain managers working at Bharti Wal-Mart, Reliance Fresh, Field-fresh, Mahindra Shubh Labh, Fresh and Healthy Enterprise (FHEL) - a wholly owned subsidiary of Concor India, Mother Dairy, and other leading food retailers operating in India for providing us valuable insights during our various meetings. Thanks are also due to hundreds of farmers, APMC commission agents, and retail vendors for their cooperation and patience during the many interviews required to complete this project. We also thank two anonymous reviewers for their insightful comments.

References

Brusco, Maria Lugia. 2011. The Many Shades of Indian Fruit Import. *Fresh Plaza*. March 17. http://www.freshplaza.com/news_detail.asp?id=77853#SlideFrame_1 (accessed January 26, 2012).

Coulter, Hugh. 2004. Wholesale Market Management Manual: Support for Agricultural Producers - Support to the Vertical Structure of Market. European Union.

Dei Rossi, Andreas. 2010. The Apple Market in India. Eurobrands 2010 report. http://www.eurobrandsindia.com/blog/tag/apple-demand-in-india/ (accessed January 26, 2012).

DGCI&S. Indian Trade Journal, 2010. 2010. Ministry of Commerce, Government of India.

Himachal Pradesh State Horticulture Report, 2009. 2009. District Horticulture Office, Shimla, Himachal Pradesh, India.

Indian Horticulture Database-2010. 2010. National Horticulture Board, Ministry of Agriculture, Government of India. http://www.scribd.com/doc/67626507/Indian-Horticulture-Database-2010 (accessed January 26, 2012).

Knight Frank, Citi Private Bank, 2012 Wealth Report. http://www.thewealthreport.net/The-Wealth-Report-2012.pdf (accessed January 26, 2012).

Landes, Maurice. 2006. India's High Internal Marketing Costs Reduce Apple Demand. *Amber Waves.* February. http://webarchives.cdlib.org/sw1vh5dg3r/http://www.ers.usda.gov/AmberWaves/February06/Findings/findings_mt2.htm (accessed November 24, 2012).

Marketing Infrastructure & Agricultural Marketing Reforms. National Informatics Centre, Ministry of Agriculture, Government of India. http://agmarknet.nic.in/amrscheme/modelact.htm (accessed January 26, 2012).

Minten, Bart, Thomas Reardon, and Anneleen Vandeplas. 2009. Linking Urban Consumers and Rural Farmers in India: A Comparison of Traditional and Modern Food Supply Chains. IFPRI Discussion Paper 00883.

Narayanan, Chitra. 2010. The Flight of the Kiwi. *The Hindi Business Line*. May 20. http://www.thehindubusinessline.in/catalyst/2010/05/20/stories/2010052050090300.htm (accessed January 26, 2012).

Pandey, Mukesh, K. Sudhir, Deepali Tewari, and Navin Nainwal. 2010. The Road Map: Linking Farmers to Markets. Joint report of SEEDS and ACDI-VOCA.

Patnaik, Gokul. 2011, Status of Agricultural Marketing Reforms. Paper presented at workshop on Policy Options and Investment Priorities for Accelerating Agricultural Productivity and Development in India, New Delhi, India, November, 10-11, 2011. http://www.igidr.ac.in/newspdf/srijit/PP-069-11b.pdf (accessed January 26, 2012).

Pingali, Prabhu and Yasmeen Khwaja. 2004. Globalisation of Indian Diets and the Transformation of Food Supply Systems. ESA Working Paper No. 04-05. Agricultural and Development Economics Division, The Food and Agriculture Organization of the United Nations.

Pulamte, Lalsiemlien. 2008. Key Issues in Post Harvest Management of Fruits and Vegetables in India. *India Science and Technology: 2008*: *S&T for Rural India and Inclusive Growth.* http://www.nistads.res.in/indiasnt2008/t6rural/t6rur14.htm (accessed January 26, 2012).

Rawat, Vikram Singh. 2009a. Needed, a Support Structure for Apple. *Fresh Plaza*. August 15. http://www.himvani.com/news/2009/08/15/needed-a-support-structure-for-apple/3405/ (accessed January 26, 2012).

Rawat, Vikram Singh. 2009b. Potential and Prospects for India's Apple. *Farmer's Collective*. September 2. http://kvfg.blogspot.com/2009/09/potential-and-prospects-for-indias.html (accessed January 26, 2012).

Venkataraman, S. 2011. The Indian Apple Market: Finding Fresh Angles. Rabo India Finance Ltd. March 3. http://www.freshproduceindia.com/resources/documents/1299582079Fresh_produce_India_-_3_Mar_2011_[Compatibility_Mode].pdf (accessed November 26, 2012).

Exhibit 1. Production Statistics, Major Apple Producing States, India (2008-2009)

State	Area (1,000 ha.)	Production (1,000 MT)	Yield (MT/ha.)
Jammu and Kashmir	133.7	1332.8	10.0
Himachal Pradesh	97.2	510.2	5.2
Uttarakhand	32.7	132.3	4.1
Arunachal Pradesh	10.8	9.8	0.9
Nagaland	0.0	0.1	0.4

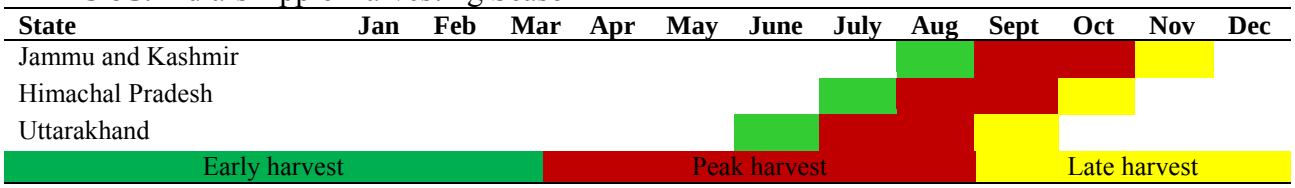
Source. Indian Horticulture Database-2010 (2010).

Exhibit 2. Production Statistics, Major Apple Producing Countries, 2009

Country	Area (ha.)	Production (MT)	Productivity (MT/ha.)
China	2,000,466	29,851,163	14.9
USA	141,676	4,431,280	31.3
Poland	171,963	2,830,870	16.5
Iran	202,000	2,660,000	13.2
Turkey	158,400	2,504,490	15.8
Italy	54,642	2,208,227	40.4
India	274,000	1,985,000	7.2
France	52,200	1,940,200	37.2
Russian Federation	243,000	1,467,000	6.0
Chile	35,000	1,370,000	39.1
Argentina	46,000	1,300,000	28.3
Brazil	37,890	1,121,468	29.6
Germany	31,800	1,046,995	32.9
Others	1,410,973	14,870,547	10.5
World	4,860,010	69,587,240	

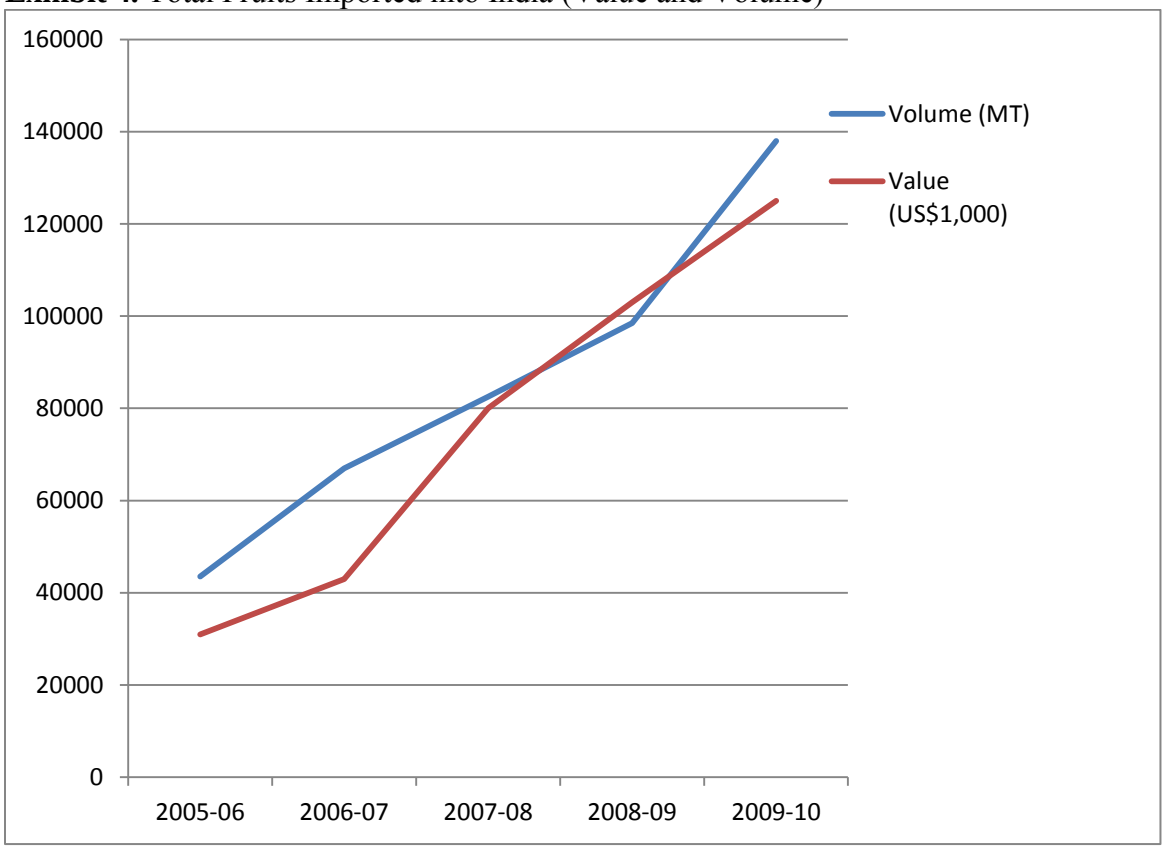
Source: Indian Horticulture Database-2010 (2010).

Exhibit 3. India's Apple Harvesting Season



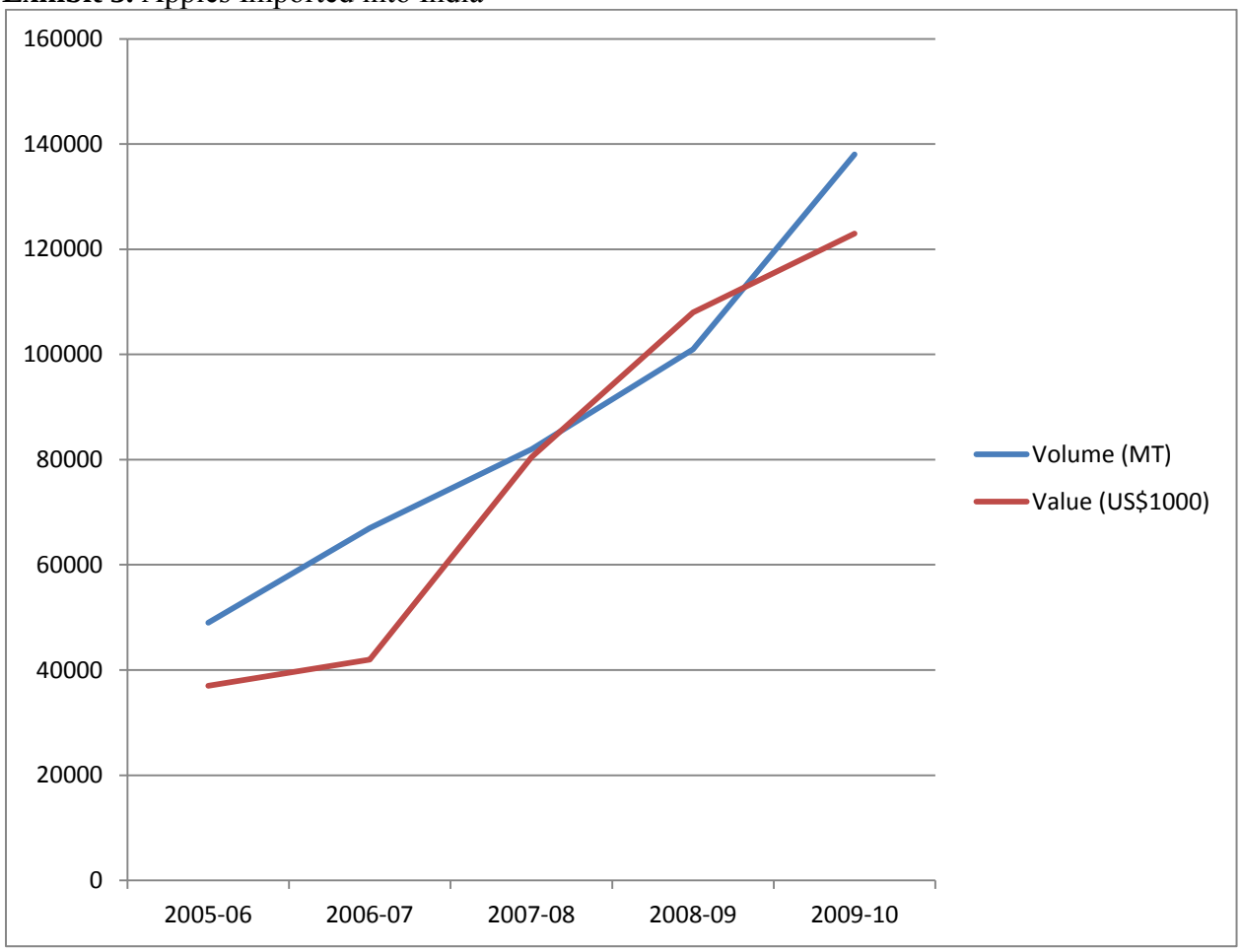
Source. Indian Horticulture Database-2010 (2010).

Exhibit 4. Total Fruits Imported into India (Value and Volume)



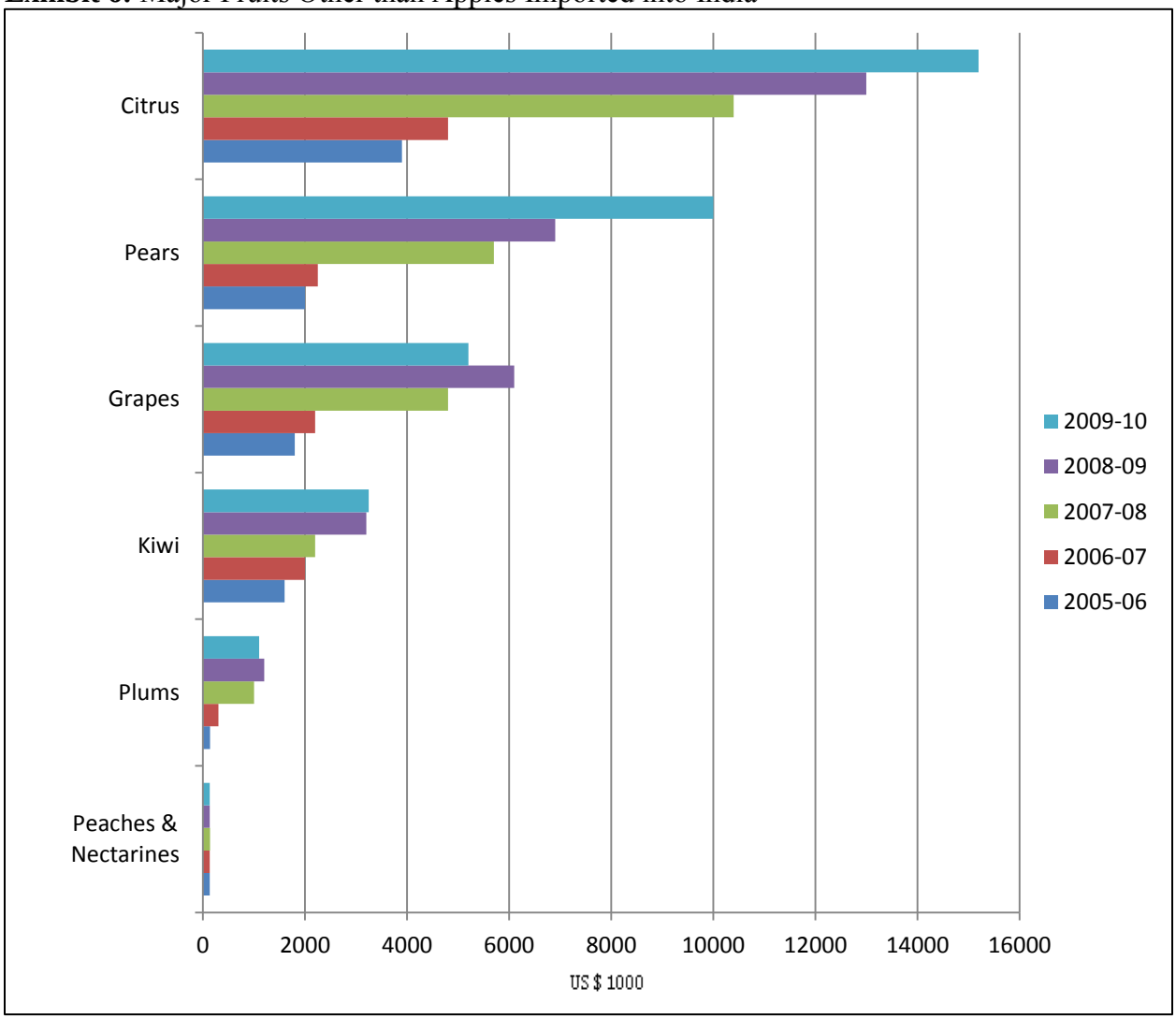
Source. DGCI&S (2010).

Exhibit 5. Apples Imported into India



Source. DGCI&S (2010).

Exhibit 6: Major Fruits Other than Apples Imported into India



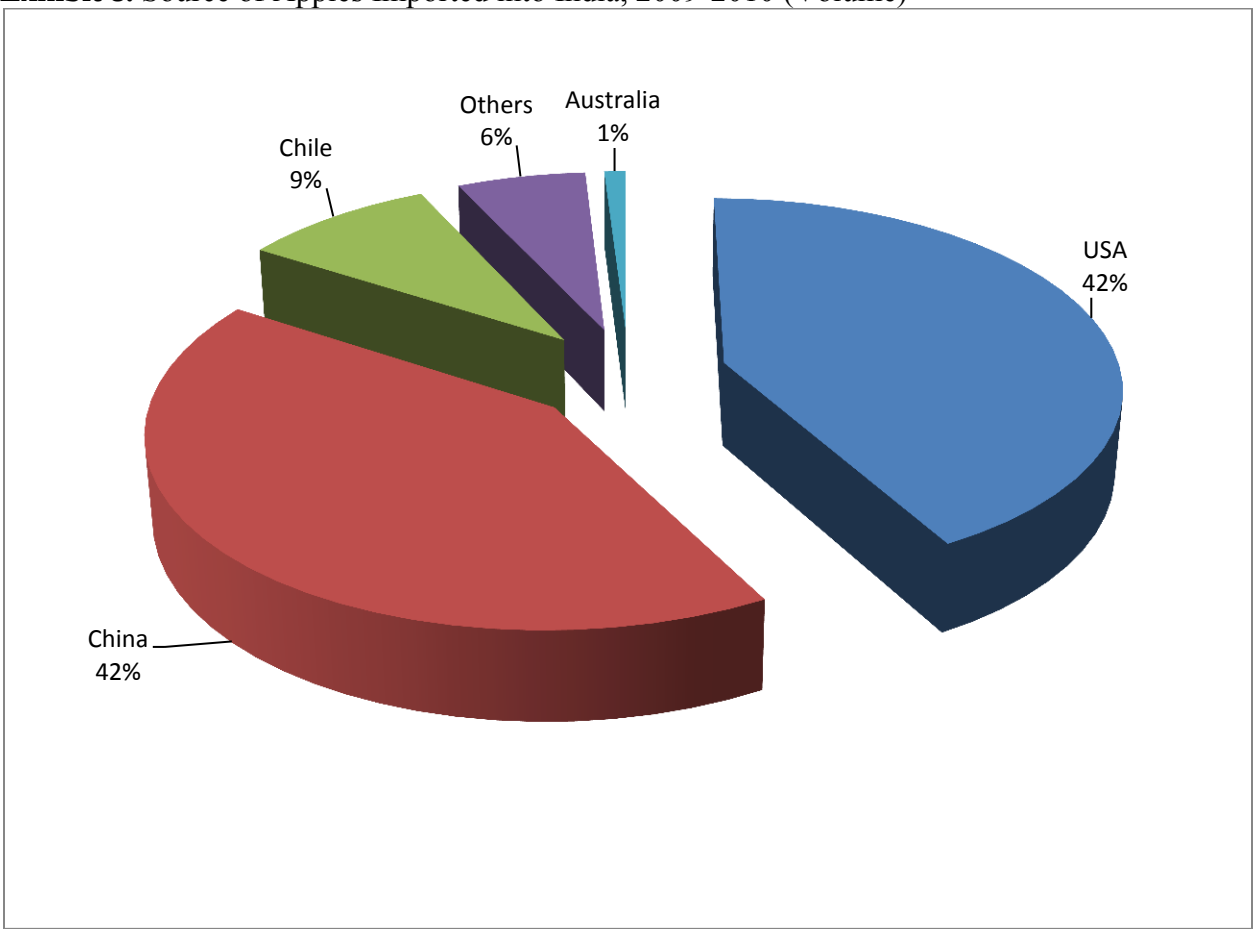
Source. DGCI&S (2010).

Exhibit 7. High Margins in Import Marketing of Apples in India

	Description	US$ per 20 kg. box
A	Import Unit price, CIF (Washington apple)	25.0
B	Expenses incurred by importer on: tariffS (50%), clearing, freight, agent commissions	17.1
C	Importer's margin	3.3
D	Realization at wholesale market (A + B +C)	45.4
E	Expenses of trader (transportation, cold storage of approximately 15 days, commission)	1.1
F	Wholesale trader's margin	2.2
G	Retailer's purchase price (D+E+F)	48.7
H	Retailer's expenses (carriage/handling, transportation, waste, other)	4.4
I	Retail margin	8.9
J	Consumer price (G+H+I)	62.0

Source. Venkataraman (2011).

Exhibit 8. Source of Apples Imported into India, 2009-2010 (Volume)



Source. Venkataraman (2011).

Exhibit 9. Intermediaries in the Indian Fruit Value Chain

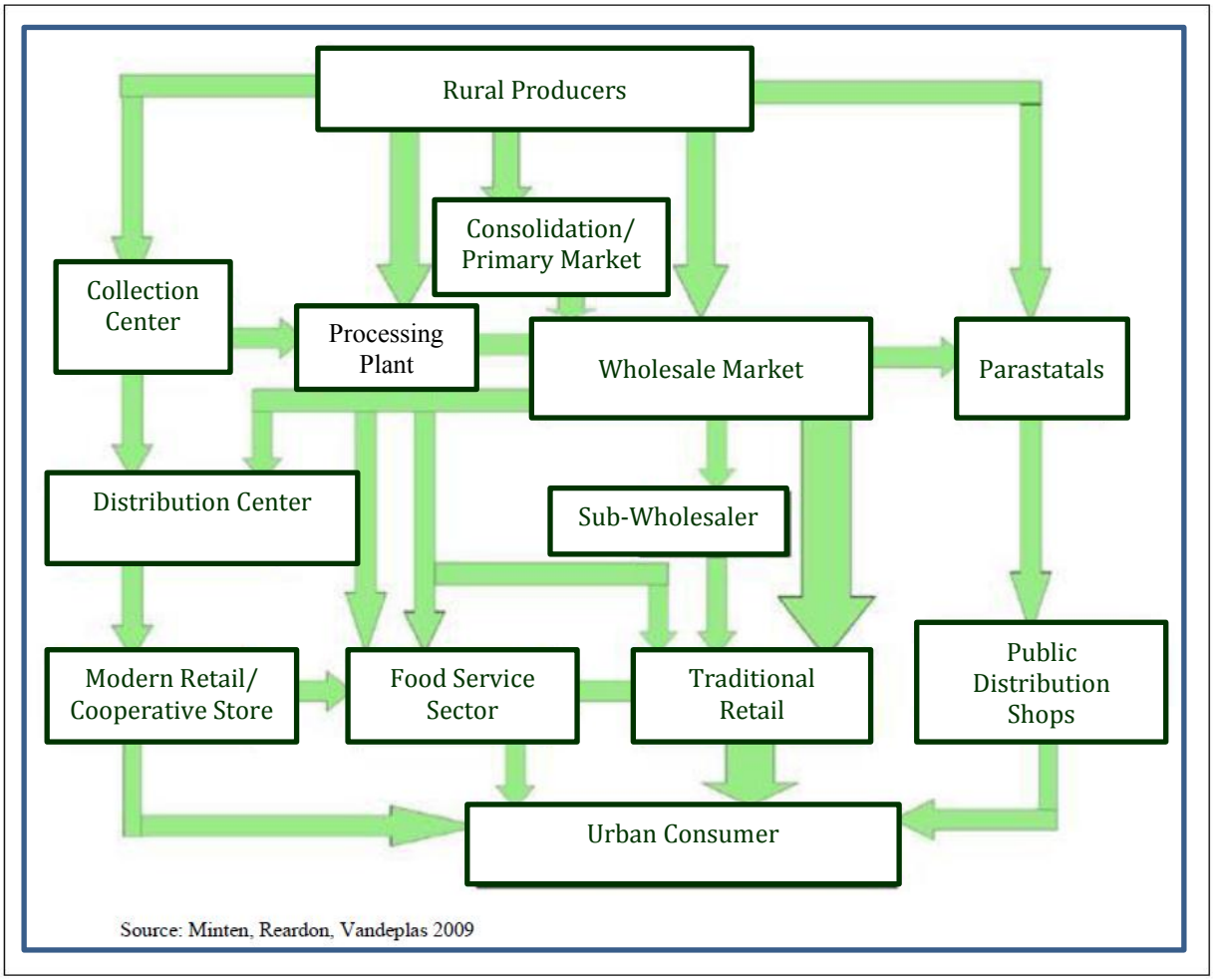


Exhibit 10. Progress of Reforms in APMC Acts in India

Stage of Reforms	Names of States/Union Territories
States/Union Territories where reforms to APMC Act have been done for Direct Marketing, Contract Farming and Markets in Private/Cooperative Sectors	Andhra Pradesh, Arunachal Pradesh, Assam, Chhattisgarh, Goa, Gujarat, Himachal Pradesh, Jharkhand, Karnataka, Madhya Pradesh, Maharashtra, Nagaland, Orissa, Rajasthan, Sikkim, and Tripura
States/UTs where reforms to APMC ACT been partially completed	a. Direct Marketing: Delhi b. Contract Farming: Haryana, Punjab & Chandigarh c. Private Markets: Punjab and Chandigarh
States /UTs where there is no APMC Act and hence no reforms required	Bihar[a], Kerala, Manipur, Andaman and Nicobar Islands, Dadra and Nagar Haveli, Daman and Dui, and Lakshadweep
States/UTs where APMC Act already provides for the reforms	Tamil Nadu
States /UTs where administrative action has been initiated for the reforms	Mizoram, Meghalaya, Harayana, Jammu & Kashmir, Uttarakhand, West Bengal, Pondicherry, NCT of Delhi, and Uttar Pradesh

[a] APMC Act repealed effective 1 September 2006.
Source. Patnaik and Gokul (2011).

Exhibit 11. Apple Procurement by Private Firms in Himachal Pradesh

Name of Firm	Year	Quantity (MT)	Average Price (Rupees[a] per kg.)
Adani Agrifresh Limited	2006	4,766.56	31.30 to 32.50
	2007	15,409,.99	24.30
	2008	19,704.48	25.30
	2009	8,783.94	41.75
Fresh and Healthy Enterprises Limited *(a subsidiary of Container Corporation of India, CONCOR)*	2006	1,060.00	29.62
	2007	10,940.00	27.87
	2008	7,720.00	35.50
	2009	2,720.00	44.12
Dev Bhoomi Cold Chain Pvt. Limited	2006	-	-
	2007	690.08	25.00 to 45.00
	2008	723.24	35.80
	2009	285.52	33.82
Mahindra Shubh Labh	2009	500.00	37.00

[a] 1 US$ = 54.07 Indian rupees (as of September 2012).
Source. Himachal Pradesh State Horticulture Report (2009).

Exhibit 12. Apple Production and Agrifresh CAS Facilities in Districts of Himachal Pradesh

Note. Shaded area shows apple producing areas as well as the area where Agrifresh operates its CAS.
Source. Himachal Pradesh State Horticulture Report (2009).

Exhibit 13. Total Number of Fruit Orchards in Himachal Pradesh

Size of Orchard	**Total**
Very Small (less than 1 ha.)	443,472
Small (1 to 2 ha.)	14,889
Small-Medium (2 to 4 ha.)	4,878
Medium (4 to 10 ha.)	932
Large (greater than 10 ha.)	83
Total	464,254

Source. Himachal Pradesh State Horticulture Report (2009).

Exhibit 14a. Price realization of farmers in Traditional APMC Chain

Item	Traditional Channel (Indian rupees per box)	Traditional Channel (as a percent of wholesale price)
Wholesale price at Delhi market	1200.00	100.0
Packaging, grading, and assembling labor cost	12.50	1.0
Packing materials	71.00	5.9
Transportation to road head	11.00	0.9
Freight to APMC market	78.00	6.5
Commission of forwarding agent, State tax, Octroi (local duty)	84.00	7.0
Loading/unloading charges	8.00	0.7
Total expenses	264.50	22.0
Net price received by apple grower	935.50	78.0

Notes.

a. A box sold through traditional channels weighs around 23 kgs. instead of the prescribed 20 kgs. Farmers do this to save on the cost of packaging and transportation; however, it leads to more rapid deterioration in the quality of the fruit.

b. 1 US$ = 54.07 Indian rupees (as of September 2012).

c. Farmers who sell their apples through the traditional APMC channel sell their entire stock of apples by the end of January every year due to lack of cold chain facilities.

Source. Based on extensive data collection and analysis by the authors and Adani Agrifresh during September to November 2010.

Exhibit 14b. Price realization of farmers selling through Adani Agrifresh chain

Adani Agrifresh sells almost 80% of their apples after the month of December when the domestic supply of apples through other domestic channels is exhausted. This is because it has CAS facilities which do not exist in traditional channels. During the August to November period, Adani's major focus is on the procurement of high quality, A-grade apples from farmers for storage in their CAS facilities in Himachal Pradesh. Salient features of apple sales by Adani Agrifresh are:

a) The price per 20 kg. box at which Adani Agrifresh sells in the wholesale market is apples based on the landed price of imported Washington apples according to the following rule of thumb: The selling price of Adani Agrifresh's apples in the wholesale market is equal to the price of imported Washington apples less Rs 200. During January to March 2011, Adani Agrifresh billed the Delhi wholesale market at an average price of Rs 1700 per 20 kg. box.
b) Adani Agrifresh procures its apples from farmers at a price of approximately 8% higher than what is offered by commission agents to farmers for comparable quality apples at the traditional APMC market. Adani Agrifresh does this to incentivize farmers to supply them with their high quality apples.
c) Farmers who supply to Adani Agrifresh do not have to bear the cost of packaging, the forwarding agent commission, state tax, Octroi, and loading and unloading charges. All of these costs are borne by Adani Agrifresh.
d) During the January to April period, Adani Agrifresh sells in the Delhi wholesale and other markets at a 30% price premium over traditional channels. This is because of the low quality of domestic apples and the excellent quality of Agrifresh's CAS apples.
e) The high quality CAS Agrifresh apples are well-accepted by consumers. Adani Agrifresh never over-packs its packaging boxes beyond the prescribed limit of 20 kgs.

Source. Based on extensive data collection and analysis by the authors and Adani Agrifresh during September to November 2010.

Exhibit 15. Fruit Production Patterns in India[a]

Contribution to Total Production by Volume

- Top two fruits = 56.9%
- Top three fruits= 69.5%
- Top four fruits=74.8%
- Top five fruits=77.5%
- Top ten fruits= 87.2%

Contribution to Total Production by Value

- Top ten fruits = 83%
- Top twenty fruits= 97%

Ranking of Fruit Production by Volume

1. Banana
2. Mango
3. Citrus
4. Papaya
5. Guava
6. Grapes
7. Pineapple
8. Sapota
9. Pomegranate
10. Lychee
11. Watermelon
12. Muskmelon
13. Orange
14. Sweet Orange
15. Lemon
16. Pear
17. Coconut
18. Kinoo
19. Babughosa (A type of pear)
20. Groundnut whole

Ranking of Fruit Production by Revenue

1. Banana
2. Apple
3. Lemon
4. Mango
5. Orange
6. Papaya
7. Watermelon
8. Muskmelon
9. Sweet Orange
10. Pomegranate
11. Pear
12. Guava
13. Grapes
14. Coconut
15. Kinoo
16. Sapota
17. Groundnut whole
18. Babughosha (A type of pear)
19. Awala
20. Peach

Ranking of Fruits by Margin

1. Kiwi
2. Strawberry
3. Lemon
4. Raspberry
5. Cherry
6. Jamun
7. Apricot
8. Apple
9. Dates
10. Plum
11. Grapes
12. Cheekoo
13. Peach
14. Groundnut whole
15. Lychee
16. Pomegranate
17. Orange
18. Belpathar
19. Kinoo
20. Green Badam

[a] **Sources.** Indian Horticulture Database-2010 (2010) and field surveys conducted by the authors.