Mango Supply Chain:  
Who is More Sustainable—MNC or Co-operative Society?

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**Executive Summary**

The scope of this paper is to analyze the sustainability of an exotic tropical fruit supply chain among two different sized firms and located in two different regions of the world. We define sustainability as net positive value to all stakeholders with the idea that systems—including natural, human, economic, societal, and political—need to be regenerative and balanced in order to last. Our fruit of choice is the mango because it has direct ties to the authors of this paper while the firms selected reflect the variability that scale has when considering supply chain relationships. The small firm we elected to work with is a local co-operative society in India called **Devgad Taluka Mango Growers (DTMG) Co-operative Society Ltd.** and the large firm we elected to analyze is a multi-national corporation (MNC) in the food and beverage space in East Africa called **The Coca-Cola Company.** Coca-Cola recently introduced the Minute-Maid brand to the region and will invest in the entire supply chain to reach its market. Our sustainability analysis, however, only considers the supply chain while the mango is ‘alive’, that is all segments prior to processing. The variety of mangoes we analyze are the Alphonso and ‘Sena’, both indigenous to their respective regions and varieties the authors have worked with in the past.

After obtaining primary and secondary sources of data, including surveys with the business owners and from the direct experience of the authors, a 5-capitals framework was employed to determine sustainability within each supply chain. The framework looked at the financial and economic impacts that each segment of the supply chain had on its stakeholders; we also assessed the social, environmental, human, and political impacts relaying the facts and only qualifying the net impact. Based on a comparative analysis of the two supply chains, it was clear that more questions surfaced than were answered. We therefore recommend that additional research be done that accounts for the framework we employed as well that a platform is created to stimulate further stakeholder dialog to better define and measure profitability, with the end goal of building stronger more holistic supply chains. We also believe that this analysis can have direct implications for our family farms in addition to other mango farmers and supply chain analysts working in agribusiness and searching for sustainability frameworks.

**Methodology, Definitions, and Assumptions**

**Method of Analysis**

The goal of this paper will be to analyze the trade-offs between the mango supply-chain of two food retailers— a large multi-national food and beverage manufacturer **The Coca-Cola Company** and Maharashtra, India based **Devgad Taluka Mango Growers (DTMG) Co-operative Society Ltd.** Both
are involved in the production and selling of mangoes; this paper will investigate and determine if their respective supply chains are sustainable. As a result of this analysis, our findings will incorporate a more comprehensive framework to measure and evaluate the supply chain.

We will incorporate a 5-capitals framework that consists of evaluating not only the financial and economic reasons for taking a specific business course, but also the social, environmental, political/civic/governance, and human aspects. This analysis stems from the stakeholder theory approach, which is becoming considered more often by firms today as public pressure mounts, information becomes more readily available, and government continues to abdicate its responsibilities. Upon considering these two supply chains for mango, we hope to gain insight into the two firms’ decision making process and analyze ways to enhance their sustainability outcomes using a lens of responsible sourcing.

Information disclaimer: The information that we use in this analysis originates from two primary sources and many secondary sources. First, we have the direct experience of two mango farming families, one in India and the other in Thailand. In addition, one team member has worked directly with mango farmers in East Africa where data is derived from direct experience. Second, we have interviewed the head of the Devgad Co-operative Society in Maharashtra, India where data was obtained through survey. Third, obtaining data from East Africa is a significant challenge. Our secondary source was a presentation performed by TechnoServe on Project Nurture as well general study of mango value chains through USAID’s knowledge database.

Definition of our Supply Chain

Because we are focusing on both a large and a small firm, it is necessary to ensure that our unit of analysis, in this case the mango itself, remains constant so that we contrast the two supply structures fairly and equitably. We will therefore discuss the supply chain throughout the full life of a mango. We define the life of the mango from pre-seedling (of the tree) to the moment it changes form, in this case to pulp, in the processing center. Therefore, all aspects of the supply chain prior to processing will be included in our analysis. We will however, identify the entire supply chain for the large firm so that readers appreciate the scope of our analysis.

Definition of Sustainability

There is no standard or widely recognized definition of sustainability, however, in 1987 the World Commission of Economic Development issued a report titled “Our Common Future”, known as the Brundtland Report, and shortly thereafter the United Nations General Assembly accepted this definition offering political capital in order to convene support around a universal understanding of what the term should mean. The classic definition of sustainability is “meeting the needs of the present without
For this paper, we will not focus on this definition as it is too broad and can still include a number of immoral and irresponsible acts by the firm and individuals. Since we want to measure and analyze sustainability within a firm’s supply chain, we will focus on a more narrow understanding of the term. We do believe that sustainability is not solely defined within the context of the firm and that there are many external factors that are impacted by the firm’s actions. We therefore consider a limited framework where the firm can take appropriate action to align itself with our definition of sustainability. In our case, we consider sustainability as **net positive value to all stakeholders with the idea that systems—including natural, human, economic, societal, and political—need to be regenerative and balanced in order to last.**

We use this definition based on our understanding of the firm’s purpose and role in society. We take the view that the firm is responsible to more than just its shareholders and that profit is not the sole imperative (Oliver F. Williams). If we are searching for a sustainable solution to the firm’s supply chain challenges, then broader more systemic design thinking must be employed to minimize or all-together eliminate the firm’s unintended negative impact on humans, society, and the environment.

**Team Assumptions**

To begin, we presume that the large firm will have less sustainable supplier relationships along its value chain since it will use quantity (size) and price (cost) as the primary criteria to measure value. On the other hand, we believe that the co-operative model would have more intimate knowledge of its members, the naming convention and genesis of co-operatives helping us define how the two sizes of the firm impact their relationship to the people they partner, contract, or transact with.

We also assume that the food industry, which has received increasing public criticism of late, will have a number of sustainability issues to choose from such as over production requiring government subsidy payments, waste and spoilage due to the market environment\(^1\), transportation emissions due to food distance miles to get to our convenient stores\(^2\), and overall societal health degradation from unhealthy and unnatural processed foods. We believe that this degree of poor food-system design would likely be translated to the mango supply chain specifically.

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\(^1\) For instance, fruits and foods not meeting the shelf-life, transportability, size, and color characteristics required of large convenient store buyers such as Walmart, SuperValue, Safeway, and Krogers are simply not used and therefore ‘wasted’ by the food system.

\(^2\) In the United States, the most frequently cited statistic is that food travels 1,500 miles on average from farm to consumer. That figure comes from work led by Rich Pirog, the associate director of the Leopold Center for Sustainable Agriculture at Iowa State University. In 2001, Pirog analyzed the transport of 28 fruits and vegetables to Iowa markets via local, regional, and conventional food distribution systems. The team calculated that produce in the conventional system—a national network using semitrailer trucks to haul food to large grocery stores—traveled an average of 1,518 miles (about 2,400 kilometers). See: Sarah DeWeerdt, “State of the World 2011” published by WorldWatch Institute.
Finally, from an investor perspective, we presume that either firm size within the mango supply chain would not be a factor in eliciting investment since most business models and processes still consider lowest price, highest quality, and supply availability and accessibility above other less measurable moral or values driven assumptions that stakeholder theory considers for value creation. Thus, any investment in the supply chain would not come from the demand side—in this case from aggregation or from the MNC, but from competition in and along the supply chain segment markets.

**Introduction**

The word “mango” stems from the Tamil word ‘mankay’ which describes the sweet tropical fruit originating from the Andaman Islands, Burma, and East India. Persian traders introduced the fruit to West Asia, then North Africa in the 10th century and finally Portuguese traders sailed with the seed to Brazil and the West Indies in the 15th century where it continues to grow today (Royal Botanic Gardens). The mango has many uses outside of eating, such as medicinal uses where the leaves are used to reduce malaria fever and the skin and pulp are used to address skin and prostate cancer. Other medicinal uses are as an: anti-viral, anti-parasitic, anti-septic, and anti-asthmatic (Hirt). Nutritional, mangoes are rich in vitamin C when the fruit is still ripening and then vitamin A as the fruit gets sweeter and the sugars develop. Fiber, potassium, copper, amino acids and omega 3 and 6 are found in mango skin and pulp (Griesbach). Today, there are over 300-2,000 mango cultivars with most having been crossed (hybrid variety) to give us the best productivity, disease resistance, shelf-life, transportability, size, and most appealing color despite its fibrous flesh and only fair taste. This tells us how significant the ‘business’ side of mangoes is and reflects the US view since it primarily refers to the crossed Tommy Atkins mango cultivar.

From a production perspective, there are 40 million metric tons (MT) of mango produced globally in 2009. India is the largest producer growing 16.3 million MT while China grows only 4.3 million MT and has to import (see Exhibit 1 for a table of mango production by country) (UNCTAD). Yet mangos are not an export fruit. Of the 40 million MT produced, only about 2.5% is exported. The largest mango exporters are Mexico (10%), Philippines (8%), and Pakistan (8%) yet these figures only account for about 1.5 million MT (see Exhibit 2 for a table of mango exporters). The largest mango importers are the USA (45%), China (10%), Netherlands (8%), UAE (5%), and France (5%) where the US imports primarily from Mexico and Peru, the EU imports mainly from Brazil and Peru, the UAE from Pakistan, and China imports from India (UNCTAD). India, not surprisingly consumes just about all its mango’s (95%) while East Africa unfortunately allows them to fall to the ground since demand is almost non-existent.
When considering the supply chain as a tool for business analytics, only very narrow criteria have traditionally been used to evaluate the efficacy of each stage in the production of tropical fruit for global markets. Traditional supply chain analytical models have largely failed to capture the full life of our tropical fruit products. In essence, it is business as usual with linear analysis offering linear solutions and the basic business formula remains unchanged: raw materials fed into a processing or manufacturing plant then packaged into a product for transport to distant places intended for urban consumers. To gain a more clear understanding of the tropical fruit landscape, many other factors such as politics and governance, societal structures, culture, geography and environment must be integrated into the analysis.

**Co-operative Model**

**India**

About 65% of Indian population depends directly on agriculture and it accounts for around 22% of GDP. Furthermore, in terms of total fruit production on a global basis, India ranks first in area and production of mangoes, accounting for about 41% of world mango production (19.22 million tons in 2010) (Kumar) (Rehmankhera). The Maharashtra region has been known to produce approximately 597,000 metric tons of mangoes, with almost 474,000 hectares under cultivation (Madaan).

Within that context, we explore the Devgad Taluka Mango Growers Co-operative Society Ltd (Devgad). Devgad is a co-operative society named after the coastal town in India where it was formed in 1987. The coop works with over 700 farmers from approximately 70 villages who grow and market the regional *Devad Hapus* mangoes, more popularly known as Alphonso mangoes, across the country and globally. The coop produces close to 50,000 tons of Alphonso mangoes with 45,000 acres under cultivation. The organization provides technical know-how, helps its members with knowledge of best cultivation practices, supplies them with fertilizers, pesticides, and creates awareness on best practices on how to manage orchards. The co-operative is owned by the member farmers and the board of directors is elected every five years from among the members. All profits come to and are distributed as dividends to the members. The directors do not earn a salary; only the managing staff does. As decided by the directors and approved by the members in AGMs and other meetings, the dividend is held back as profits for investment in objects of common benefit; the brochure in Exhibit 3 highlights an example of how the dividends are used to invest in a factory that benefits the coop’s operations. The nature of the co-operative is such that there is no sole family or clan that runs the business decisions. Instead, it represents a mix of many castes, religions (primarily Hindu, but diverse), and is an overall communal operation. Women also hold certain positions on the Board, however they are not normally active in the day-to-day activities and decision-making processes. The Board has seen some challenges in getting women engaged
in Board activities. This may be the result of the women’s domestic responsibilities and other social challenges conflicting with their co-operative participation.

As seen in Exhibit 4, the co-operative is the central intermediary between farmer groups and the buyer of Devgad mangoes. Furthermore, by facilitating distribution and transportation, Devgad provides an important business scale to the farmers who would otherwise have to resort to these arrangements on an individual basis. The co-operative also acts as a mediating link between mango growers and state government, agricultural universities, and government agencies.

**Supply Chain Overview**

The supply chain under review can be summarized primarily as the ‘production’ and ‘distribution’ phases within the life-cycle of the mango (see Exhibit 5 for a supply chain depiction of this). The phases of consumption and waste management are not explored for this co-operative model.

*Production:* This phase can be defined to cover the period when the trees are planted as saplings to the time fruit is in the tree. There are three primary activities that take place during this phase. First, the harvest period is marked by the planting of the mango trees. The resources used are rain-fed and pumped irrigation and a mix of natural and chemical fertilizers such as Di-Ammonium Phosphate (DAP), Urea and cow manure. Fertilizers are applied only once during the rainy season. For a normal sized tree, it takes approximately 35 kg of organic fertilizers, such as cow manure compost or vermicompost, goat manure and approximately 5 kg of chemical fertilizer such as Urea and DAP. Pesticides are generally provided between the months of October and February and there is no fixed quantity or fixed type of fertilizer. Thus, the production process is an annual cycle with a designated time line to provide external nutrients to plantations.

Second, plucking is a very important aspect of the production process because the timing is crucial to increase mango shelf life before the distribution stage. It is common practice to pluck the mangoes from the trees when the fruits are 75% ripe. This ensures longevity to the mango while it goes through the process of distribution since fully ripe mangoes are both fragile to transport and also sour quickly.

Third, ripening occurs when mangoes are dipped in aqueous mixture, primarily consisting of Ethrel and water. Ethrel is an external heating agent that is used to release Ethylene gas to provide necessary heat for uniform ‘ripening’. Since not all mangoes achieve the same state of ripening in the ‘plucking’ stage, this activity allows for standardized appearance. Furthermore, this reduces damage in transportation and ensures that mangoes have similar texture and flavor.
**Distribution:** This phase is defined as the time from when the mangoes are ready to be shipped (packaging) until they reach the end consumer (transportation). It is important to have a quick turnaround between the production and distribution phases since no cold-storage or warehousing option is feasible.

**Packaging** accounts for who the end-consumers are. If mangoes are travelling to retailers and traders, the mangoes are packed in boxes made of wooden strips that can be easily dismantled. These strips are brought in from states in Southern India that are known for making pliable wood and are not manufactured on-site by the Devgad co-operative. The benefit of this packaging is that the wooden strips are re-usable and are returned to the co-operative. It is estimated that about 90% are returned, yet only 80-75% are usable because of damage caused by nails or because of the monsoon rains. The wood that is not used for packaging purposes is then used as fuel. When preparing a package for final consumers, the co-operative packs the mangoes into re-cycled paper cartons. The primary packing material are dry leaves (the by-product of rice that is used to ripen mangoes) and is made locally. The mangoes are packed in cartons of 1, 2, or 5 dozen mangoes with 1 dozen mangoes per box. The weight of mangoes ranges between 2.5 KG to 3.5 KG per dozen, and this has an impact on the capacity of the boxes and in turn the number of vehicles used in the next activity within this stage – transportation.

**Transportation** is not owned or managed by the Devgad co-operative. They have aligned with third party transport operators providing mango box moving services. Thus the co-operative does not get involved in the transporters’ management practices including choice of vehicles or polices.

**Internal Analysis**

The supply chain activities simply provide the foundation for our analysis to be completed. We now begin to analyze Devgad’s supply chain using the 5-capitals framework which accounts for economic and financial impacts along with social, environmental, political, and human dimensions as well. See also a SWOT analysis in Exhibit 6.

**Economic:** The co-operative model has contributed to local economic progress by bringing together over 700 farmers within the Devgad community over 25 years. Crucial to the economic prosperity of the region, Devgad brings together farmers who otherwise are unable to participate in the market because of economic marginalization, limited quality control, and non-existent bargaining power with traders. Devgad has limited financial capacity when compared to large corporations because of its limited economies of scale. It only deals with produce from 700 farmers in a market where the number of other competitors (even though they are fragmented) runs into the millions. Limited financial resources prevent Devgad from creating a more sustainable and efficient production process, which also results in lower revenues for its members. The current supply chain does not help Devgad create brand value and is hurting their profit margin for two reasons. First, the current mango supply chain in India is complex and
influenced by middlemen and traders. Second, farmers have limited information about market prices because they rely on 3rd party transporters.

**Social:** There is an unequal division of land among farmers and production inputs are not shared with farmers. Every farmer has to buy and arrange their own farm inputs including fertilizers and pesticides. As a result, production per unit of land can vary from farmer to farmer depending on resource availability and accessibility. Even though the co-operative model is an open model with participation for all, farmers with a larger produce usually have a bigger share in the co-operative society and thus have a greater say in the supply chain process. Furthermore, farmers with larger produce and shares in the co-operative society are usually given preferential treatment for transportation of their produce. As discussed earlier, gender inequality exists within Devgad’s Board. Women are not active participants and it is unclear what efforts have been made for greater gender equity progress within the co-operative.

**Environmental:** The combined use of both chemical and natural fertilizers makes waste-management problematic. The result is a ‘monstrous moral hybrid’ that renders it unable to be recycled or reused by either system. Most monstrous hybrids are neither recyclable nor reusable. The use of Ethylene gas for ripening mangoes serves as an important process to longer shelf life and transportability. While it does not compromise the flavor of the fruit, it does add to the list of chemicals used during the mango supply chain. The co-operative has a system in place where it attempts to use local and re-usable material for packaging such as down-cycled wooden crates and cartons made of used paper. However, the manufacturing process of wooden crates involves the use of fossil fuels. Furthermore, transportation of mangoes to market for wholesale as well as individual delivery also relies on fossil fuel burning trucks.

**Political:** The co-operative is not aligned with the ruling party. Unfortunately, this leads to delayed government benefits such as subsidized seeds or tax benefits for its members. Corruption is also an issue that is difficult to quantify but which must be highlighted as a transaction cost.

**Human:** There are dangerous chemical compounds that are used during the phases discussed, however the co-operative does not have protective equipment to limit or prevent human contact with toxins. This creates concerns about the long-term health of the workers. Due to the nature of agriculture, the production phase includes an ‘all-hands-on-deck’ approach which occasionally uses informal child labor. Finally, in the distribution process, most packaging and transport requires cooler weather since excessive sunlight can damage mangoes and prevent their marketability.

**MNC Model**

**About Coca-Cola**

Founded in 1886, the Coca-Cola Company, also known as Coca-Cola, is the largest beverage company in the world. In 2011, Coca-Cola realized more than $45 billion in operating revenues and more
than $10 billion in operating net income. Coca-Cola has 15 $1 billion brands and distributes products in more than 200 countries worldwide. Coca-Cola’s global supply chain and distribution operations have been fundamental to its continued success, so much so that academics and other industries, such as the medical field, look to Coca-Cola’s model to leverage best practices (Yadav).

Coca-Cola’s strategic vision for 2020 anticipates doubling revenues placing greater pressure on reliable sourcing for the long term (Coca-Cola Company). As a result, Coca-Cola has entered into many new emerging markets to broaden its geographic supply chain network. In order to ensure that quality standards are followed, production capacity is maximized, and infrastructure is available for transportation, Coca-Cola has embraced the idea of public private partnerships (PPPs) and helped organize co-operative type business models with TechnoServe, an emerging market business development nonprofit, that they refer to as producer business groups (TechnoServe).

While Coca-Cola is predominantly known for soft drinks, fruits are a major production input in many of its products, including its Minute Maid Juice Brand. Coca-Cola’s fruit juice products rely on a steady stream of agricultural produce from a wide range of sourcing locations. Minute Maid is primary known for its orange juice, which is much larger in scale and scope than the mango supply chain. To date, Coca-Cola has only recently moved into the tropical fruit space, initially penetrating the market with its Odwalla brand in India. The only other mango production for a Coca-Cola brand is in Haiti and East Africa—both new supply chains that require significant investment to reach market. This paper will concentrate on Coca-Cola’s mango supply chain in East Africa where a new public private partnership titled “Project Nurture” has been established between the Bill and Melinda Gates Foundation, TechnoServe, Coca-Cola, government agricultural extension offices, NGO’s, and other private sector agronomy firms.

**East Africa**

The eastern region of Africa is one of the more unique and diverse places on our planet. From an agricultural perspective, it is an agrarian society with upwards of 80% of the population engaged in subsistence farming and accounting for nearly 45% of GDP for the region (World Bank). Although the region is a net importer of food, it has the largest share of exports on the continent—and this makes sense: Ethiopia is the largest maize producer and Kenya the largest dairy producer, two dietary staples for East Africans (FAO STAT). With respect to mango, Sub-Saharan Africa produces 2.8 million MT of mango, over half of which is from East Africa, primarily for internal consumption while formal market demand is nearly non-existent (FAO STAT).
Supply Chain Overview

The supply chain for mangoes can generally be broken out into six phases: Input Suppliers, Farmers or producers, Assemblers and traders, Wholesalers and processors, retailers, and customers (TechnoServe). For the purpose of this paper we analyze the supply chain specifically to the mango and stop once the mangoes from the trader to the wholesaler. This more closely aligns to the cooperative model described above that does not enter into processing. Through public private partnerships, Coca-Cola heavily influences the use of sustainable practices among input suppliers and producers through investments and donations to nonprofits, such as those in Project Nurture.

Project Nurture Supply Chain Overview

In East Africa, the mango has typically been a subsistence crop, one that every farmer has on their farm and that is turned to in times of need. The mango, although widely available in the region, is not a staple in the diet for most adults, however you would be hard pressed not to find a child eating mango throughout the region. This cultural relationship to mango is important because it speaks to the marketability of the crop and the limited investment that farmers and the government have placed in it. The entire supply chain of mango could easily be interpreted as farm to farmer. Yet this story is slowly beginning to change. In Eastern and Southern Africa the market for organic produce is growing at a 3-yr average of 34%, with consumer trends increasingly moving toward healthier diets. With this level of growth, SME firms began considering the market for mango juice, but could not enter because of cheap concentrate imports from India and elsewhere. But now that the trends of social responsibility and small holder have surfaced in the general development debate, larger firms, like Coca-Cola have emerged with significant investment dollars, in this case $11.5 million, to build the entire supply chain from the ground up. To do this, Coca-Cola has partnered with TechnoServe of the US to fully develop a more robust and sustainable mango juice product. Inherent in the design of this business model are the socially desirable affects that many social entrepreneurs would applaud. However, we realize that in the supply chain under review, a number of other dimensions within our 5-capitals framework are ignored or considered unimportant.

The supply chain segments prior to processing includes research and development, farm input supplies and materials, other supplies, primary production, aggregation and mobilization, transportation, trading and grading, transportation, and wholesale. The supply chain activities include: 1) Research and Development where Coca-Cola performs due diligence on new juice brands as customer preferences change from unhealthy Coca-Cola soft-drink products to fruit juices; 2) Raw Materials Market where local firms and suppliers sell farm inputs such as seedlings (in nurseries), fertilizer, farm implements and

3 Note: Transportation of raw material inputs are not included in this analysis.
tools, while government investment in agriculture extension agents and land tenure laws and systems for land use are core to the establishment of productive farms; 3) Other Input Markets where the sale of credit financing and insurance takes place along with appropriate training and education for farmers; 4) Primary Production from existing “Sena” variety trees with new grafted seedlings planned; 5) Mobilization and Aggregation of small holders to create scale economies through ‘Producer Business Groups’; 6) Bulking and Sorting at re-furbished facilities central to the farmers; and 7) Transporting mangoes between sorting facilities and the processing facility, which is also central to the two production zones.

**Internal Analysis**

We apply our 5-capitals framework to each segment of the mango supply chain in East Africa and learn that a number of responsible and equitable aspects within the chain exist, specifically as a result of how Project Nurture collaboratively designed the supply chain. We find that the stakeholders involved are a broad representation of civil society, private sector, and government with significant voice from the ‘bottom’. We also learn that economic information is difficult to find due to competition and Coca-Cola being a first mover in this space. Yet it is clear that a number of stakeholders benefit along each segment of the supply chain, possibly re-distributing value from downstream activities that we do not analyze. Socially, the coordination and incorporation of co-operatives into a private sector supply chain is unheard of and therefore is a great benefit to society; and this includes the gender equity component as well. On the environmental dimension, the partnership with organic agronomists for pest and disease control is new in the corporate setting, another positive. But there are hidden environmental costs related to water and land use, including policies associated with this that cannot be priced in due to data restrictions. In terms of labor and the human impact, the scale of this project out shines any in living memory: upwards of 54,000 small holder farmers will be incorporated into the model. The outspoken critics will indicate that middle-men will suffer the consequences since they will be priced out, but if we know middle-men, they will find a way to participate in the market that benefits them. Finally, the political aspect is incorporated with the partnership of the Ugandan and Kenyan governments. This however comes at a price since much of the resources leveraged are from the donor level, with very little resources offered by local governments (due to budgetary limitations). A more comprehensive analysis can be found in Exhibit 7.
Comparative Analysis

Having used the 5-capitals framework to analyze each respective supply chain independently allows us to make some general comparisons. The general comparisons we will highlight consider five dimensions that broadly correlate with the capitals framework. These areas are production inputs, product sourcing, natural resource use, overall energy use, and the social implications and effects within the supply chain. We use these dimensions to further explore areas that are both specific to a supply chain segment and that affect the entire chain (see Exhibit 8 for an overview of supply chain analysis).

**Production inputs** are for the most part similar across both firms. Both firms will utilize indigenous trees to produce mangoes. The possible downside to this is the production capacity of newer grafted trees often times produces three to four times the yield leading us to question the trade-off between using indigenous trees that take up more space possibly leading to deforestation or further land pressures on growing populations in both the India and East Africa cases. We therefore cannot offer a concrete positive or negative valuation of this due to future unknowns; however, if industry demand remains constant, using indigenous trees is a net positive for both firms. The other production input we analyze is fertilizer consumption and use. Both firms use a form of integrated pest management, yet in Devgad’s case, synthetic fertilizers are used to a greater extent than we initially presumed. In Coca-Cola’s case, they have partnered with Real IPM, a South African firm that incorporates more biologically natural systems for pest management which includes organic applications and companion planting to support the biodiversity of trees. Even with these organic interventions, Coca-Cola must still apply synthetic fertilizers that can be toxic, yet this amount is much less than what we anticipated for such a large firms often times associated with the larger synthetic food system.

**Product sourcing** has always been a challenge for the food system. The reason is economies of scale often directly correlate with profitability for a large firm. Working with many small holders is costly and requires strong relationship building, something large firms typically do not specialize in due to their bureaucracies. For both firms, they work with small holders (TechnoServe). Distribution within small holders continues to favor the power structures that exist in those societies. For instance, in the case of Devgad, women are discriminated against at the small holder level while tribalism affects the East

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4 For Coca-Cola, the “Sena” mango variety is a small and rather sweet mango fruit which is local to Eastern Uganda and Western Kenya. The word “Sena” is Luganda for “to scoop or to pick up”. This is because it is harvested by climbing up a tree, shaking a branch and picking up the fruits that fall to the ground. This variety of tree fruits abundantly and is not commercially grown but rather a tree in a homestead with little commercial value attached, giving rise to the name “Sena” or just go pick up all that you can carry. The season for harvest is typically May – July, but may vary with area and variety (see Exhibit 9 for a table of Ugandan mango fruiting periods).

5 In the case of Kenya, in 1963 10% of the country was covered in tropical rainforest, whereas in 2006 only 1.7% survived. See BBC News, “Kenya’s Heart Stops Pumping” - http://news.bbc.co.uk/2/hi/africa/8057316.stm

6 According to the World Bank, in 2011, Uganda was growing the fastest at 3.2% (formally), Kenya at 2.7%, and India at 1.4%. Yet 1.4% on over 1 billion people is much more than 3.2% on 30 million people in Uganda’s case.
African case and stronger relationships to local political systems favors those already in positions of power. With a broader understanding of the food system and the historical context that small holders have continuously been excluded from formal markets, the use of small holders is a net positive for both supply chains.

**Natural resource use** is one of the most significant inputs in agriculture. Our focus here is on the use of water. Both firms utilize rain fed systems of irrigation due to limited rural infrastructure and this produces quality mangoes in both cases. As indicated earlier, capital investment for the co-operative society is difficult to access and therefore limits the supply chain investments. The potential for damage arises when a larger firm, like Coca-Cola, needs to produce greater quantities of mango to meet consumer demand. We can only speculate that the challenge will come when additional water resources are needed which may preempt the firm to tap public water tables below the surface of their small holder farms. In addition, there have been dramatic shifts in climate in the East African region lately. In 2011, one of the worst droughts in 60 years covered the region and rain fall itself has fallen less. Uganda rains have declined from normal averages by 20% and Kenya rains have declined more than 100 millimeters (also 20%) since mid-1970’s, with drying trends impacting heavily populated areas the most (FEWS NET). Since we cannot predict the future demand, the current natural resource use is considered to be a net positive for both firms since natural irrigation schemes are nature’s gifts.

**Energy use** for the earlier segments of the supply chain prior to processing are mostly natural and in particular are the sun and human labor. Yet we still must consider the transportation aspects of aggregation prior to processing. Both firms utilize fossil-fuel-polluting diesel trucks however the in Coca-Cola’s case, they have strategically positioned their processing facility between both the Ugandan and Kenyan production zones limiting transport miles prior to processing. We therefore consider this a net positive for Coca-Cola and a net negative for Devgad (even considering that Indian mangoes will be consumed on the local markets, they may be consumed at much farther distances than Maharashtra).

**Social effects** in this context include trust, human labor, equity, education, and culture to name but a few. Along these lines, we see that Devgad has a long standing relationship with its producer base whereas Coca-Cola is only just beginning; therefore social capital must be earned for the large firm, a net negative for Coca-Cola. We also find that both firms offer local labor to small holders and promote social justice and equity by translating fairer prices farther up the supply chain. Both firms also offer education to its farmers, yet it could be argued that with such a robust public-private-partnership for Project Nurture in East Africa, that education is greater, especially since they have formalized partners in agronomy (e.g. Real IPM). It is still too soon to consider the impact on local East African culture, yet the mere fact that Coca-Cola is partnering with a local NGO demonstrates that local civil society can translate any misconceptions that a direct firm relationship might miss. This is inherent in the co-operative society.
model. Yet the final aspect that tips social effects in favor of Coca-Cola is the overwhelming scale with which their model impacts small holders. Their goal is to work with 54,000 small holder farmers in contrast to 700 farmers for the co-operative society. Since we have not seen the longer term impacts of what these relationships mean for Coca-Cola and the communities they work in, we can only use current scenarios. We therefore believe that this is a net positive for both firms, but the massive scale that Coca-Cola offers means more sustainable possibilities when measuring social aspects.

The question of ‘who is more sustainable or responsible’ is not appropriate in this context. The better question to assert is: “which firm offers more comprehensive value to its stakeholders when considering more than just profits?” (since profits do not account for the other dimensions which also offer value, but which are not measured). Another drawback that we can relate to the supply chain analysis is information flows versus physical flows. Typically, supply chains connect the physical aspects of the firm’s dealings and transactions, however it fails to consider the information that is exchanged along the way. These linkages between firms include information sharing, bulk purchasing of inputs, contract farming, and industry branding campaigns for instance. Additionally, the supply chain is not static or fixed, market dynamics do in fact matter, quality and service are important, and the business environment is often not considered—even though we considered the political dimension in our analysis. Due to data limitations, value captured at each link in the chain is not easily identified nor openly offered by businesses since this information could be the ‘secret sauce’ maintaining the firm’s existence. Finally, a common mistake in the analysis is shifting value within the supply chain instead of creating more value when the analysis is completed. In our case, we are redistributing value higher up the supply chain, closer to small holders.

Understanding our Assumptions

When our team initially set out to uncover both mango supply chains, we put forth some assumptions based on our own understanding of the food system and how different sized firms have resources to employ. We were proven wrong in presuming that Coca-Cola viewed supply chain inputs in a narrow business (profit only) perspective. Their public-private-partnership in fact works at the grass roots level, incorporating communities and local voices as they build their business. With respect to supplier relationships, again we were proven wrong since we presumed that Coca-Cola as a large firm would be less sustainable due to high levels of resource extraction and greater exploitative power over its suppliers. Clearly they are interested in investing in the supply chain to gain greater control over their production inputs but also to more fully integrate ecological, social, and economic value along the supply

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7 The characteristics of value chain relationships that have the largest effect on the level of trust between participants include – length of trading relationship, ordering procedures, contractual relationship, inspection, degree of dependence, technical assistance, communication, price determination, credit extension, and outsourcing payment terms—all in priority order (Labaste).
chain. On the other hand, Devgad is not able to offer this level of investment, but we anticipated this due to the nature of the co-operative society and scale opportunities.

In Devgad’s case, we were re-affirmed in their goals of ensuring social and economic justice to their farmers by establishing fair prices, bargaining power, and product consolidation for reduced carbon footprint. On the other hand, we learned that not all their farming practices were natural prompting us to consider their use of toxic synthetic fertilizers as “monstrous moral hybrids”, a term coined by Jane Jacobs and which speaks to the co-mingling of two different value systems—the commerce syndrome and the guardian syndrome. Devgad’s basic farmland practices are sustainable, but it mixes biological and chemical fertilizer nutrients and uses chemical compounds for artificial ripening.

These assumptions are important because they emphasize how our underlying beliefs in a system can sometimes fail to fully explain how business models work. A number of new questions emerge to which we do not immediately have the answer, since we have yet to work through these questions individually, in groups, as a society, or in the firm. Yet by offering up alternatives that themselves are unsustainable and that do not fully incorporate holistic design principles, we further alienate the sustainability debate due to the weak alternatives. Our finding has been that we need to create a platform for dialog to ensure that we can incorporate all stakeholders in the conversation while also re-evaluating and re-measuring how we see value.

**Conclusion**

We have analyzed the whole mango fruit in the supply chain of two very different firms, in two different markets. The mango supply chain for a co-operative society like Devgad in India differs only slightly when comparing this to a large MNC like Coca-Cola who is vertically integrated in East Africa. From our sustainability lens where we believe that systems must be regenerative and balanced in order to last, we consider each firms supply chain using economic, social, environmental, political, and human impact assessments presenting this data for comparison. We do not conclude that one supply chain is superior to the other, however, we have highlighted the differences for further analysis and debate to unfold. Specifically, we ask: *Do smaller and locally connected suppliers indicate more sustainable practices? How much does investment play a role in achieving sustainable value chains? Will large corporations become true leaders in sustainability? Are the goals for sustainability in-line with the goals of corporations?*

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8 The idea is that when you co-mingle these systems together, what is considered a virtue in one system turns into a vice as a result of the inherent change in the dynamics of the system with the introduction of a new value. See “Systems of Survival: A Dialogue on the Moral Foundations of Commerce and Politics” by Jane Jacobs, 1992.
If there is one thing that we learned as a result of the sustainability debate, it is that we are never comparing mangoes to mangoes. As long as values, morality, and doing the ‘right’ thing is looked at through a narrow business lens of economic and financial indicators of conventional profit, where not all of the costs are incorporated into the price of products and where reporting standards are not designed to measure more comprehensively the areas of life that we value most, then we will continue to struggle with the sustainability debate. In closing, Wendell Berry expressed this most eloquently when he wrote in 1969:

“We have lived our lives by the assumption that what was good for us would be good for the world.

We have been wrong.

We must change our lives so that it will be possible to live by the contrary assumption,

that what is good for the world will be good for us.

And this requires that we make the effort to know the world and learn

what is good for it.”
Bibliography

FAO STAT. Food and Agriculture Organization of the United Nations. 2013. 2013
### Exhibit 1
Global Mango Production 2010 (MT)

<table>
<thead>
<tr>
<th>Country</th>
<th>Production</th>
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</thead>
<tbody>
<tr>
<td>India</td>
<td>16,337,400</td>
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<tr>
<td>China</td>
<td>4,351,593</td>
</tr>
<tr>
<td>Thailand</td>
<td>2,550,600</td>
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<tr>
<td>Pakistan</td>
<td>1,784,300</td>
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<tr>
<td>Mexico</td>
<td>1,632,650</td>
</tr>
<tr>
<td>Indonesia</td>
<td>1,313,540</td>
</tr>
<tr>
<td>Brazil</td>
<td>1,188,910</td>
</tr>
<tr>
<td>Bangladesh</td>
<td>1,047,850</td>
</tr>
<tr>
<td>Philippines</td>
<td>823,576</td>
</tr>
<tr>
<td>Nigeria</td>
<td>796,200</td>
</tr>
</tbody>
</table>

Source: UNCTAD

### Exhibit 2
Global Mango Exports 2011 (% Share of total)

<table>
<thead>
<tr>
<th>Country</th>
<th>Export Share (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mexico</td>
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<tr>
<td>Philippines</td>
<td>7.8</td>
</tr>
<tr>
<td>Pakistan</td>
<td>7.6</td>
</tr>
<tr>
<td>Brazil</td>
<td>6.0</td>
</tr>
<tr>
<td>India</td>
<td>5.2</td>
</tr>
<tr>
<td>Netherlands</td>
<td>3.3</td>
</tr>
<tr>
<td>Peru</td>
<td>2.0</td>
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<td>Guatemala</td>
<td>1.9</td>
</tr>
<tr>
<td>France</td>
<td>1.7</td>
</tr>
<tr>
<td>Haiti</td>
<td>1.3</td>
</tr>
</tbody>
</table>

Source: CIA World Factbook 2011

### Exhibit 3

**New Chapter in Devgad's Life...**

After 25 years of serving interests of Alphonso mango farmers, Devgad Taluka Amba Upadak Satsakari Sanstha Maryadit has taken an ambitious project of a processing factory at Dahholi Palarhav. The factory worth Rs five crore with contribution from Government of Maharashtra, marks a new chapter in the life of Devgad and the hundreds of mango growers in the taluka. This strengthens the efforts of our Sanstha to ensure a strong place for Devgad Mango and its products in the market.

You know the challenges before us in our efforts to cultivate the Devgad Alphonso Mango. The fruit we grow is recognised as world’s best mango. Globally and in many markets in India, traders and vendors sell any mangoes using the Devgad name and fill their pockets. Why should we let them do that? Why should we not stand up for our mango and ensure that we get adequate returns for our efforts? It is not always possible to send our fruits everywhere because of its perishable nature. In such places, pulp and other products made from the fruit can be sent. Processing the fruit also increases its value and shelf life, which brings additional income for farmers.

With these thoughts, our former MLA Shri Ajit Gogate conceptualised the factory and started its process in his tenure as the MLA. MLA Shri Pramod Jathar continued with the baton he took over from Shri Gogate and with his untiring efforts, got the project approved from the ministry and he has received the first installment of the Government’s contribution.

Now this is just the start. The factory is expected to be constructed and start functioning in 2 years, if we receive support from all of our members and well-wishers. The Sanstha is doing its part and you also have to do your bit. Now it is a big responsibility before all of us to raise the funding and share capital for the factory. This is going to be your factory and you have to put your contribution into it. Please come forward and write the new chapter.
### Exhibit 6
SWOT Analysis – Devgad Co-operative Society

<table>
<thead>
<tr>
<th><strong>Strengths</strong></th>
<th><strong>Weaknesses</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>+ 700+ farmers are engaged in this co-operative.</td>
<td>- Lack of financial resources</td>
</tr>
<tr>
<td>+ Expertise in mango production and brand name of Devgad for alphonso mangoes</td>
<td>- Political Connections</td>
</tr>
<tr>
<td>+ Online ordering to reach end-consumers directly</td>
<td>- Use of mixed chemical and natural fertilizers</td>
</tr>
<tr>
<td>+ Use of re-usable and locally available packaging material</td>
<td>- Lack of control over the transportation phase</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Opportunities</strong></th>
<th><strong>Threats</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>+ Investments in the community to engage women and youth</td>
<td>- Change in consumer tastes</td>
</tr>
<tr>
<td>+ Expanding exports using cold storage option</td>
<td>- Climate change or change in harvest and production seasons</td>
</tr>
</tbody>
</table>
Exhibit 7
Mango Specific Supply Chain in East Africa—Details

R&D: The research and development phase is probably one of the most important as it directly relates to the final product that Coke will produce. Coke performs due diligence on new juice brands and develops an understanding of customer preferences. It must take into account any health aspects to product consumption.

- Stakeholders
  - The Bill & Melinda in partnership with TechnoServe aims to help 54,000 small-scale mango and passion fruit farmers in Kenya and Uganda double their fruit income.
  - TechnoServe provides support by having individuals partners with various small growers to enable them to become better by educating them on best practices as it relates to growing mangoes
  - US AID in partnership with TechnoServe will look to contribute $7.5 million to help develop a sustainable mango industry in Haiti
  - Coca-Cola South African Bottling Co provides the location where mangos will eventually turn into a juice product

- Economic
  - More research money is needed on the “Sena” mango variety. In the past, buyers considered this variety to be too low quality for fruit juice, but through education and awareness, buyers can be informed that this in fact is not the case. As a result, this will lead to more purchases of the “Sena” mango variety.

- Human
  - Coca-cola has many varieties of juices and soda products. They must consider the health impacts to their consumers.

Raw Materials: Before any mangos can be grown, the growers and farmers need to have a source for growing the mango. This is normally various mango seeds that come from seed dealers or nurseries. Additionally, to enable better growth, these growers and farmers need to find fertilizer to help in the cultivation of the Magno.

- Stakeholders
  - Kenyan Agricultural Research Insitute (KARI) seeks to enable higher yield to growers and farmers by introducing additional mango varieties.
  - National Crops Resources Research Institute (NaCRII) investigates how various types of fertilizer can provide better growing conditions to the mango
  - Real-IPM is an organization that looks to provide education to growers to become insecticide-free.

- Economic
  - Seedlings, fertilizer, land, water are all raw materials that at some point go into some part of the mango life. These are all expenses to farmers/growers that must account for them as part of their business.

- Social
  - Small holders do not need to replant trees as the “Sena” variety that is already present is used to grow the Mango.

- Environmental
  - There is a large environmental benefit to the region since no need to cut down mango trees to re-plant or to clear more land for mango trees as the “Sena” variety supposedly is
native to Eastern Africa. Growers also need to think about integrated pest management a system which reduces synthetic fertilizer consumption and if Real-IPM can be delivered, then huge benefits would come and provide for sustainable agriculture. Additionally, growers need to think about the possibilities of drought in the region as this location has a tendency to be dry. Additionally water availability is a challenge, which results in soil degradation as the land is exacerbated by synthetic fertilizers.

- **Natural Resources**
  - The scale that a Coca-Cola will need to supply its manufacturing plant will far outweigh those mango trees already in existences in Uganda and Kenya and as a result more land might be required. Farmers will look to leverage solar energy for instance and water for irrigation.

**Other Inputs:** This phase of the supply chain includes other potential inputs that don’t directly involve working with the mango plant. These could be things like financing, insurance, and training and education.

- **Stakeholders**
  - Financial institutions, Equity Bank, Centenary Bank, World Bank
- **Economic**
  - Investors that decide to participate in the local eastern African economy have the potential to see above market level returns as these areas may not be saturated with advanced/modern tools and implementations. Growers/Farmers might purchase other suppliers from larger vendors in Kenya, leaving Uganda vendors out. There is also a sense of excessive levels of credit that in turn causes inflation in an already volatile market. Kenyan CPI for example reached 19% in 2012, but now currently at 3.7%. The Uganda CPI reached 30% in 2012, but is now only 4.9%.
    - [http://www.knbs.or.ke/](http://www.knbs.or.ke/)
- **Social**
  - We have already seen the effect of excessive levels of credit into a small region of an economy can do to prices. Without proper education on insurance, farmers might not understand its use and benefit. As a result, there needs to be greater community wide knowledge outreach and education on sustainable farm practices
- **Political**
  - The financial markets must be defined enough for investor to enter the market and see returns. Furthermore, there must be a connection to high level ministry officials to properly develop policy to support development. Lastly, with insurance being matched by USAID’s AMA program, the local financial markets are not evolving nor participating.

**Primary Production:** The primary production phase includes having existing Sena mango trees at networked small holder’s farms. Additionally, new grafted mango seedling can be planted to expand the variety.

- **Stakeholders**
  - Small holders (growers)
  - Farmer groups / cooperatives
- **Economic**
  - For Coca-Cola, a sustainable agriculture campaign highlights new markets for their products. The hope is that this effort increases small holder farmer income from underutilized capacity of existing resources (mango trees) on ‘shamba’. Additionally,
local demand for mangoes has increased prices. This is good for those selling locally, but negative for those buying locally.


- **Social**
  - On the social side, there may be possible tensions between those ‘in’ the market and those ‘outside’ the market. Most village communities do not like to see their neighbors succeed and there seems to be a high level of competition. As a result this could have the potential to produce unknown effects and further entrench power structures (corruption, favoritism, paternalism, tribalism, etc.).

- **Environmental**
  - There is little environmental impact using rain-fed agriculture so no there is excessive use of water unless Coca-Cola introduces methods to tap water tables using bore holes and rivers. However, this could potentially limit diversity of plantings. Historically when a cash crop is introduced, many flock to this and the market is saturated. Some examples include vanilla, coffee, moringa, etc.

- **Human**
  - There have been approximately 40,000, small holder farmers trained along with 14,000 women and 56,000 farmers considered small holders.

- **Political**
  - The political impact Ministry of Agriculture must begin to track this data and offer statistics for other businesses. This might give greater voice to small farmers in the region if local government supports their efforts.

- **Natural Resources**
  - In the east African area Mango Farming there is no mechanization. Thus, carbon capture is increased (with reduced soil uncovering and increased tree cover). One topic to think about is if pumps are introduced to wells, then this could potentially be powered by solar or electric and as a result use some of the natural resources.

**Aggregation:** In the aggregation phase of the supply change, Coca Cola must organize farmers to create scale via farmer groups and cooperatives. This would include activities such as bulking & sorting. Additionally, Coke should look to deliver business development services in order to create a sustainable aggregation cycle.

- **Stakeholders**
  - Farm Concern International
  - Kainjia Mango Farmers Association

- **Economic**
  - Coke should look to spur economic growth. This in turn would reduce the cost to manufacturers and buyers and open markets for small holders who couldn’t find these markets before. If this process happens at the local level, it might also duplicate itself at the wholesale level closer to urban areas/processing centers which typical to have more middle men in the value chain

- **Social**
  - Trust is the more important and the most challenging for these regions. Those who will benefit from this new market will be defined by those power structures in place now. Typically, there exists no organizing body due to limited trust / corruption among farmers. What this regions needs is an external actor. If the middle men can be cut out it might improve the social capital of the area

- **Environmental**
  - The environmental impact packaging material might be an issue at this point if not addressed sustainably
• Human
  o The political impact middle-men might be out of a job and might look for other ways of disrupting the market. However, small holders are gaining greater share of rewards

• Political
  o Middle-men most likely have more voice at higher levels of government or at least are connected to local governance structures. As a result, they may have greater influence with various policy creation.
To put the analysis in perspective, most products in developing countries use relatively simple supply chains that focus on getting a product, such as an undifferentiated commodity to either domestic or international markets. From this perspective, the challenges are to find low transaction costs, to push greater quantities of product to the market, and to reduce losses from spoilage, waste, or theft. From the perspective of the in-country supply chain participants, these chains are typically supply and production driven, which poses its own challenges if the producer’s interests do not align with market needs, usually for less integrated firms. The key here is to find ways to reduce production and logistic barriers along with improving the enabling environment through government policy, tax subsidy, or import levies to protect against cheaper competition and therefore to offer control over an environment that is volatile and informal. There is a “market information gate” that prevents small domestic producers from understanding the export market, presenting both a challenge and an opportunity for forward or backward integration along the supply chain (Labaste 85). We find this very situation in Devgad’s case since mangoes in the Indian market are undifferentiated, whereas mangoes in the US or EU are ‘exotic’. Therefore, Devgad’s primary challenges of capital restrictions and low brand value reinforce this view since they are not exporting. On the other hand, Coca-Cola as a large MNC, is fully integrating forward and backward along the supply chain with their end consumer in regional markets, requiring export and their supply chain participants are driven by demand, not supply.

### Exhibit 8
Supply Chain Specific Analysis Framework

### Exhibit 9
Mango Fruiting Periods in Uganda and Kenya, East Africa

<table>
<thead>
<tr>
<th>Months</th>
<th>J</th>
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<td>Central region (Masaka, Luwero)</td>
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Source: Market survey 2003