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Creating Sustainable Businesses by Reducing Food Waste: A Value Chain Framework for Eliminating Inefficiencies

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Abstract

This study proposes a systematic value chain approach to helping businesses identify and eliminate inefficiencies. The authors have developed a robust framework, which food-sector entrepreneurs can use to increase profitability of an existing business or to create new profitable opportunities. The value chain approach provides win-win opportunities for players within the value chain. To test the robustness of the framework, the authors use food waste as an example of a critical inefficiency and apply it to two different food sector business cases, each operating in diverse conditions. Because the suggested framework addresses the core elements and parameters for the existence and competitiveness of a business, the model can be adapted to other sectors.

Keywords: profitability with sustainability, value chain interventions, market intelligence, innovative entrepreneurship, food waste

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Introduction

Food waste management is one of the most relevant and critical issues today due to the loss in economic value, its influence on the environment and its impact on food security. Many studies have demonstrated that the largest percentage of the waste takes place in different links of the food value chain. Some studies estimate the total wastage percentages to be around 40% in the agro-food sector (Waarts 2010). In the Netherlands, the value of the total food wastage is estimated to be around € 4.4 billion a year of which € 2.4 billion worth of food (10% of all purchased food) is thrown away by the end-consumers and € 2 billion worth of food gets wasted along the different links of the food chain (Waarts 2010). The wastage numbers provided above are quite alarming and have unintended repercussions on costs, environment, carbon footprint, energy, water, and other ethical aspects such as animal wellbeing and food security. Because of these concerns, consumers and government expect the food business entrepreneurs to continuously endeavor to reduce the inefficiencies which lead to wastage in food value. However, in addition to consumer and regulatory pressure, sustainable profit opportunity should motivate the entrepreneur to take initiatives to prevent and minimize food waste. The motivation for this study is to provide the entrepreneur with a value chain framework to better enable him to identify and exploit profitable business opportunities in eliminating inefficiencies such as food waste.

The study intends to address the following main research question:

Can a value chain approach help an entrepreneur recognize and develop profitable business opportunities in the reduction of food waste (or other related inefficiencies)?

The following sub questions are set forth to answer this main research question

1. Which value chain parameters/levers are responsible for food waste (or other related inefficiencies)?
2. What are the critical stages for unlocking the profitable potential hidden within food waste (or other related inefficiencies)?
3. What would a robust framework "which is applicable for a variety of businesses operating within the food value chains at different stages of the life-cycle" look like?
4. To what extent is a value chain framework relevant and applicable to other industrial sectors?

To achieve the objectives mentioned above:

1. We analyzed the literature to identify the critical parameters that influence efficiency within value chains. This detailed investigation of the literature helped us identify the pain areas or bottlenecks for value chains.

2. Based on the understanding obtained from step 1, we have suggested a two stage solution approach (the framework) to overcome value chain bottlenecks.

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3. Finally, we have tested the robustness of our framework (approach) with two different real-life business cases within the food sector, operating at two different extremes of the value chain life cycle spectrum.

The main contribution of this study is the development of a framework that an entrepreneur can use as an effective tool to increase profitability of an existing business or to create new profitable business opportunities. The suggested framework identifies different parameters which act as critical bottlenecks in the effective performance of the value chains. It divides these parameters into two different categories. The Category-1 challenges are relevant for businesses operating in value chains which are in the early stages of their life cycle. The Category-1 challenges are "Lack of organized financing sources for key value adding stake-holders", "Fragmented supply base", "Centralized processing", "Logistics and other key infrastructural challenges", "Misaligned incentives" and "Quality monitoring and control". Category-2 challenges are "Product and Demand characteristics." A two-staged approach addressing different category challenges is suggested. The Category-2 challenges are relevant for business in both developed and developing countries. However, before businesses address the Category-2 challenges, they must first address the Category-1 challenges.

To test the relevance of the suggested framework in practice, we have applied the framework to two different food sector business cases each operating under different conditions. The first case study is about a dairy value chain in India where all the Category-1 challenges presented within the framework are experienced. The second case is about the vegetable value chain in the Netherlands and how an innovative entrepreneur has created a profitable and sustainable business by addressing Category-2 challenges and creating the right value chain intervention.

Literature Analysis and Motivation

There is a vast body of literature focusing on how social and environmental investments impact financial performance (Dowell et al. 2000; Griffin and Mahon 1997; Roman et al. 1999). However, understanding the contribution of various investments in sustainability initiatives to improved shareholder value, and identifying which projects provide the greatest net benefits to both the company and society, is certainly a major challenge for managers formulating a sustainability strategy (King and Lenox 2002; Martin 2002; McWilliams and Siegel 2001; Prahalad 2010). In order to properly evaluate the impact of investments in sustainability, Epstein and Roy (2003) have proposed a framework to assist managers in making the 'business case' for sustainability initiatives. Other literature studies in the context of global value chains are Gereffi (1999),Gereffi et al. 2005; Kaplinsky 2000; Kaplinsky and Morris 2002; Sturgeon 2001; Gibbon 2001; and, Gibbon and Bair 2008. The focus of all these studies is on governance and upgrading opportunities in developing country value chains. Russo and Fouts (1997), drawing on the resource-based view of the firm, have demonstrated that environmental performance and economic performance are positively linked. Russo (2002) also concluded that for any natural resource-based industry to prosper, the natural, social, and economic influences should converge. The objectives of both the above studies are in line with triple P objectives proposed within this paper.

The most insightful conclusion of Parmigiani et al. (2011), although supply chain oriented, is that firms must leverage their existing technical and relational capabilities within their supply

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chains toward social and environmental issues. To develop the most critical capabilities, firms need to consider stakeholder exposure to particular social and environmental issues across their supply chain, which includes control (the degree to which they cause or influence actions in the supply chain) and accountability (the degree to which they must justify their actions). In some ways our study takes a similar standpoint with the difference being that it focuses on the critical and practical operational challenges facing value chains.

Rappaport (2006) proposes 10 very insightful and effective ways for ensuring that executives make decisions without sacrificing the longer-term interests of the shareholders. Our study complements Rappaport (2006) by bringing a value chain perspective which is an additional dimension for sustaining and improving the competitiveness of the business. More importantly, the current study provides a possibility for executives to look beyond their company boundaries for opportunities.

The most recent work by Trienekens (2011) is very insightful since it takes a very holistic approach and suggests a three-component framework for value chain analysis in developing countries. Though our study resembles the work of Trienekens (2011), (we also use the value chain approach and a validation of the framework with a case study), Trienekens's work differs from our study in several ways. Firstly, the components identified within the study of Trienekens (2011) are macro-level value chain factors, whereas the focal point of our study is the entrepreneur within the value chain and how he can drive efficiency and effectiveness within it. Secondly, the framework suggested within this study provides starting points for entrepreneurs operating in value chains which are at different stages of development, whereas Trienekens (2011) specifically addresses the constraints within developing country value chains. Finally, the scope and relevance for our framework may be extended and applied to other non-food sectors to facilitate the elimination of inefficiencies and the reduction of product and service value.

Of significant relevance is the KIT (2010) work which covers a diverse range of case studies in the food and agribusiness sector from a wide range of emerging economies. The basic theme of the study was how providing financing can strengthen the links among all the value chain players and promote a progressive and efficient value chain. The KIT (2010) study shows how channeling funds to a previously underfinanced value chain player empowers him to participate in value chain governance. Traders, processors, retailers are made to build strong relationships with the other value chain partners to achieve value chain efficiency and robustness and this helps ensure the repayment of the loans. This approach has resulted in efficiency enhancement and waste reduction in all the 13 different case studies presented.

The study by Nalla (2008) emphasizes the relevance of incentive alignment for achieving coordination within the chain and for eliminating all the inefficiencies within it. Within this study clear analytical contractual mechanisms have been proposed to eliminate the double marginalization effects which are most prevalent in value chains across different industry sectors. Someren and Nijhof (2010) discuss nine different Dutch case studies of innovative business in the food and agribusiness from the Triple P business development point of view. The study suggests that this approach leads to improved business performance with respect to social (people), ecological (planet) and financial (profit) values. These cases and the Triple P framework discussed within the book have provided insights necessary for the development of the framework within this paper.

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The opportunity recognition literature addresses the critical issue of how entrepreneurs identify opportunities for new business ventures. Baron (2006) suggests that entrepreneurs use cognitive frameworks they possess to "connect the dots" between changes in technology, demographics, markets, government policies, and other factors. For experienced entrepreneurs the approach and framework developed within the current study could serve as a support tool for the cognitive framework they have built through experience. For beginning entrepreneurs our study could facilitate the process of building such frameworks in a process driven manner. Guber et al. (2008) suggest that entrepreneurs play a fundamental role in bringing new technologies to market. One of the major claims of our study is that technology is one of the critical interventions for eliminating inefficiencies and for adding value to the products. Hence, our study provides a framework which can improve the process of opportunity recognition for entrepreneurs.

In the next section, we provide a detailed explanation of the proposed framework and the model.

Framework and Model

The detailed analysis and understanding of the literature presented in the previous section enabled us to build the framework described in Figure 1. On the left-hand side of the proposed framework, we discuss the different parameters which form the critical bottlenecks in the performance of value chains. The parameters are divided into two different categories, 1 and 2. On the right-hand side, a two-stage solution approach will facilitate inefficiency elimination in the value chains. A detailed explanation of the parameters in each category and the reasoning behind the two staged approach follows.

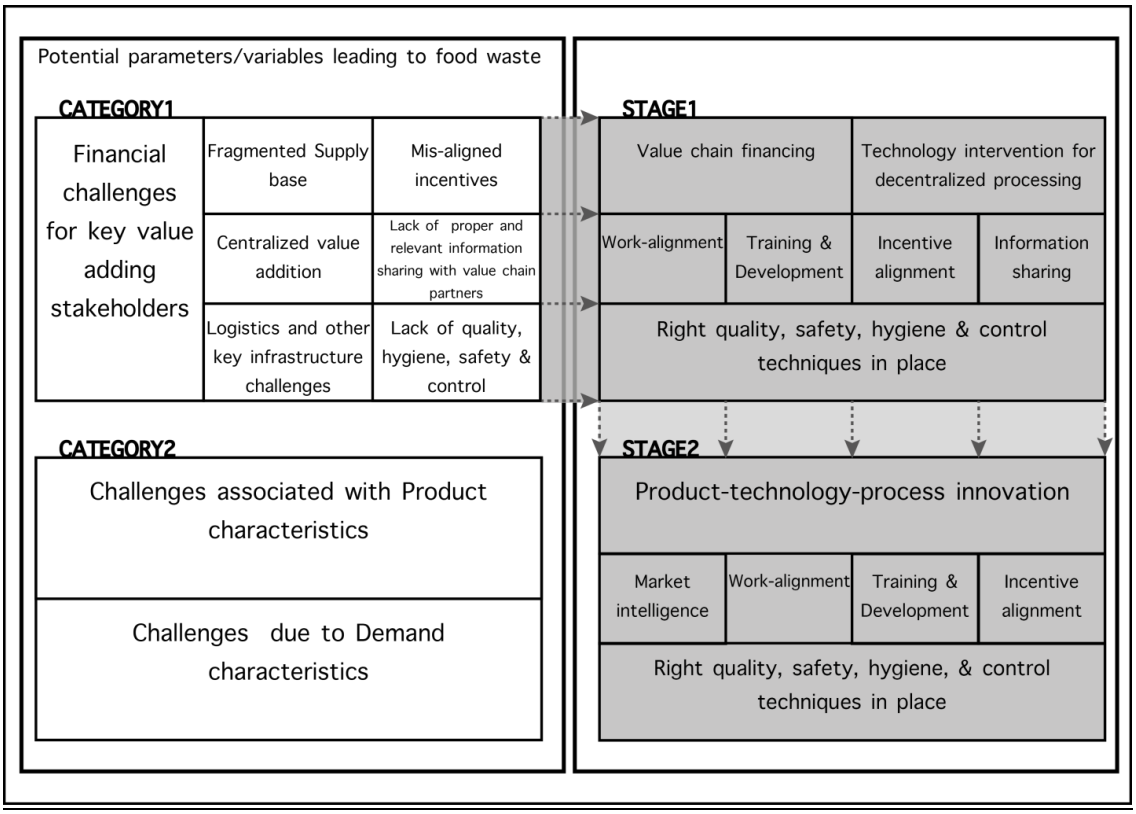

Figure 1. Value Chain Framework

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Category-1 Challenges

The Category-1 challenges are relevant for businesses operating in value chains in the early stages of their life cycle. Most food value chains in emerging countries are in this stage

For early stage value chains, lack of access to financial resources for the key stakeholders form the critical bottleneck. This leads to several inefficiencies.

Lack of financial resources for key value adding stake holders is a critical impediment for the smooth functioning of the value chains (KIT 2010). Key value added stakeholders refers to farmers/producers and the collectors/primary processors. This critical constraint leads to several constraints and challenges:.

I. *Fragmented supply base:* Due to the lack of available professional financial sources/resources, an individual farmer is not able to build production volumes and grow his production capacity by increasing his core resources (land holding, number of animals, innovative and high value-added processing capacities, etc.).

II. *Centralized processing:* Most of the available technologies for higher value added processing require higher production volumes and higher upfront capital investments. The low production farmer cannot provide the high raw material capacities and cannot finance the necessary investment from his current production. This fragmented supply base in combination with the high-volume technologies mandates value addition processing be centralized and carried out away from the production/supply base. This centralized processing model facilitates the entry of several echelons of middlemen, most of whom add insignificant value but a lot of overhead costs to the chain.

III. *Logistics and other key infrastructural challenges:* The lack of financial resources creates logistics and infrastructure challenges related to preservation and transport of the raw material, and this can lead to a high level of wastage along the entire value chain.

IV. *Misaligned incentives:* The lack of financial resources, the fragmented supply base and inefficient numbers of echelons within the value chain provides fewer to no negotiation opportunities for the upstream players. This imbalance in negotiation power leads to misaligned incentives.

V. *Lack of proper and relevant information sharing with the value chain partners:* The lack of financial resources, the fragmented supply base, inefficient numbers of echelons with-in the value chain and misaligned incentives creates scope for information asymmetry. In value chains which experience Category-1 challenges, the transactions are mostly carried out at arm-length. The only information that is generally shared is that of price and volumes. This kind of information sharing makes the value chains reactive rather than proactive and hence the value addition possibilities, quality standards and other critical aspects are rarely thought about, discussed and improved upon.

VI. *Quality monitoring and control:* The lack of proper logistics and transportation infrastructure leads to poor quality, less hygiene and a less safe product.

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In Figure 1, the Category-1 challenges are presented in three columns (read from left to right). This indicates that the challenge in column-1 (i.e., the lack of access to professional finance) leads to the challenges in column-2, which in turn lead to the challenges in column 3.

Category-2 challenges/inefficiencies are caused by product and demand characteristics. The details related to these challenges are presented below.

Category-2 Challenges

Product characteristics: food products such as milk, fresh produce, meat and marine products have a short shelf life and hence certain inefficiencies related to wastages are inherent within the product characteristics.

Demand characteristics: In addition to the challenges associated with the product characteristics, dynamic and changing consumer behavior leads to further inefficiencies and wastage. Fast changing consumption patterns lead to higher demand uncertainty for existing value chain products in favor of fresh or innovatively processed products.

All businesses within the food and agribusiness sector face both Category-1 and Category-2 challenges at some stage in their value chain life cycle. Mature businesses operating within established value chains, such are common in developed countries, have largely overcome the Category-1 challenges. Within our framework we have suggested a two-stage approach for addressing the challenges within both categories. The details related to each stage are described below.

Two-Stage Solution Approach

Stage-1, proposes a value chain restructuring approach with an objective to fine tune the parameters which are internal to the value chain. Within this stage, value chain financing mechanisms and right technology interventions would be the key drivers of the value chain restructuring. Within this model, financing is not necessarily directed at individual businesses, but is provided only within the context of a value-chain (KIT 2010). As an example, a producer could get financing only after he has signed contracts with a buyer organization or a network of buyers, thereby strengthening the overall value chain and demonstrating his place within it.

Once the value chain finance mechanisms and the right technology interventions are arranged, *work-alignment* becomes critical. The players within the value chain have to carry out different or additional activities than they did before the restructuring. For work realignment to be successful, the incentives for all the players need to be fair and well aligned. The critical guideline for proper *incentive alignment* is that win-win opportunities must be created for all the players within the value chain. Fair incentive distribution requires the *right information sharing tools* be identified and embedded within the value chain. Li et al. (2006) address the level and the quality of information sharing dimensions and relate the importance of these elements to firms competitive advantage. Williamson (2010) and Coase (1937) and several other industrial organization studies support the importance of player risk sharing, information sharing, incentive and work alignment suggested within this paper.

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Finally restructuring alone will not sustain value chain change and evolution if the players within the chain are not trained to perform their activities efficiently and effectively. Hence *training and capacity building* are the final critical elements to realize and sustain the benefits of restructuring.

When business in a value chain has overcome Stage-1 challenges, the next evolutionary path is Stage-2. Stage-2 is about innovation in product-process technology. More importantly, its focus almost always is to work out new products and new solutions for the benefits of people-planet-profit (3P) elements of the business (Someren and Nijhof 2010). Market intelligence is identified as the critical element within this process and is appropriately embedded into an efficient value chain. Here the focus is on continuously bringing new and innovative products and creating new and untested markets. The other elements of work alignment, incentive alignment, information sharing and training are as critical as in Stage-1. However, businesses facing Category-2 challenges are facing a different level and type of technology interventions when compared to Category-1 businesses. In most cases, businesses with Category-2 challenges most likely have sources of finance in place. Because Category-2 challenges have to do with product and demand characteristics, businesses continuously experience these challenges and have to adapt to consumer behavior and market signals on a continuous basis.

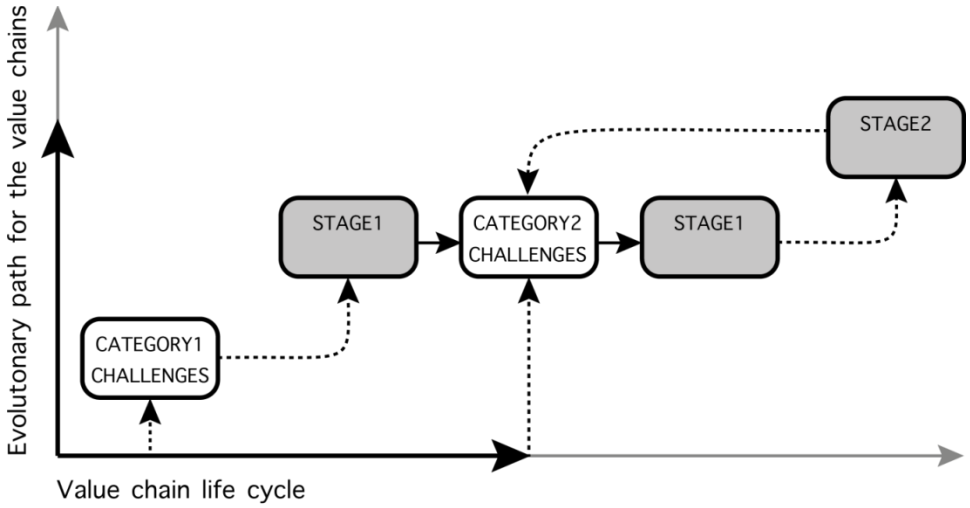

Figure 2. Evolutionary Path for Value Chains

Figure 2 presents the evolutionary path for the value chains and complements the Figure 1 framework. Category-1 challenges are at the lower left end of the value chain life cycle and must be overcome to achieve Stage-1 level of development. Once the value chain realizes Stage-1 improvement, Category-2 challenges come into play. Business in developed countries have to go through Stage-1 first before Stage-2 challenges.

The two case studies discussed in the next section provide greater clarity with regard to the framework developed within this paper. The first case study is about the dairy value chain in India where all the Category-1 challenges presented within the framework are experienced. The

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second case is examines the vegetable value chain in the Netherlands and how one company has created a sustainable and profitable business by addressing the Category-2 challenges.

Case Study 1: Dairy Value Chain in India

The dairy value chain in India begins with numerous low volume farmers. The average herd size in India is two-three dairy cows compared to 70 to 80 in a developed country such as The Netherlands. Indian milk is gathered and processed in a four-tier structure as depicted in Figure 3:

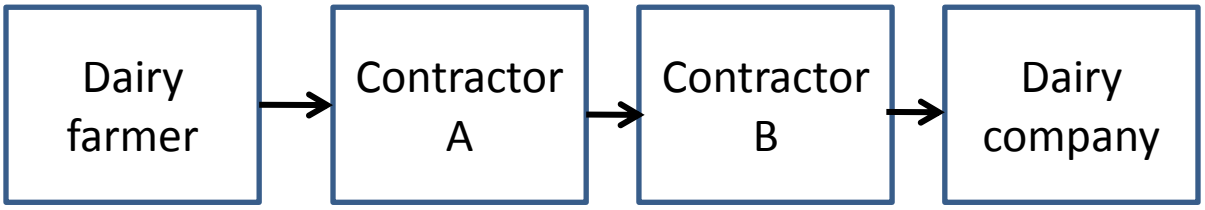

Figure 3. Dairy value chain in India

In a typical private dairy value chain, the farmers bring the milk in buckets or steel vessels to a local collection centre (Contractor A) located in the center of the village. Around 30 – 50 farmers come to these collection centers to sell their milk twice a day. On average, around 500-600 liters of milk are collected and stored in 40-liter cans before being transported in vans arriving from Contractor B. Contractor B represents the pasteurizing center that collects and pasteurizes milk from the various farm collection centers. Daily collected/pasteurized volumes are around 10,000 liters. The pasteurized milk is sold to brand name dairy companies located in the city. The dairy companies receive an average quantity of 40,000 liters of pasteurized milk per day (LPD) from the pasteurizing centers and does further processing and marketing of the milk and milk products.

The highly fragmented, multi-tier chain described above results from ~~a~~ lack of organized financing sources for key value adding stake-holders. The individual farmer is unable to make any value-adding investments (ie increasing herd size and raw milk supply, processing, storage & transportation infrastructure improvement) because he lacks credit worthiness. Hence, the production and collection links within this value chain cannot evolve beyond the high wastages and inefficiencies which characterize such a highly fragmented structure. All the major problems listed in our framework and described below in further detail are caused by the lack of financial help at the level of the farmers and contractors.

I. *Fragmented supply base:* The raw milk is produced by numerous small scale subsistence dairy farmers. The real value-added processing occurs at the dairy company where the higher volumes concentrate (40,000 litres/day).

II. *Centralized processing:* Large scale dairy processing and packaging technologies are designed for volumes ranging from 40,000 liters/day to 1.0 million liters/day. This limits the higher level value addition to big dairy companies capable of making higher investments and marketing greater volume of products.

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III. *Logistics and other key infrastructural challenges:* There are a number of infrastructure related bottlenecks. There is a lack of availability of BMCs (Bulk Milk Chillers) and milking machines as well as knowhow of dairy farm management. Investments at the farmer/collector level are not undertaken partly due to the long gestation period /uncertainty regarding returns and the lack of credit worthiness. Hence, the value chain structure does not evolve to address the inefficiencies/wastage within the value chain.

IV. *Misaligned incentives:* Within the value chain structure, the middlemen (contractor A and contractor B) takes up a dominant position by making use of constraints such as farmer fragmentation, the low supply volume of each individual farmer, their geographic distance from the market, and the farmers' day-to-day requirements to make a livelihood.

V. *Lack of proper and relevant information sharing with the value chain partners:* The dairy farmers, easily replaced and at least two tiers removed from the value addition point in the chain, lack information on how their raw milk is used and what end prices can be had for the value added products. In this way they do not gain a good understanding of the market and of any improvement possibilities. At the other end, it is very difficult for the fourth tier dairy company to trace or control the quality of the raw milk or guarantee supply.

VI. *Quality monitoring and control:* Milk is a highly perishable product known to be vulnerable to fast growing micro-organisms. Thus it is important that quality control be carried out at all stages in the milk production chain. Quality control not only refers to micro logical safety but is also related to the nutritional quality of the raw milk and the products made from it. Quality depends on all the value chain players working in coordination and utilizing proper storage and transportation infrastructure to deliver a safe and nutritious product to the end-consumers. The Indian dairy value chain lacks both infrastructure and coordination resulting in uncertain supply and quality.

Solution Approach in Context of the Value Chain Framework

It is clear from this analysis that the challenges within the Indian value chain are not limited to any one individual business but result from constraints imposed by the value chain structure. The traditional business model traps the players, from the farmer producing the raw milk, to the collection and transportation middlemen, into roles that add little product value at each stage of production, and leaves each of them at subsistence production levels that prevent them from taking a progressive and evolutionary course in their dairy farming. What is needed is a way for each of the players in the chain to add value and boost their incomes and participation at their level of production and thereby raise the value of the entire chain.

An innovative and modular technology which can decentralize the transformation of raw milk into high value end products is available to do this. The technology is designed to collect, store and cool the raw milk until enough is available for pasteurization. After pasteurization / homo-genization it can pack the milk into sachets. Furthermore, the technology offers extra options to make yoghurt/curd with cup filling machines and can also perform cheese production. Adoption of this technology moves value added dairy processing down the value chain as it can processes capacities ranging from 5000LPH (liters per hour) (120,000 liter/24hr day) to 10000LPH. This

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value chain intervention can occur at the level of contractor B because of the match with the volumes(10,000 liters/day) available at his level. The new technology makes contractor B or even A finance worthy within a value chain finance model [KIT (2010)]. However, the benefits are not limited to contractor B but provide incentives for the entire value chain to improve efficiency, effectiveness and transparency.

The modular processing technology facilitates higher levels of value addition for smaller quantities and more importantly as per market requirements. This ability to process smaller quantities pushes the value addition further upstream. This increases shelf-life, reduces wastage, improves overall quality and increases the price realization for the upstream players. More importantly, such intervention reduces the need for high margin, low value adding middlemen who trade on the perishability of raw milk. For any downstream player to exist within the chain he has to add significant value, not simply high margin/high wastage collection and transportation services, The proposed intervention reduces the number of transactions and brings higher efficiencies into the value chain and this further increases the price that can be got from the end-consumer. The above argument is in line with the industrial organizations literature (Williamson (2010) and Coase (1937). Below, we explain other critical elements to be addressed in Stage-1.

Information Sharing

With the proposed intervention, information sharing along the entire value chain becomes more symmetric. Inventory level information and overall market demand for refined milk products now concern contractor B. Contractor B will have to provide contractor A with his procurement plans. Based on these inputs contractor A in turn makes his procurement plan and communicates it to the farm base. The farm base plans its deliveries accordingly. Contractor B is now making refined dairy products, not simply collecting and pasteurizing. Concern for the quality and supply volume of the raw milk is now shifted down the chain, and the entire process of milk production must be documented, made traceable and all product safety information (timing of milking, storage conditions, bacterial count at each step made publically available.

Work Alignment

The shift in the location of production means that all the players must change the way they do things. Contractor B communicates his procurement plans to the farmers (directly or optionally via A) and ensures milk-quality and traceability which means that he is taking initiatives to match the supply with demand and facilitate higher quality standards. Contractor A will produce higher value-added products and supply them to the established dairy companies. No longer having a monopoly on producing refined dairy products, the dairy companies will focus on their core strength which is marketing and distribution, strengthening their brand and increasing the sales volume. Significant gains in overall production volumes can be expected due to reduction in product loss due to spoilage. The increase in demand due to the new emphasis on marketing means incentive for the farmers to produce more milk. This new work structure will create a greater incentive for the value chain players to adapt and evolve.

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Incentive Alignment

As each player is carrying out more activities and adding higher value, the value chain as a whole realizes higher value and a higher profit is created. For example, if the above modular machine is purchased by contractor A (or for that matter any entrepreneur) to make a local product called curd (which is more simple variant of Yoghurt) total higher value can be created for the same 10,000 liters of milk which can be distributed along the entire value chain. Already in the Indian context there is a price realization that varies from 60-100% for the farmers operating within different value chains. The difference in price is the final consumption form of the base product. In cases where lower prices are attained the milk is offered in its most basic form and value added products such as curd, local cheese types, butter, clarified butter and other products obtain the higher price.

Training and Development

To realize the above possibilities the right training and capacity development should take place at each link of the value chain. NGO and developmental organizations can begin initiatives to offer training and extension services which helps the farm level players increase their income levels. Several value chains are being supported by local NGO organizations for training and capacity building.

Even with the best processing capabilities and the best value chain infrastructure there is a limitation to the shelf life for a product such as milk. Furthermore, Indian consumers preferences are changing dynamically as they are starting to seek for new and innovative products for consumption. Hence, once the dairy value chain solves the challenges within the first category the next evolutionary stage would be to enhance value by addressing the product and demand characteristics. In the next subsection we present a Stage-1 solution which addresses the concerns related to the Category-1 challenges which are the critical addressable bottlenecks for the Indian dairy value chain.

Case Study 2: Vegetable Value Chain in the Netherlands

The turnover of vegetables constitutes over 30% of the entire horticulture industry in the Netherlands. The total area of vegetables under glass is about 5.041ha (in 2010), which is about 48% of the total area under glasshouses. From these 5.041 ha 33% consists of tomatoes, 31.9% sweet peppers, 17% cucumbers and the rest consists of other vegetables (e.g., eggplants, radishes) (Productschap Tuinbouw 2010). According to the statistical data from 2010, world exports in vegetables total € 9.3 billion, of which one-third were trans shipments via the Netherlands and 10% of all vegetables traded in the world market were grown in the Netherlands. Traditionally, Dutch vegetable supply chains consist of growers, auctions, wholesalers, and retailers. The auctions are a common marketplace where growers and wholesalers and/or retailers meet and the auction clock determines the price of the goods. The simple value chain in its operational form is depicted in Figure 4.

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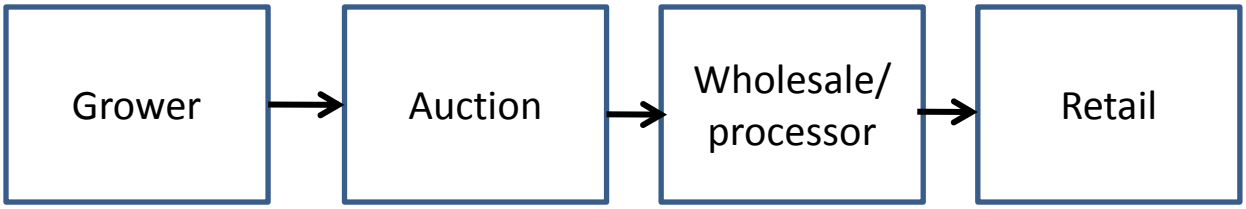

Figure 4. The Vegetable Value Chain in the Netherlands

In a drive to improve efficiency the Dutch vegetables value chain has reduced the number of auctions from 28 in 1990 to six in 2001. The largest ones are Greenery, Zon, and Fruitmasters. In 1996 most Dutch horticultural auctions merged into the Greenery (except for Zon) (Bijman 2002). The aim of the newly established auction was to convert the traditional auction, which only offered products to potential buyers, into a market organization selling products through long-term relationships and arranged weekly prices and delivery according to the requirements of the client. Many large leading growers did not join the Greenery, but formed growers' associations to market their tomatoes, sweet peppers, cucumbers and eggplants under their own brand names. These groups were the first offering flexible, last minute and year-round delivery, high quality standards, certifications, and 'tracking and tracing'. Another group of growers made delivery arrangements with different big exporters/wholesalers on a yearly basis (e.g. Holland crop with Bakker Barendrecht BV). Some of these exporters also formed growers' associations to take advantage of EU subsidies for marketing activities (Bijman 2002). In developing their marketing strategy, growers' associations sell: 1) through the auction or contract negotiation, 2) under producer or retailer brand, 3) to a specific wholesaler or retailer, 4) individual products or packages of products (Boonekamp 2002). The emergence of growers' associations is a response to the increasing differentiation of demand and supply in agri-food markets (Hendrikse and Bijman 2001). Growers in associations are considered more flexible in terms of making specific products for different outlets.

The financial markets in the Netherlands are well developed and quite accessible to all the key value-adding stakeholders within the value chain. A strong and feasible business case is, of course, a necessary condition to get to the finance, but the means or channels to achieve finance for demonstrated business cases are well established.

I. *Fragmented supply base:* The supply chain is not fragmented into unmanageable levels and because of the presence of the auction system and market connectivity the grower is in a good position to sell his produce through transparent and efficient channels.

II. *Centralized processing:* The processing and value addition as desired by the customer base occurs at each link of the value chain ensuring better price realizations for all the value chain players.

III. *Logistics and other key infrastructural challenges:* During the transformation phase for efficiency improvement, the logistics system for handling vegetables has also improved its effectiveness and is considered to be one of the most efficient systems in the world.

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IV. *Misaligned incentives:* Transparent market information provided by a well-structured public auction system, gives symmetric negotiating strength to each value chain player.

V. *Quality monitoring and control:* Stringent quality standards are created and maintained by all the players within the value chain.

It is clear from this analysis that the vegetable supply chain in the Netherlands has very effective systems in place and has evolved beyond Category-1 challenges. However, about 2.5% of the 1.6 billion kilograms of greenhouse vegetables produced in a year are rejected by the market. Produce may be rejected because it is aesthetically unappealing or is not packaged or processed to meet the growing demand for freshly cut, packed products. Currently the majority of this 40 million kg left-over flow is turned into compost, resulting in a substantial loss which affects the entire value chain. The value chain needs to overcome Category-2 challenges concerning product and demand characteristics in an innovative manner to eliminate/reduce this inefficiency.

Solution Approach in Context of Proposed Framework

An innovative European company has managed to create a profitable business by converting the horticulture waste into fresh vegetable juices and natural food colors. It has developed various patented technologies (in cooperation with a number of partners) to enable reprocessing of class 3 greenhouse vegetables into consumer products. Since the technology is mobile it can easily be transported to fresh-cut industry production sites and greenhouses. The left-over generated at these sites is converted into fresh juices and natural colorants which are subsequently bottled and processed by other companies and made into consumer products. The demand for these products is growing by 10% each year. In essence, the company has facilitated new links within the produce value chain in a way that benefits all the value chain players. This initiative has generated substantial positive returns for all the players in the horticulture value chain (including the end consumers) making this one of the most successful examples of sustainable and socially responsible entrepreneurial initiative. Repurposing previously leftover produce results in enormous cost savings in the transportation of residual products and compost. Estimates have shown that a total distance of 750,000 kilometers is traveled to transport compost every year. Collecting and recycling left-over flows on site at the production/sales facility results in an enormous reduction of transportation costs and CO2 emissions, reduces the impact on the environment, and increases the yield of the horticultural food chain.

The above initiative has facilitated the restructuring of the value chain (See Figure 5). It demonstrates that a new value chain has emerged out of the waste flow. This new value chain has made it possible to bring high value products in the form of natural and healthy juices into the market. The new link increases the overall value generated within the value chain because it facilitates only the best grade products get to auction and enables an alternative for unsold products to be redirected into the new chain.

Because this value chain is newly created, it faces many of the Stage-1 challenges previously discussed. Financing must be procured by all the participatory and value adding stakeholders. Also, new logistical systems and market connections needs to be worked out. i.e., the Stage-1 elements become the critical starting points for the newly developed value chain to function.

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Once the stage one elements are in place the most critical Stage-2 elements need to be worked out. For the Stage-2 developments, the right mix of product-process-technology becomes critical. The new technology for making new product has created the possibility of a new value chain. This new product technology combination will need to evolve new links within the older value chain. The elements described below describe how this is created and sustained in the context of the value chain framework.

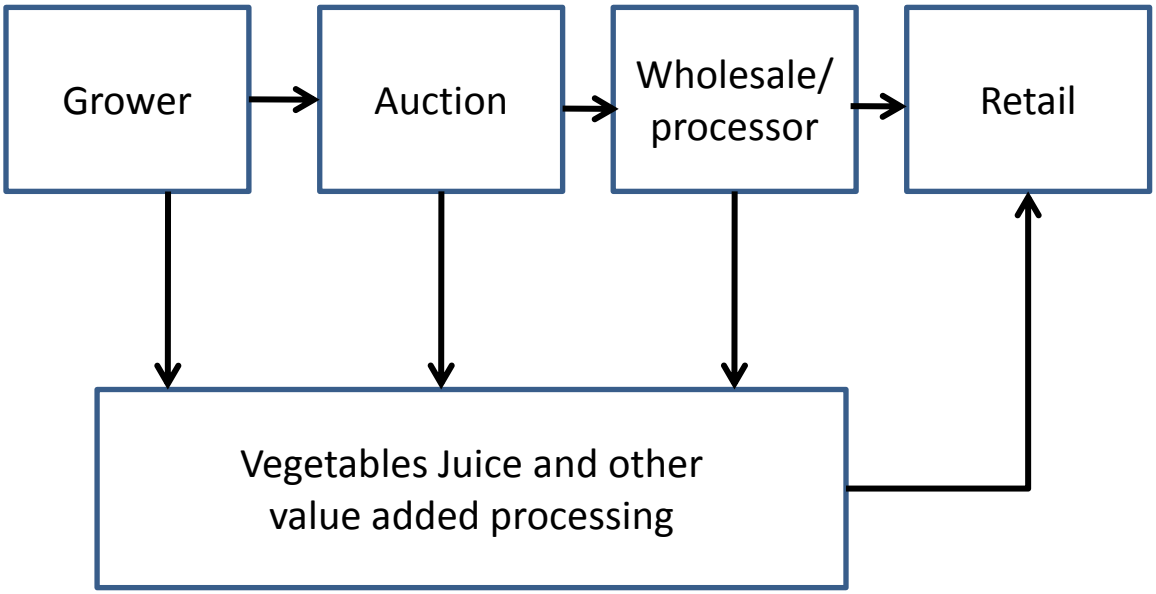

Figure 5. Reengineered vegetable value chain in the Netherlands

Market Intelligence

Because the products are new and innovative, market intelligence and understanding of the consumer is very critical for success. This market intelligence needs to be embedded into the innovation process for launching new products or fine-tuning existing ones.

Insformation Sharing

Information sharing has to be more robust because of the creation of the new links within the value chain. For example, communication needs to be very clear concerning the quantities of produce that can be sourced from growers/wholesalers to the juice bottling companies and subsequently to the retailer for purposes of production, marketing and distribution. These new specifications will also affect the available quantities and grades negotiated between the auction houses and the growers.

Work Alignment

The grower will now treat the product previously considered waste as a product variant and should handle it according to the needs and requirements of the bottling company. The right preservation standards and quality control standards need to be developed and maintained.

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Similarly, if the auction houses or wholesalers anticipate selling the left over good quality produce through this newly created channel they should also have the required processes in place. Hence, it is clear that the work needs to be aligned based on the requirements and transactions carried out within this newly created value chain.

Incentive Alignment

The success and sustainability of the new value chain depends on smooth and symmetric information flow and also on the proper alignment of incentives. The grower gets higher revenue as he is able to sell his previous waste at a premium. The auction houses have less wastage as they can choose to take only the top grade products from the grower which they can also sell at a premium All of this reduces costs due to wastages or losses and increases useful inventory. The bottler and new retail channels are selling a premium product made out of a very ordinary, low value product and this leads to better price realization for all players in the channel.

Training and Development

New technologies and their created value chains require new skills. In this case the European company in collaboration with various universities has initiated training and capacity building programs for the players within the value chain.

Conclusions

The proposed framework within this study presents the entrepreneur with a potent tool to analyze the value chain and bring in the most appropriate and profitable interventions. Our main objective is to show how a value chain approach can aid an entrepreneur to recognize and capitalize on the revealed opportunities. Secondarily, by contributing to overall efficiency and reducing wastage, we hope to contribute to a more sustainable economic future, particularly in the generalized case of food value chains.

Although this framework was applied only to the food sector, we believe it to be valid and relevant to other industrial sectors.

This study has limitations regarding the quantification of the results that can be obtained using the suggested value chain framework. Analytical tools to improve quantification would be very valuable and could be a topic for future research. In addition, detailed further development of the framework parameters and interventions as well as its direct application to other industrial sectors suggest other interesting research opportunities.

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