Modeling the Distribution of Organic Coffee Supply Chain from Junín Region, Peru

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***Abstract*—This research uses Supply Chain (SC) data gathered during the distribution and transportation activities of organic coffee. The purpose of this research is to analyze different ways in which crop-chain solutions are adopted in the region of Junín, Peru. The disintegration of the SC is revealed, as each cooperative member works uncoordinatedly on his own leading to different results standards with high costs and low returns. The study focused on different entities from farmers to the port of Callao of an organic coffee supply chain where disintegration is constant. The paper describes a misaligned supply chain including poorly collaboration. All problems found will be an opportunity to develop a distribution model in the organic coffee supply chain of Junín region.**

Keywords*—Food supply chain management (SCM), supply chain management, supply chain, distribution, delivery, transportation, performance, coffee, Peru.*

1. Introduction

Coffee is a non-integrated logistics process, where the agents and the owners are fragmented in each link of the chain; small farmers produce and harvest the crop, then are tendered to the hands of the collectors who then sell to exporters located in the main cities of the country [5], [19]. Transportation services tend to be outsourced at every stage of the chain in reason to maintain strong buyer-supplier relationships [66]. The production nodes are located in the forest with low accessibility. The small coffee producers are organized in cooperatives /associations located in the regions of San Martín, Cusco, Ayacucho, and Junín. The transportation process is outsourced in small to medium-sized informal cargo vehicles. The products travel great distances to the different packing locations until it reaches to the exporting ports. Then, the Peruvian coffee supply chain has incorporated uncertainty in transport operations and great impact on economy and environmental sustainability [33], [64].

To decide on the proposed integration model, the scope of the research must be defined based on current proposals found in the literature review [1], [23]. The study search was carried out with keywords such as "distribution SC", "agricultural supply chain" and "integration model for agribusiness supply chain", to achieve a global view of the topic presented [13], [48], [54].

To obtain more relevant information, a study was undertaken to examine the SC collaboration through a qualitative research approach [7]. The data was presented to an executive panel of the main cooperatives [45], [67].

The following sections present a summary of the relevant literature reviewed, the in-depth analysis of the methodology applied in the research, as well as the initial situation of the chain studied [17]. The research hypothesis was also defined and presented.

The best model of transport and distribution in the SC must have the following capabilities effectiveness including improvements in customer responsiveness and better access to target market segments [67].

The proposed model covers the progression of such relationships including antecedents, collaboration, and consequences. This study present various elements of business model to be linked: structure, processes, suppliers, transports, and people [62]. Each one is discussed and supported by the data provided by the surveys. In this study, the coffee

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supply chain integration and transportation is investigated along the logistics activities using interview and survey in order to explore managerial implications [63]. Firms engaged in collaboration to develop, maintain, and enhance SC capabilities that contributed to strengthening firm performance and, ultimately, improve competitive advantage [49]. Consider the triad of strategy, flexibility and results in coffee supply chain will help cooperatives, associations, intermediaries and farmers optimize supply chain operations [4], [51], [61].

2. Literature Review

2.1 Supply Chain Management

SCM is described as the functions of transportation and logistics of traders and retailers [12]. It also describes all value-added activities from the transformation of raw materials to tender to the end-users, including recycling [10], [36], [57].

SCM is defined as the integration of fundamental business processes from the original vendors to the end-user by providing products, services, and information that add value to customers and stakeholders [35].

The objectives of the SCM are: reduce process cycles, improve service levels, and increase the flexibility of logistics activities to reduce the consumption of resources within the SC [32], [52]. This allows the company to emerge, to act, and to continue growing, by increasing the production and sales [24]. Thus, transport should be characterized by reliability while the loads should be without damages [26].

It is imperative to improve the understanding of the SC practices in different regions of the world; this would allow organizations to employ different business strategies due to increasing competitive pressures as a result of globalized customers [53], [59].

2.2 Food Supply Chain

The exchange of information in the food SC is a critical factor for successful integration [9], and the problems can be solved efficiently. Likewise, mutuality communication is a key element in the system since the lack of this attribute leads to fragmentation, opportunism, and a desire for over-control over the SC. This component, however, generates policies and actively promotes the culture of mistrust [11].

The lack of integration of the SC in the agricultural processing companies is a world-wide concern because the application of green SC as proposed by solving high-quality products with high added value [48], [30]. The integration of the chain guarantees the flow of deliveries, the coordination, and the information technology [3], [52]. It has been shown that a meta-analysis study provides broader areas of research during the chain integration by providing a firm and a more competitive advantage [27], [28], [29], [31].

2.3 Performance in the Supply Chain

The food security failures have led to higher attention in food traceability as a means of identifying the causes of SC deficiencies [41].

The strategic alliance, the quality of the information, and the trust and commitment are related to the quality of the food [16]. To do this, the size, types, and location of the facility must be determined, as it has an impact on SC performance, logistics costs, and customer service levels [32].

2.4 Flexibility in the Supply Chain

The flexibility of the SC takes into account the interaction between internal organizational functions, such as manufacturing or marketing, and the partner of the external SC and the possible effects on the customer [8]. The flexibility of the process is related to the number of product types to be produced in each plant in the SC. The flexibility of logistics incorporates the flexibility or distribution or distribution approaches to launch a product the market and the upward or acquisition flexibility, which is to obtain a product from a supplier [58], as shown in Figure 1. The integration and flexibility in supply chain management requires a massive commitment by members: suppliers, farmers, cooperative, associations, transports and customers [60].

2.5 Distribution in the Supply Chain

The distribution network design (DND) aims to shape the structure of the distribution network, determine the number of steps and for each step the type, size, number and location of the facilities where the product is temporarily stored. Through an effective distribution network design, the inventory, transportation, and installation costs can be significantly reduced while increasing (or at least maintaining) the level of service [25], [32], [40].

The specific circumstances of business may require a higher level of SC flexibility to mitigate risk and achieve business objectives, as well as the flexibility of access or the ability to ensure broad distribution coverage. This often requires SC partners to add capacity and consider redundancy of supply. This is possible if the SC partners have a common goal and are willing to share the advantages and disadvantages [59].

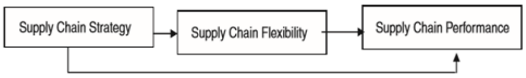

Figure 1: Basic Research Model, Ahmad & Fantazy (2014)

2.5.1 Integrated distribution

The term supply chain integration (SCI) has been defined as the degree of commitment to suppliers and customers. The terms supply chain collaboration and supply chain coordination is used to describe elements of SCI [15], [51]. As collaboration begins with customers and extends backward from the enterprise [14], integration is necessary internally

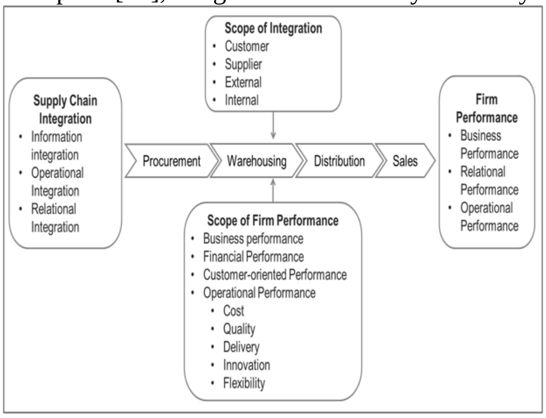

Figure 2: Integrated distribution chain. Adapted from Leuschner, Stefan Gold y Pasi Heikkurinen (2013).

and externally a supply chain in essence comprises a network of firms, where collaboration should be viewed from all perspectives: suppliers, farmers, transports, intermediaries and customers [42], [43], [44], [55]. Also, integration involves coordinating the flow of deliveries and backward coordination of information technology. The conceptual framework of the research is shown in figure 2.

The results of the empirical research on the relationship between SCI and company performance that can lead to generalizable evidence for the advancement of theory and practice in SCI were integrated. Results may be affected, such as sample sizes and measurement errors in the original studies [28].

2.5.2 Distribution and transportation logistics in Peru

Currently, the coffee SC is not integrated; instead, different agents and owners are involved in every aspect of the SC. Small farmers who produce and harvest the crop pass at the hands of the collectors and sell to the exporters located in the main cities of the country. Transportation services in areas of low accessibility such the jungle represent a challenge. Small coffee producers are organized in cooperatives located in the regions of San Martín, Cusco, Ayacucho, and Junín where this research project is focused.

The characteristics of the cargo collection vary depending on the scale of the producer. Due to the inability to supply a truck, small coffee producers tend to mobilize their products to a nearby storage facility run by public entities (such as regional governments) where they sell their production to intermediaries who then sell their products to the distributors, processing plants, or export companies. The transportation of coffee is outsourced mostly and transported in small to medium-sized informal cargo vehicles packed in sacks or loose [33]. The products have to travel long distances due to the location of the productive nodes in relation to the location of the warehouses, plants, and export outlets, making intensive use of both the primary and secondary roads, see figure 3.

Figure 3: Land Transportation, from Amazon, by Andes(4,818m) to Callao Port. Adapted from MTC-Peru Map (2017).

3. Research Method

3.1 Mapping of the Organic Coffee Supply Chain

SCC has become a strategic challenge for companies that wish to achieve their economic, social, and environmental sustainability targets, [38]. Most researchers' define SCC as a partnership process in which no less than two independent parties work hand in hand to mastermind and execute SC operations for the fulfillment of common goals and mutual benefits [9]. To understand the organic coffee SC operation, the transportation section was outlined first. The transportation consists of six tiers as illustrated in figure 4.

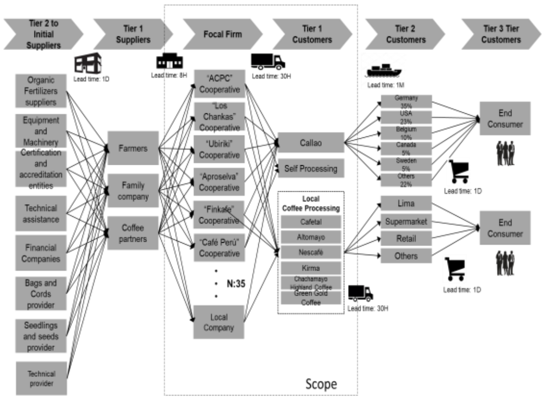

Figure 4: Organic coffee distribution channel, Junín region (2017)

A detailed representation of the analysis process is shown in figure 5, a series of steps that create a value added for the cooperatives, customers, and stakeholders interacting through the SC. The strategic dimension of SC makes it essential that their actions be measured and then analyzed and improved each process [18].

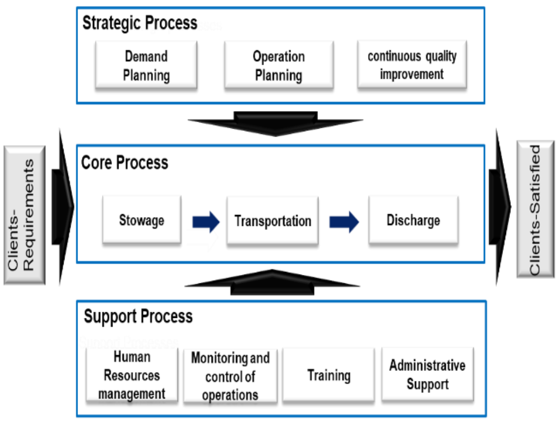

Figure 5: Macro process SC "Distribution and Transportation" Adapted from Alexander H. Hubner (2017)

3.2 Distribution and Transportation Macro Process

Including in the SC, the following strategic processes are included: Demand planning, operations planning, and continuous quality improvement planning. These planning processes are classified as long, medium, and short-term, per the planning horizon of the cooperatives. The master's planning coordinates and determines the basic rules of the regular operations [22].

The planning processes in coffee supply chain enable to appropriately manage operational problems by scanning and evaluating alternatives that are appropriated with the short-term and long-term goals of the coffee supply chain [56].

Also, it was observed that the core processes such as storage, transportation, and discharge of these processes must be linked by vertical and horizontal information. In addition to that, the following are the support process: Human resources management, monitoring and control of operations, training and administrative support. Finally, the food supply chain model for distribution must be a integrated global architecture where stakeholders are involved with new conceptual framework, tools, and technologies [50], [68].

Additionally, the coffee supply chain model for distribution in the region need to work in quality and safety issues [37]. In this sense, the framework proposed must consider primary technologies for traceability [69]. Also, sharing information could affect the operational performance in positive [70]. The coffee supply chain model must consider complexity and visibility, the solutions need to offer delivery on a just in time and pressure to reduce wastes in the food supply chain [53].

4. Measurement, Data Analysis, and Results

The coffee is transported from Chanchamayo-Junín to the processing plants in Lima that consist in the preparation, packing and storing in temporary deposits at the port of Callao until they are loaded in the vessels for final destination to various countries in different continents. In the Junín region, 35 coffee cooperatives were analyzed. Out of 35 coffee cooperatives, 19 completed the survey providing more relevant data to the analysis.

The instrument of measurement used is the Cronbach's Alpha, necessary to perform a reliability analysis [16], in his book, "Research Methodology" indicates that internal consistency of an instrument can be measured by Cronbach's Alpha, which assumes that the questions (measured on a Likert scale) measure a construct and are highly correlated. The closer the alpha is to one, the greater the internal consistency of the items, which means that the items or questions are highly correlated and have high reliability.

To find the Cronbach's alpha value for the proposed instrument, the SPSS 22 was used and included in the analysis of the first ten surveys as a pilot test, see Table 1.

Table 1: Table of processing of cases by alpha of Cronbach with results of SPSS 22 (2017)

Summary of case processing

		N	%
Cases	Valid	10	100.0
	Excluded[a]	0	0.0
	Total	10	100.0

a. the list elimination is based on all the variables

The purpose of the pilot test was to identify poor performing items rather than create highly purified scales. Full construct validity was examined using the final sample and is described subsequently. Coefficient alpha was used to examine inter-item reliability based on the pretest sample [20].

Table 2: Analysis of Cronbach's alpha with results of SPSS 22 (2017)

Reliability statistics

Cronbach alpha	N of elements
0.840	35

Table 3: Metrics: Summary of data

Process	Metrics	Measurable		Description
		Current	Goal	
Make	Storage factor resulting	0.6	0.64	Tendency to increase
Plan	Efficiency in meeting planned time	30.47	18	Tendency to decrease
Source	Unit cost in US US$/TM per cooperative	58.38	54.42	Tendency to decrease
Deliver	Documentation processed correctly	0.76	0.88	Tendency to increase

From Tables 1 and 2, it can be observed that the instrument used has a Cronbach's Alpha of 0.840, this means that the survey prepared by the researchers is of high reliability according to the table 3, Metrics: Sum of values of the Alpha of Cronbach.
Figure 6 shows the main problem of the distribution and transportation that was obtained from the timely surveys. Experts emphasized the need for integrative approaches [22].

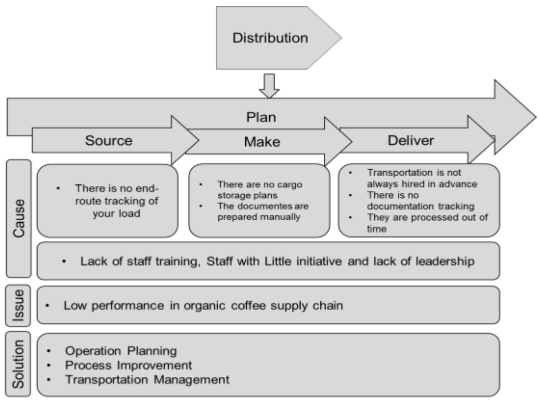

Figure 6: Low performance in the SC of organic coffee. Adapted from Hubner (2013).

5. Metrics

The Cronbach test helps to determine that the instrument used is highly reliable in the 19 cooperatives [6]. The results are shown in table 3. The survey showed that the coffee SC inefficiencies are caused by the convoluted transportation network which directly impacts the storage, delivery time, documentation errors, and higher transportation cost [10].
Storage factor: An efficiency objective, which allows measuring how efficiently space is being used for specific goods in a given space. It is calculated by dividing the volume by the space capacity.
- Efficiency meeting the delivery time: This objective allows us to measure how efficient the cooperative is regarding the delivery time. It is calculated by dividing the expected arrival time vs. the actual time for each cooperative.
- Unit cost in US $/ TM per cooperative: It is calculated by dividing the estimated shipping cost by the weight handled in tons.
- Documentation processed correctly: It is an indicator as to how the process is prepared without errors minimizing the delays caused by documentation errors.

6. Hypotheses development

Based on the above literature and the findings in the field, the hypothesis of this research is stated as follows: The enforcement of an integration model in the distribution process of the organic coffee SC improves its operational performance.

7. Proposal Model

The survey results show that the main causes of SC poor performance are caused by transportation problems, ineffective performance monitoring, incorrect documentation preparation, and lack of planning in the loading and unloading of transported goods.
Given the current situation of the 19 disintegrated cooperatives, a model is proposed which is based on different research articles and successful best practices implemented worldwide and adapted to the current scenario in the Peruvian Andean in the Junín region.

The organic and sustainable coffee SC model is shown in Figure 7. The model considers the best practices for sharing the information and improving the coordination among coffee supply chain member [65].

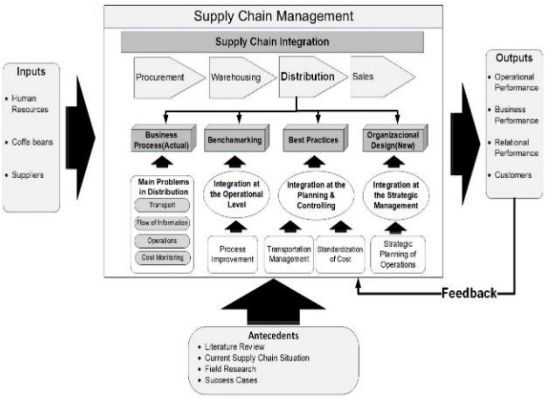

Figure 7: A framework of chain integration model. Adapted from Dominique Estampe, Samir Lamouri, Jean-LucParis, Sakira Brahim-Dejelloul, 2017; Rotaru, et al., 2013

7.1 Benchmarking

Benchmarking is a powerful tool largely accepted to be used as a planning tool for process improvement, time constraint removal, and used in every form of process comparison [34]. Each performance measurement, internal measurement process, and reflection to one or another standard is labeled as a benchmarking activity, thus is measuring your performance against that best-in-class companies; determining how the best in class achieve those performance levels and using the information as the basis for your own company´s targets, strategies, and implementations [2]. Then you must set goals and objectives that can offer the same degree of reliability as other companies, making use of the different resources at the time of production of an application, is seeing it from the point of improvements of the SC.

It´s carried out to review best practices regarding compliance with the SC of each of the cooperatives studied to improve efficiency in the four processes mentioned above [47].

7.2 Operation Planning

Most cooperatives consist of five stages in the implementation of stevedoring projects: Planning preparation, storage, pickup, and dispatch. These steps are explained as follows:

· Planning: Thorough analysis of what is required, to identify business processes, interfaces, personalization, data source, and timeline settings, Startup plan.

· Preparation: Defines the process to be carried out, the approval, measurement of risks, needs of tools and security [41].

Storage: Handling of tools necessary to carry out the process without problems through process control.

· Pickup: Waiting planning to collect at the time of having objects on the floor.

· Dispatch: Storage or service management and coordination [21].

During the storage planning, a higher factor needed to be in consideration to support the additional demand.

7.3 Transportation Management

Most cooperatives consist of five stages in the implementation of stevedoring projects: Planning preparation, storage, pickup, and dispatch. These steps are explained as follows:

• Planning: Thorough analysis of what is required, to identify business processes, interfaces, personalization, data source, and timeline settings, Startup plan [39].

• Preparation: Defines the process to be carried out, the approval, measurement of risks, needs of tools and security.

According to Tseng and Long Yue [57], five key terms are considered in all logistical activities, logistics operations, entry logistics, materials management, physical distribution, and SCM. Logistics describes the entire process of materials and products that move in and out of the company. Inbound logistics covers the movement of material received from suppliers and material management, which describes the movement of materials and components within the company.

Physical distribution refers to the movement of goods from the end of the assembly line to the final customer. Using a well-managed transport system, the goods could be sent to the right place at the right time to meet customer demand; as a result, it brings efficiency and builds a bond between the cooperatives and the distributors.

Therefore, transportation is the basis of efficiency and economy in business logistics and extends other functions of the logistics system. In addition, a good transport system that carries out logistic activities brings benefits not only to the quality of the service but also to the competitiveness of the company. Tracing the cargo will help the cooperatives minimize cargo complaints about late arrivals. Additional, the transport system should consider both contemporary environmental issues and traditional economic factors in order to developing a greener supply chain [44], [54].

According to the best practices of the transport administration would be:

· The documented process to manage transportation includes inbound, outbound, and freight payment.

· Routing guides consider total landed cost (by source, by lane, by product, service level requirements, carrier performance requirements, and carrier contract terms.
· A process is in place to control inbound transportation base on the potential for economies of scale, carrier 3PL contract terms, and on the availability of systems to plan, monitor and proactively manage inbound flow from suppliers [46].
· Review and revise the carrier contracts at least once a year and keep up to date the Standard Operating Procedures.

8. Conclusions and future research

The proposed integration proposal is viable, approved, and used by the coffee cooperatives. Likewise, the proposed model is also recommended to the rest of the cooperatives in the region.
Given the increased volumes of organic coffee through the SC, it is recommended to be managed directly by the coffee cooperatives instead of third parties or intermediaries.
The proposed model of SCI can serve as a reference to others food SC, cooperatives/associations or firms located in others emerging countries.
The present research was centered on Junín's organic coffee SC; however, in order to have a national perspective, it would be imperative that more research studies are conducted in the northern region in Piura, Cajamarca, Amazonas or San Martin, where 43% of coffee production is presented and where the industry is progressively developing.

In addition, others limitations for this research are taken into account:
· Because the Andean and Amazon routes, travel to the coffee fields takes an average of 22 hours by road, only land transportation is possible.
· Reaction to change: an organizational change may represent a major impact on all parties involved in the coffee process.
· The farmer's business knowledge: currently, producers only work within their family circle and do not have knowledge or expertise on how to run a business. Farmers lack entrepreneur's business acumen [47].

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