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COORDINATION TO REDUCE FOOD WASTE IN FRUITS AND VEGETABLE SUPPLY CHAIN: EVIDENCES FROM CEAGESP

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ABSTRACT

Purpose: This research describes how coordination mechanisms can prevent food waste at CEAGESP.

Methodology: Data collection occurred from March 2018 to April 2019, through observation, in-depth interviews and secondary data collection at CEAGESP.

Findings: While the framework used indicates the influence of governance mechanisms in the coordination of the supply chain, our findings indicate that it is a bilateral relationship: governance influences coordination, but coordination also exerts influence on governance. Positive influence probably is mediated by collaboration and learning, impacting on a better supply chain performance. This leads food waste reduction or prevention, but probably this result can be extended to other situations.

Originality/value: This article contributes to the literature by relating coordination mechanisms and governance structures. Practical implications: Managerially it contributes by presenting opportunities to reduce food losses and waste through supply chain governance and coordination.

Keywords: coordination; distributor; food waste prevention; supply chain governance; sustainability.

1 Introduction

It is estimated that about 25-33% of all food produced in the world is lost or wasted (FAO, 2013) from initial agricultural production down to final household consumption (Gustavsson et al., 2011). Most of the waste tend to occur in the agricultural and post-harvest activities of the chain at developing countries and at near consumption in developed countries (Ciccatiello et al., 2016; Gustavsson et al., 2011; Parfitt et al., 2010). It is estimates that from 5% to 17% of that waste is produced at the retail and distribution level (Ciccatiello et al, 2016; FAO 2014). The main causes are related to the absence of infrastructure, the lack of managerial capabilities, investment in technologies, mechanical damage and/or spillage during food handling, failure to meet quality standards set by retails, and an overall lack of coordination across the supply chain (EC, 2010; FAO, 2013; Gustavsson et al., 2011; Parfitt et al, 2010).

Food waste reduction and prevention is important because there are negative externalities that arise throughout the entire lifecycle of food and adversely impact the society, having at least three big impacts: economic, environmental and social impact. Economically it represents a waste of resources used in production, such as land, water, labor, energy, etc. and profitability. Environmentally, it also leads to unnecessary CO2 emissions and air pollution caused mainly by the discard of food on landfill or incineration and by the use of all machinery involved in the production and transportation of the food chain; and socially it worsened food security by reducing access to food through the decrease of availability and price elevation. (Cicatiello 2016; FAO, 2013; Gustavsson et al., 2011; Kummu et al., 2012; Lundqvist et al., 2008). Therefore, reducing food waste can save economic resources, reduce costs, improve food security, and minimize negative social and environmental impacts, as well as answer the growing pressure that businesses are facing to become more sustainable (Thyberg & Tonjes, 2016). It contributes to the creation of a sustainable food system (Lipinski et al., 2013). Food

waste reduction and prevention also meets the Agenda 2030 goals, since its target 12.3 aims to half food loss and waste in supply chains until 2030 (UN General Assembly, 2015). However, due to the complex nature of the food supply it is a big challenge for researchers and practitioners (Raak et al. 2017).

Previous literatures on food waste introduce the importance of relationships among different activities of the food chain (De Steur et al, 2016; Gustavsson et. al., 2011; Mena et. al., 2011); the importance of collaboration in the supply chain to reduce or prevent food waste, since choices made by one agent affect the choices made by others stakeholders' up or downstream in the value chain (Bilska, et al., 2016; Halloran at al., 2014; Priefer, Jörissen & Bräutigam, 2016); and the necessity of better coordinations mechanisms (Govindan, K., 2018). In this sense, many managerial actions to reduce food waste can be made through increasing coordination between supply chain agents and stakeholders (Gadde & Amani, 2016).

Moreover, research on food waste tends to focus at household and retail level. Emerging literature covering food supply chains provides insights into the somewhat neglected question of food waste generation outside the household (Papargyropoulou et al., 2016). Wholesaler is a stakeholder that so far has not received much attention in food waste investigations. According to Mena, et al. (2014) it is related to the fact that in most of situations the volume of food managed by them is comparatively small. As a result, some investigations consider wholesale and retail together when analyzing distribution channels(for example, see Vergheseet al., 2013).

However, these investigations disregard the importance that wholesaler has in many markets around the world. For example, Brazil runs the Latin America´s largest wholesale of fruits and vegetables, the world's third largest in volume of trade: CEAGESP - São Paulo General Warehousing and Centers Company [*Companhia de Entrepostos e Armazéns Gerais de São Paulo*] (Guerra et al., 2012; São Paulo, 2019). CEAGESP markets in average 283 thousand tons of food per month, with food products coming from 1,500 municipalities in 22 Brazilian states and also from 19 countries. It connects producers and distributors with wholesales, retails, restaurants and general consumer (CEAGESP, 2019). According to Garrone et al. (2014), this gaps in literature exist because the significance of food waste has been recognised only recently (Garrone et al., 2014). According Timmermans et al. (2014) both developed and developing countries can learn from each other, towards a global level repository of analysis and solutions to address food losses and waste (FLW), justifying the relevance of this research in the biggest wholesaler of Brazil..

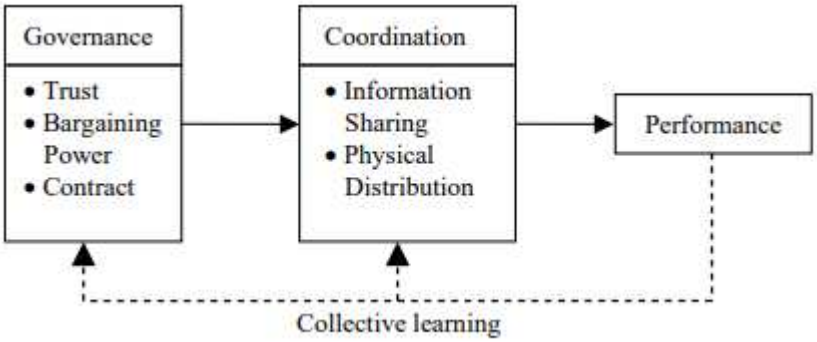
Therefore, considering that: a) Brazil is one of the largest food producers in the world; b) CEAGESP representativeness as wholesaler; c) CEAGESP promotes a wide interaction among several stakeholders in the food supply supply; d) coordination mechanisms between different stakeholders are important to food loss and waste reduction; e) 2030 Agenda goals; the present research intends to contribute to practice and theory through analysing the following research question: **How do coordination mechanisms can prevent food waste at CEAGESP?**

This study seeks to answer this question by carrying out a qualitative research based on site observation, secondary data and interviews in CEAGESP in order to provide theoretical and practical contribution regarding the wholesale role at the food value chain and as a potential actor helping to address food waste. Besides this introduction, the second section reviews the theoretical background on supply chain coordination and governance. The third section explains the methodology. The fourth section presents the case under study and the research. findings. The fifth part discusses the findings and, finally, the sixth concludes with implications for theory and practice.

2 Theoretical background

Coordination is considered as a key issue in supply chain management (Kanda & Deshmukh, 2008) and performance (Handayati, Simatupang & Perdana, 2015). This paper adopts the framework proposed by Ghosh & Fedorowicz (2008) in relation to supply chain coordination and governance framework, presented in Figure 1:

Figure 1 - Framework for supply chain coordination



Source: Ghosh & Fedorowicz (2008)

The framework departs from the understanding that coordination is needed to guarantee both the timely flow of information and of materials, which are reflected in the supply chain performance. In order to succeed in coordination, supply chain agents in each company need to agree on common governance mechanisms to manage the flow of information and materials, which support the processes and structure in the relationships between organizations. The most relevant enablers that aid interorganizational coordination and information sharing are trust, bargaining power and contracts. The outcome of coordination is performance. The outcome of coordination and performance leads to feedback or collective learning in the supply chain (Ghosh & Fedorowicz, 2008). As most literature in supply chain management uses coordination and governance with similar meaning, the use of of both concepts distinguishing their meanings and exploring their complementarity can add to this area of research.

Bargaining power relates to relative size of partners, control over resources, control over processes, and share of the firm in total value added (Ghosh & Fedorowicz, 2008). Timmermans et al. (2014) found that depending on market or purchasing power, position, and capacity of coordination some agents in food supply chain may suffer less from food loss and waste and impose the costs of inefficiency to less well-positioned agents. Halloran et al. (2014) and Richards et al. (2013) found that due to their bargaining power, food retailers strongly influence other actors along the food supply chain, which may further affect the generation of food waste, mostly affecting farmers. Devin & Richards (2016) proposes access to alternative markets to increase the bargaining power of growers, as to give them more channels to distribute their produce and in turn, lower their levels of food waste. Levins (2002) proposes that collective bargaining is the best alternative and the way for farmers to negotiate with traditional supply chain problems.

Contract relates to the existence of a written, legal document which defines roles and responsibilities of both parties. It also related to risk sharing, incentive and responsibilities alignment. (Ghosh & Fedorowicz, 2008). Considering the example given above, in relation to bargaining power, Timmermans et al. (2014) explain that in competitive markets, economic losses can be assumed by subaltern agents that under contract must submit to the standards imposed by another supply chain with more power in relation to coordination, which usually is a supermarket chain, a trader or even a processing industry. Devin & Richards (2016) found

similar results, in which supermarkets have got an abundance of some food variety, even though they have a fixed contract with a grower, they may reject the produce or offer 50 % less.

Trust might be calculative when reflects an assessment of a partner's likely cooperation; competence when it reflects the ability of a chain member to perform a task that it says it can perform; integrity when there is an belief that a company makes good faith agreements; and predictability when it related to actions consistency. Trust as a governance mechanism plays a crucial role in sharing information along supply chain. It works in conjunction with power and contracts in governing the exchange of information (Ghosh & Fedorowicz, 2008). A lack of trust in a supply chain relationship can lead to less supplier transparency, resulting intopotential problems being hidden (Tachizawa and Wong, 2015). In the opposite way, high levels of trust are associated with greater encouragement to systemic change throughout the food supply chain in relation to food waste reduction (Halloran at al., 2014).

The governance mechanisms of trust, bargaining power and, contract are considered as drivers to inter-organizational information sharing (Ghosh & Fedorowicz, 2008). Supply chain performance is better enhanced when activities are coordinated under an integrated information sharing environment (Lee et al., 2000). In relation to physical distribution, it helps especially on reducing inventory levels improving the supply chain profitability (Lee et al., 1997). Collaboration and information technology infrastructure are important for information sharing (Shore and Venkatachalam, 2003). In this sense, information sharing is a mechanism to improve production and distribution practices through all value chain activities in order to address food loss and waste, including the promotion of better consumption practices. Capacity building training should be implemented in order to have food chain improvement, value creation, packaging, quality and safety, good practices, sorting and grading, transportation, traceability and storage. Moreover, capacity building in the form of education, training and extension services for farmers and all actors along the food chain is a key tool for reducing food losses and waste (Timmermans et al., 2014).

Performance is related to measurement of how well a initiative, process or system is functioning (Ghosh & Fedorowicz, 2008; Gunasekaran et al., 2001). Supply chain performance can be measured according to three main groups: resource, output and flexibility. Resources involves inventory levels, personnel requirements, equipment utilization, energy usage and general costs (as manufacturing cost, distribution costs, inventory, etc.). Output is related to customer responsiveness, product quality and the quantity of final product produced. Flexibility is related to volume, delivery, mix and new product flexibility, such as promote reductions in the number of lost sales, and the ability to respond to and accommodate new products, new markets, or new competitors (Beamon, 1999). It is expected that improving the efficiency and performance of the whole supply chain significantly reduce the perishable food waste (Kaipia, Dukovska-Popovska & Loikkanen, 2013).

In this sense, one relevant conclusion in the study of Ghosh & Fedorowicz (2008) can help understand the supply chains of fruits and vegetables in Brazil in relation to food waste. They found that a successful supply chain coordination relies on the existence of good communication-enhancing governance mechanisms that can be clearly linked to performance and process improvements. It is the knowledge of the role of the governance mechanisms that will enable the supply chain agents to realign interfirm relationships and contribute to supply chain performance.

Feedback or collective learning in supply chain relates to the fact that organizations learn from the mistakes committed by themselves or others, from opportunities lost due to negligence, or from inadequate information sharing. Feedback process helps to detect deficiencies in information sharing and physical distribution flows, and it strongly affects the role that trust, power and contracts will play in the future supply chain coordination (Ghosh &

Fedorowicz, 2008). In fact, shared learning, and sharing of experiences, is key to food loss and waste reduction (Timmermans et al., 2014).

Based on this perspective, Table 1 presents the categories of analysis that will allow to analyze how coordination mechanisms can prevent food waste at CEAGESP. These categories enable the investigation of how governance mechanisms are related to the coordination of food supply chain of fruits and vegetables in Brazil and impact on its performance.

Table 1 – Categories to analyze food waste in fruits and vegetables in CEAGESP

Categories of analysis	**Elements**
Governance	
Bargaining power	Relative size of partners; control over resources; control over processes; share of the firm in total value added
Contract	Existence of a written, legal document; risk sharing; incentive alignment; and responsibilities alignment
Trust	Calculative; competence; integrity; and predictability
Coordination	
Information flow	Information sharing; collaboration; and information technology infrastructure.
Materials flow	Physical distribution of products; sorting and grading; transportation; storage; good practices; and traceability.
Performance	
Resource	Inventory levels; personnel requirements; equipment utilization; energy usage; and general costs
Output	Customer responsiveness; and product quality and the quantity of final product produced.
Flexibility	Volume; delivery; and mix and new product flexibility

Source: Authors, based on Ghosh & Fedorowicz (2008)

3 Research methodology

Data collection occurred from March 2018 to April 2019, through site observation, in-depth interviews and secondary data collection at CEAGESP. Primary data collection was performed in 3 stages, described in Table 2. A field diary was carried out and photos were taken.

Except for step 2, all interviews were recorded and transcribed. In addition, secondary data were collected from websites, scientific papers and online publications.

Table 2 - Primary data collection stages

Period	**Activities**
March 2018	Observation visit to CEAGESP, observation visit to CEAGESP Food Bank; interview with the manager of the CEAGESP Food Bank (interviewee 1). Interview length: 36 min - recorded
September 2018	Observation visit to CEAGESP, observation visit to CEAGESP Food Bank; interview with the agronomist responsible for the Quality Center in Horticulture of CEAGESP (interviewee 2 - interviewee 1). Interview length: 1h10 min - not recorded.
April 2019	Observation visit to CEAGESP, interview with the agronomist responsible for the Quality Center in Horticulture of CEAGESP (interviewee 2). Interview length: 2h45min - recorded

The gathered data was analyzed by content analysis with joint participation in all processes by all research team, who coded and enhanced the analysis together. Codification was based on prior literature, as previous exposed in Table 1. All recorded interviews were transcribed and analyzed along with the field notes and photographs during the visits.

4 Results

4.1 Case description

CEAGESP is a wholesaler connected to the Brazilian Ministry of Agriculture, Livestock and Supply. The company has two distinct business units, which are complementary: storage and commercialization centers. In relation to commercialization centers, the focus of analysis in this study, CEAGESP holds the largest public warehouses of São Paulo and a complex of 13 central wholesalers, ensuring the supply of fruits and vegetables to the Brazilian population. The observations visits happened in the unit of São Paulo, the largest in the country. At CEAGESP in São Paulo there are around 2000 wholesales, with products coming from all over the country and from abroad. Most of products negotiate there come from very small growers. Around 90% of the products that go to CEAGESP are sold in the same day.

In relation to the operation of the unit, the commercialization is a complex and dynamic task. It receives the product around 2 am, at 5 am people are on the spot trading, at around 7am they have all negotiation made, and around 10am everything is sold. It is a very short period of time, especially considering the amount of people involved in this operation on daily basis. There are different kinds of negotiation. One of them is consignation, in which the wholesaler works as a dealer, who receives a commission / percentage of the sales. Another is a price combination before sending the product to commercialization.

The interviewee 2 explains that CEAGESP has a low food waste volume, compared to other countries because the unit receives customers with high, medium and low demand in terms of quality standards - in relation to size and shape of food products, while in other countries the acceptance of low quality products is lower. However, the total quantity of wasted food is still significant. The unit generates 1.5% of total garbage, which corresponds to hundred

and fifty tons per day. One part of this garbage is box and other material stuff. Of this total volume, around 8-9% are fruits and vegetables, but it is food that cannot be sold or donated anymore.

Donations occur at an earlier stage, when a) the product was not sold and due to its perishability there will be no time for new commercialization process, but it can still be consumed; b) when a product is seized for fiscal and bureaucratic reasons and the owner does not regularize the situation within 24 hours. In these cases, CEAGESP has 300 different charity institutions that go to the site to collect the food and redistribute it. It also has its own food bank located within the company.

4.1 Managerial challenges related to food waste prevention

Based on interviews, on-site observations and secondary data collected it was possible to identify relevant potential for food waste reduction through improvement in governance and supply chain coordination. These issues involve interaction between the agents in the supply chain. The interviewee 2 explains that "to try to change the sector you have to work with all the chain. Everyplace you must work in improvements. The change must begin at the grower and goes to retail and consumer".

Quality standard is the main issue throughout the full supply chain. The standards of quality exist because each product has different sizes and shapes. Some are more valued by end consumers, who are willing to pay a higher price for these food products. In this way, products that have the standard valued by the market have a better price and products that are non-standard are cheaper. The interviewee 2 explains that the best grade classification is priced 27% above than the less valued ones. This impacts the choices and actions of other supply chain actors, as well as impact in the costs and revenues of supply chain members.

About **contract**, since there is a lack of a contractual mechanism and as result relationships in this sense are very informal. Brazil does not have a regulation that establishes the trading rules. The interviewee 2 explains that the United States has an interesting model, since they have a commercial code specific for perishable products that establish the duties and obligations of the grower, the transportation, the wholesale, the retail. They also have fast judging of the commercial problems. In Brazil, there are no clear rules. As there is a value differentiation defined by quality and size, and there are no rules, pricing is also not very clear for buyer and suppliers. This uncertainty impacts on the efficiency of negotiations in terms of speed and potential generation of food waste. In addition, the agent with more bargaining power usually makes a decision about price.

In relation to bargaining power, retail is the strongest agent in the food supply chain in Brazil. It is a common practice from retail not to sell the products and only make a discount on the amount paid to producers or distributors, transferring the costs of losses. In many situations, retail does not give back the product to them.

On the other hand, the growers are the agents who face high costs. They are characterized as "fragile" in the negotiation process (interviewee 2). The first problem is related to their lack of representativeness in the discussions about food waste. Interviewee 2 explains that "We don´t know how much the losses at the grower is [...] Nobody talks about losses at the production. It is a lot of loss". Growers need to meet marketing standards, since products with a higher quality standard receive a higher value and products of lower quality or are not accepted by the market or receive a very low value, which often does not justify sending the product to wholesale or retail. There are reports that many producers, when identifying that the product is not in the aesthetic standard valued by the market, decide to leave the product on the ground without harvesting, because the cost of taking it to the market is not profitable.

A relevant governance problem relates to the lower bargaining power of producers, comparing to all other agents in the entire supply chain. In most cases, the costs of food wasted (due to aesthetic standards or damage during handling) or not sold are discounted from growers, especially when the sale is by consignment. There are cases in which the grower receives nothing and even owes payment to the wholesaler, due to the transportation costs. As there is no legislation protecting growers, the weakest link ends up suffering the consequences and costs of food waste.

There has been a very recent change dating back to 2019, which has not yet had any effects in the market and has some flaws already perceived. There is a new regulation from the Ministry of Agriculture about minimum quality standards. The company that has the product at the moment is responsible for the quality. Therefore, problems like decays and deep damages and immatures or overmatured are considered outside the minimum quality standards.

The low bargaining power of growers stems from several issues, one of which is related to the concept of **trust**. Brazil is characterized as having many small producers. While in other countries it is possible to find associations of growers to do commercialization and improvement in the productive processes, which increases their power in the market, in Brazil the situation is the opposite. The interviewee 2 explains that Brazil has very little growers' organization. The country has some associations, but they do not commercialize in a collaborative way in the case of fruits and vegetables. The growers do not believe in their association due to the institutional environment and corruption questions that happen in Brazil. This undermines the evolution of collaborative initiatives.

The fruits and vegetables face some coordination problems in relation to **material flow**. For three years CEAGESP made a research, in which they analyzed every week several products. Of these products they took the most valuable and the less valuable one of every week and evaluated the attributes of each one. It was the same food products, from the same grower, and collected at the same time. After three years they feel confident to explain the main reasons of the value differentiation, without considering the shape and size, only the quality of the food. The first reason of the price differentiation was the incorrect grading in relation to size, shape and color. There is a need of homogeneity because there is different values and buyer pay different according to its perception about the characteristic of the food (not related to nutritious content but aesthetic).When the products are homogeneous it is easier to make a value differentiation and to growers have better price selling products of higher quality. The second reason was the incorrect harvest time, since some products were harvest before ripening. Many fruits are harvest precociously harvested in purpose to not show damage problems. The problem is shown at the consumer level only. Physical damage due to handling was the third reason, which leads to injury to the food, causing more waste. This research was published in collaboration with Embrapa (Brazilian Agricultural Research Corporation). The promotion of local buying would not solve the problem of supply chain out, but would enable the selling of ripe products from small growers.

Minimal handling is an important problem related to **material flow** that was quoted in the interviews and verified in the observations. Food is handled at various times; it has often been possible to find damaged food resulted from handling during observations. The interviews point out that growers don´t know the value differentiation that it is practiced in the market. They put together products of different values. This way, the mix would force the wholesaler in CEAGESP to grade again the product and to change the pack. Every time someone handle the product increases the chances of damaging it, leading to food waste. There is market for all sizes and different qualities of products. If the products come well graded from the grower, it would avoid the damage by the handling of the food, as well as they would receive a better value by the group of products of better quality, for being more homogeneous.

However, this problem is not exclusive to the grower. This is also happening at wholesale and retail. Handling occurs for other reasons in these other agents. For example, in retail it is a common practice to pile the products out of the box that the producer sent and stack on the shelf. So, even if the producer has done the correct grading, it ends up messing with other products. It was clear that in some situations the retailer prefers to receive the products without grading, because they can pay a lower value to the producer.

Another problem in **material flow** is related to the lack of adequate storage and cold chain systems in all the supply chain. In many places there is no refrigeration. For example, it was possible to observe food transported in trucks without refrigeration under the heat of more than 30 degrees Celsius. At CEAGESP, the biggest problem is that different products have different storages temperatures and they are put together in the same place and at the same time. This problem is common to the entire supply chain. As these products come most of the time warm and it is put on the refrigeration chamber with many other products, generating more food waste. In addition, most products need to be sold on the same day which result in price variation from one week to the other, even from one day to the other "because you are racing against time, because we do not have refrigerator storages, you have to harvest today" (interviewee 2) . Finally, this impacts on water loss of the product, which is of great relevance for its quality. Before the harvest, the product has a natural transpiration system. When there is no refrigeration after harvesting it will lose a lot of water. Water losing is a stress factor, and it loses very fast, impairing the quality of the product.

Wooden boxes used for the transport of food are also questions related to **material flow** that generate waste of food. During the observations were verified many foods damaged by the peels and stacking in these boxes. The use of returnable plastic boxes would cause less food waste. However, it is very difficult to implement it, once it is difficult to control the flow of boxes. Many of these boxes do not return as their price are high.

According to CEAGESP, there is some difficulties in relation to **information flow**. The first one is that they perceived that food services have a lot of difficult to choose which product to use, since there is a value differentiation by grade. They don't know what the meaning of the different grades is. Even if they ask for a specific grade, they are not able to evaluate if they are receiving the grade asked or not. Most important, they don't know which grade gives the best cost benefit for them since many products are used as ingredients to prepare food no mattering their aesthetic appearance.

When the product cannot be sold or is seized, and is still fit for consumption, there is an option to avoid food waste. The CEAGESP Food Bank collects these foods and delivers them to charities. However, they face some problems related to governance and coordination. The first problem is related to logistics and **material flow**. When wholesalers want to donate food, they want that CEAGESP take out the product immediately to leave the sales space available. Getting the product out quickly is not an easy task for the food bank. Another problem is that they do not always get their donations. For example, someone can donate a truck full of papayas for the food bank. There is no way to distribute a papaya truck only to small associations, not always the associations have the feasibility to go to collect only one type of food, for them it is better to obtain diversity.

Finally, another problem faced by the food bank concerns lack of **trust**. Some growers and wholesalers prefer to throw food in the trash instead of donating to the food bank. They do not trust the institutions: "This is the big problem. Because when you have politicians working in the system, they always think that somebody is donating to have votes, because the food bank chooses the association and the municipality [for which food will be donated.] So, the big problem is not only in this situation, but in many others" (interviewee 2). The interviewee 3 also reports that many people do not trust that food will be donated. According to him, any people believe that people in the food bank will pick up food for their own use or for resale.

4.1 Actions of CEAGESP and potential actions related to food waste prevention

In relation to quality standards, CEAGESP carries out an important activity that promotes more coordination through information flow as leaflets on quality standards. The interview 2 explains that “they can use it as a negotiation language”. The reason to the make such leaflets is to make possible to have a fairer trade and to make possible to adopt other kind of negotiation and marketing systems, such as ecommerce. CEAGESP proposes some quality standards which are voluntary. There also publications that explain in detail that “when you talk about the most valuable tomato you are saying that it is size must be…” (interviewee 2). Moreover, when problems occur CEAGESP helps supply chain in solving the problems.

Quality standards demands trust and transparency. Agents in the supply chain must be sincere in describing their product to enable proper marketing and no break in trust: “So, the producer would have to say 'my product is not good enough, it is not the best quality'" (interviewee 2).And today what happens is that information does not flow easily.

Regarding the weakness of the producers, CEAGESP seeks to strengthen collaboration with the CATI (Coordination of Integral Technical Assistance), which in Brazil provides services of technical assistance and rural extension to the small and medium rural producers, and with other governmental entities of rural assistance. Government exchanges in the country often hamper our collaborative processes. But the biggest difficulty is that most of the people who work with rural extension, focus on productive processes in technical terms and do not help with marketing issues.

Regarding minimum handling, CEAGESP promotes training at the retail level in collaboration with ABRAS (Brazilian Association of Supermarkets). However, the action seems to be totally inadequate and new initiatives need to be undertaken. In relation to the lack of refrigeration or different refrigeration requirements for each food, CEAGESP asked the refrigeration industry if it is possible to do something about it. They explain that they never achieved better results, because so far there is no machine that is made by demand. Probably if there was some machine, the value would be too high, making it difficult to buy.

In relation to the replacement of wooden boxes with returnable plastic boxes for transport, the CEAGESP interview clarifies that CEAGESP is assisting in the attempt to establish a national standard of package to avoid the wooden boxes. They made a pilot project in another Brazilian state that implemented the plastic boxes. That was possible to use returnable packaging in an open circle, 'called Bank of Uai Boxes'. It is working very well. It suggests that it is important to implement the program of logistic modernization of the sector to use palletization, for example, from the grower, seeking minimal handling throughout the supply chain.

Palletization would help in another essential activity in reducing food waste: traceability and food labelling. Having the name of the producer in the products it is possible to trace the origin of the food. Today the execution of palletization, food labeling, and traceability is the exception. But for this it is necessary that the box that came from the producer is exposed in the retail, instead of the fruits and vegetables to be stacked. This would allow an adequate evaluation of minimal quality patterns, traceability, seasonality and if they are working with local production, which are important elements when reducing food waste. CEAGESP has been enforcing on food labeling for many years, with some successful stories, but it recognizes that much more needs to be done in this regard in the country.

In relation to the problem that food service does not know what the meaning of the different grades is, CEAGESP has initiatives that allow to improve coordination in relation to information flow. In cooperation with national research agencies, they developed a program

which is called ‘Horti Choice’. It is a decision tool made especially for food service to help recognize the different standards of food products and the best cost benefit option, to find local suppliers, to help in the identification of substitute food if some is missing in the market. They estimate that they have provided training for ten thousand people in restaurants. The idea is to expand and create a tool for retail.

Finally, regarding the problems faced by the Food Bank, CEAGESP has studied the best options. There are some meetings under way to discuss the logistic solutions to the problems faced. In relation to building of trust, respondent 3 informs that CEAGESP is working to increase the transparency of donations. It has been trying to inform producers and wholesalers as far as possible the quantity of product received, the origin, to whom it was donated and in what quantity. But this is a job that demands a lot from the team and is being improved.

Table 3 summarizes the results.

Table 3 – Summary of the results

Mechanisms	**Impact on performance**	**CEAGESP acction**
Governance - Contract - Brazil does not have a regulation that establishes the rules of negotiation, what are the duties and obligations of the grower, the transportation, the wholesale, the retail.	The large differentiation of value of value in relation to quality standards is not very clear in the negotiation process. This promotes an unfair system, which ends up hampering the agents with less power	• CEAGESP has developed documentation on quality standard • CEAGESP made publications explaining in detail the characteristics of quality standards. • CEAGESP assists in problem solving.
Governance - Bargaining power: retailer with greater power and grower being the most fragile agent of the supply chain.	Producer is who is penalized with the costs of waste due to aesthetic issues, products damaged during handling, and unsold products.	CEAGESP seeks to strengthen collaboration government agencies to make efforts to improve farmers' skills in terms of marketing and not just production.
Governance - Trust - the growers don´t believe in their association and the country has no association of producers to market fruits and vegetables	It undermines the producer bargaining power	-
Coordination - material flow: there is a value differentiation due to incorrect grading, incorrect harvest point, and physical damage	Increases handling of the product, which causes more food waste; less value paid for food and waste of food	-
Coordination - material flow: handling	Causes more food waste	Training at retail level in collaboration with ABRAS
Coordination - material flow: lack of refrigeration or lack of refrigeration technology	Food waste; water waste; products need to be sold on the same day due to perishability; and big price variation	-
Coordination - material flow : packages	Damage of food, leading to waste	CEAGESP is assisting in the standardization of boxes in the country and has developed a pilot project in another Brazilian state
Coordination - material flow - Lack of palletization, food	Prejudices an assessment of the of minimal quality patterns,	-

labelling and traceability	traceability, seasonality and if supply chain is working with local production, which are important elements when reducing food waste	
Coordination -information - food service don't know what the meaning of the different grades is	Inability to evaluate the best cost benefit; pay higher price unnecessarily; loses the possibility of buying food that would be wasted for aesthetic reasons at a lower value	CEAGESP has developed a decision tool to help restaurants recognize the different market standards and the best cost benefit option
Coordination - material flow - logistics problem in the food Bank	Impossibility to receive donations; and difficulty in donating some food	-
Governance - Trust - lack of donation due to lack of trust	Producers and wholesalers throw food out instead of donating for not trusting the food bank	Food Bank has sought to improve transparency on donations received and destination

5 Discussion

In this research it was possible to identify a series of issues related to governance and coordination that affect the generation of food waste. The identified causes are in line with the results of other contexts (EC, 2010, FAO, 2013, Gustavsson et al., 2011; Parfitt et al, 2010) regarding the entire supply chain, especially in relation to the problems of quality standards, mechanical damage and / or spillage during food handling, lack of knowledge, lack of technologies, and lack of coordination across the supply chain.

Retail is the agent with more bargaining power and imposing the costs of inefficiency on agents with less power in the supply chain is a result aligned with the propositions of Devin & Richards (2016), Halloran et al. (2014), Richards et al. (2013) and Timmermans et al. (2014). This is hampered by the lack of a negotiation regulation or contract (Ghosh & Fedorowicz, 2008) that establishes what are the duties and obligations of the agents involved. Producers are the agents who suffer the most from inefficiency related to food waste. Having differentiated value according to the quality of the product and the absence of more transparent mechanisms in the commercialization, in some situations the producer hides certain problems when harvesting products that are still unripe. Tachizawa and Wong (2015) had already verified occurrences of this type. This leads to problems of lack of transparency, leading to potential problems being hidden (Tachizawa and Wong, 2015).

The lack of trust of producers in associations and the lack of qualification in terms of marketing impairs their union into market together and increase their bargaining power. If this were possible, they could increase their power by negotiating collectively, as proposed by Levins (2002). However, a possibility that did not appear in the research refers to the existence of alternative markets (Devin & Richards, 2016). Those products that have the lowest value in CEAGESP due to appearance can find new markets with the emergence of business platforms that are proposed to commercialize "imperfect" foods, opening up new markets.

Problems of material distribution / flow (Ghosh & Fedorowicz, 2008) as damage due to excess of handling, packaging and lack of infrastructure are quite impressive in the generation of food waste and decreasing the supply chain profitability. These problems have been the target of previous research and actions carried out by CEAGESP. Difficulties in the flow of

information also showed negative impacts on the performance of the supply chain and the generation of food waste.

If performance is related to the measurement of how well the system is functioning (Ghosh & Fedorowicz, 2008; Gunasekaran et al., 2001), the results show several potentials to reduce food waste and improve supply chain performance in terms of governance and coordination. The findings evidence the complexity of the supply chain (De Steur et al, 2016, Gustavsson et al., 2011, Mena et al., 2011) and how the actions of a agents impact and assess the other stakeholders in the value chain, both up and downstream, as proposed by Bilska, et al. (2016), Halloran et al. (2014), Priefer, Jörissen & Bräutigam (2016). This complex interfirm relationships reflects the importance of collaboration to reduce or prevent food waste.

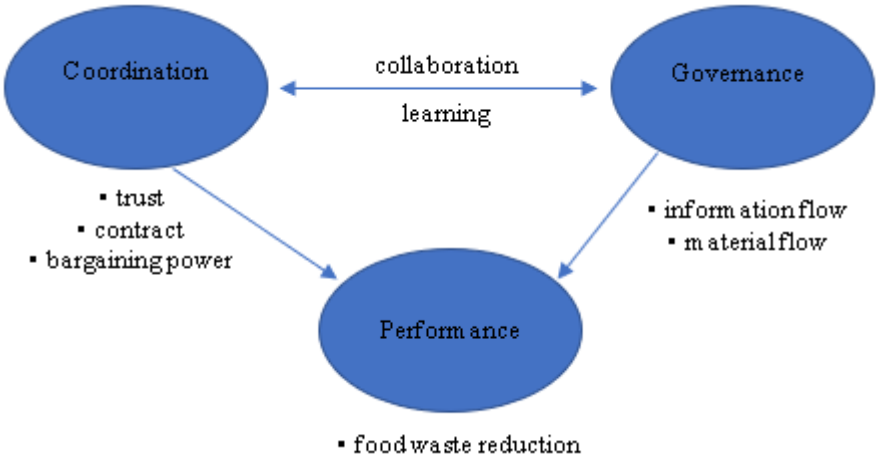
The establishment of collaborations with other stakeholders appears as one of the bases of the actions that CEAGESP develops to help address food waste problems impacting in the performance of the supply chain. Through collaboration, CEAGESP performs some actions to identify the causes of waste. For example, this occurs when doing studies with other institutions and universities, when doing analyzes with data from producers, distributors and retailers. It seems that this link has a greater force to establish trust ties with the other stakeholders. Without trust, obtaining data and collaboration would not be possible. In fact, Halloran at al. (2014) identified that high levels of trust are associated with greater encouragement to systemic change throughout the food supply chain in relation to food waste reduction (Halloran at al., 2014). This was verified in the case of CEAGESP.

Based on the identification of causes, or feedback in the concept of Ghosh & Fedorowicz (2008), CEAGESP also uses collaboration as a starting point to develop solutions, make pilot projects, and implement the solutions, as proposed by Timmermans et al. (2014), programs to develop capacity in food chain improvement, value addition, packaging, quality, good practices, grading, transportation, traceability and training. The company also use collaboration and information technology infrastructure to promote information sharing, as suggested by Shore and Venkatachalam, 2003. By doing so, they promote learning in the food supply chain. This learning is expected to improve the efficiency and performance of the chain and reduce the food waste.

If a successful supply chain coordination relies on the existence of good communication-enhancing governance mechanisms, which in turn are linked to performance improvements the role of CEAGESP is more aligned with the promotion of coordination, improving information and material flow. However, the improvement in coordination processes is reflected in governance mechanisms, especially power imbalance, trust and, to some extent, contracts. The improvement in the governance mechanisms will also enable the supply chain to contribute to supply chain performance.

Based on these findings, while the framework proposed by Ghosh & Fedorowicz (2008) shows governance impacting on coordination, our findings indicate that it is not a flow in a single direction, but that both influence one another. Collaboration is a necessary element, as well as learning. In the case analyzed, the image below reflects the results found:

Figure 2 - Framework with the results identified in the research



6 Final Remarks

This article contributes to the literature by relating coordination mechanisms and governance structures. While the framework used indicates the influence of governance mechanisms in the coordination of the supply chain, our findings indicate that it is a bilateral relationship: governance influences coordination, but coordination also exerts influence on governance. Positive influence probably is mediated by collaboration and learning, impacting on a better supply chain performance. This leads food waste reduction or prevention, but probably this result can be extended to other situations. The practical impact of this research is that it contributes by presenting opportunities to reduce food losses and waste through supply chain governance and collaboration.

The main limitation of this study is to focus the analysis only on the wholesale activity of the fresh and vegetables supply chain, which may limit the extent of the results found. This was a strategic choice due to the complexity of relationships in the food chain. New investigations can analyze the same research question with other supply chain agents, such as producers and retail in order to validate the and expand the findings of this research. It is also suggested to perform studies in different regional and national contexts in order to verify similarities and differences. Quantitative studies can also be performed to validate the framework with the results identified in the research.

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