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Food Retail as the Coordinator Agent of Food Supply Chain: Challenges and Opportunities for Reducing Loss and Waste

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ABSTRACT

Reducing food loss and waste is part of the food security objectives, and there is plenty of research worldwide to try dealing with this issue. This article proposes a theoretical analysis of food loss and waste in light of the agribusiness system approach, having the value system as a whole at a strategic level. Retail is appointed as the coordinating agent for having consumption information: several studies addressing sustainability use this approach. Some opportunities and challenges are pointed out, so that coordination can be promoted along the chain, engaged by their environment, along with strategies of agents in collaborative actions.

Keywords*: food waste; supply chain management; retail coordination.*

1 Introduction

In 1996, during the World Food Summit, food security was defined as the condition in which "all people, at all times, have physical and economic access to sufficient, safe and nutritious food in the face of their dietary needs and preferences for a healthy life and active" (FAO, 1996). Security and access to food are dimensions directly related to sustainable development and the topic of waste. Worldwide, 14% of food is lost along the production chain before reaching the consumer, part of this process is due to the lack of food security due to its processes along the production chain (FAO, 2019). Meeting the objectives of total food security requires recognition of the impacts of food waste, whether caused by the lack of security in the production chain and its processes and the impacts of these on climate change, making it a virtuous circle (FAO, 2020).

Concerns about food loss and waste date back to the 1980s when they were defined by the Food and Agriculture Organization (FAO, 1981), as a relevant part of the issue of food security and the fight against hunger. The discussion of this important topic goes beyond its definitions and determinations of the differences between loss and waste (Rocha, 1995; Smill, 2004; Stuart, 2009; Gustavasson, Cederberg and Sonesson, 2011; Porpino et al., 2018). Research, reports and engagements of agents in the production chain gain space worldwide and in Brazil for diagnosing the evolution of the situation, formulating public and private policies so that practical actions can be taken (Boston Consulting Group, 2018; Porpino and Wansink, 2015; Porpino, 2016; Porpino et al., 2018; Melo et al, 2018; Embrapa, 2018; Abras, 2019; Porpino, 2019).

In Brazil, several problems are identified as challenges for the reduction of 10% of lost and wasted food (Melo et.al, 2018). The different agents face different problems intrinsic to their internal processes and also to services such as transportation and storage. Difficulties in definitions and measurement methodologies require internal and related standards from other countries in order to standardize global controls (Bellemare, et al. 2017). In addition to the formulation of public policies for such processes to occur. All of these themes are addressed in the book "*Perdas e desperdício de alimentos: estratégias para redução*" (Food Losses and Waste: reduction strategies) organized by Brazilian congressman Evair Vieira de Melo with the contribution of several researchers and institutions.

Although there is an approach to waste in all the productive links of different agribusiness chains and also the relationship with the legislature, addressing at the strategic level of the chain based on theories of supply chains, networks and strategy, which are themes that are already widely used, is not observed. worked in agribusiness. The value system was a concept introduced by Richardson in 1972 based on contractual arrangements, extending the limits of companies already worked by Coase (1937) and which mechanisms as incentives can be applied for coordination between companies (Zylberstajn and Farina, 1999), which serves as the basis for the debate of this article.

In this sense, the economic concepts of the Transaction Cost Theory (Williamson, 1975) for the Agribusiness System approach (Davis and Goldberg, 1957; Goldberg, 1968) is the essence of what this work presents regarding the role of the coordination of one of the supply chain agents for modifying the treatment of losses and waste. The approach of the agribusiness system is adopted in this article to analyze the opportunities and challenges across the frontier of the discussion on losses and waste. It differs from the production chain or supply systems approach in that it incorporates aspects of the institutional and organizational environment, such as support and regulatory institutions, and is not exclusively focused on the transformation stages of the final product (Zylbersztajn, 2000).

The purpose of this article is to explore how the coordination mechanisms, if ordered by the food retailer, can define business solutions for the treatment of losses and waste. The intention of this article is not to provoke a specific debate for a chain, but the discussion of how this agent, which holds the demand information, can contribute to such reductions and complement the intense efforts of researchers, their institutions, organizations and the public power to accelerate this process in Brazil.

In the sequence, it is proposed to discuss the agribusiness system and the coordination mechanisms based on the Transaction Costs Theory, arguing that the flow of information throughout the agribusiness system is essential for the reduction of losses and waste. This is the densest part of this essay, which later indicates retail as this coordinating agent, which is justified by the level of information it has. In closing, opportunities and challenges for the treatment of losses and waste are addressed based on this proposed vision.

2 A New Approach to Losses and Waste: Coordination in the Agribusiness System

The agribusiness system is an approach that brings together the concepts of the New Institutional Economy, Transaction Cost Theory and goes beyond the supply chain view. Coordination between agents is the key to delimiting optimal transactions. We propose an analysis of these concepts in their beginnings and how they were explored by Brazilian authors to look at the perspective of food loss and waste as the key problems to be analyzed. We believe that the relationships between agents, if better coordinated, can lead to their minimization of transaction costs and the maximization of agents' actions to reduce loss and waste.

The agribusiness system (SAG) comprises a vision of the Coasean firm expanded to the entire supply chain. The firm is seen by the New Institutional Economics approach, not only as a nexus of contracts, but as contracts defined from specific modes of governance that vary from markets to hierarchies. Market relations are characterized by the absence of specific assets, the price signaling is sufficient to promote adaptations to the set of contracts and the firm's relations. The understanding of how the relations between the agents of the system, the links in the chain, establish their exchanges is important, because in some way, the procedural, logistical and storage losses are embedded in the final price, whether it is established through mechanisms of market, contracts or even if it is a fully vertically integrated chain.

The definition of these relationships depends on the characteristics of the transaction and the institutional environment in search of a design that promotes efficient internal and external coordination (Williamson, 1985). John Commons already placed the transaction as the fundamental element of analysis, since it promotes the operation of the relations between the structures of property rights and institutions (Williamson, 1996). The dimensions of the transaction - frequency, degree of uncertainty and asset specificity are established by Williamson (1991). The transaction between two agents occurs through exchanges of products or services that can be characterized as a set of attributes that are priced according to their property rights, degree of measurability and specification.

However, this flow of transactions is flawed, as internal or external contracts can present problems, as a result of agency problems derived from opportunistic behavior, information asymmetry and the existence of almost income between agents inside the firm or even between firms. This reinforces the author's proposition that there are transaction costs in contracts, ex-ante and ex-post, within firms and between firms (Williamson, 1996). Such concepts are fundamental to the understanding of exchange or purchase and sale between agents, and also what are the failures of coordination or exchange of information that occur for the treatment of losses and waste. An example is purchases beyond the flow of demand, increasing storage and risk of loss and waste. What can also happen in an increase in production due to the precariousness of information exchange mechanisms.

When it comes to a system of firms, in this case the SAG, from farm to fork, the relevance of coordination gains magnitude in operational terms to reduce costs and also to meet consumer demands. Adams and Goldsmith's (1999) work addresses the need for trust between the parts of the chain, more precisely the relationship between two companies to create strategic alliances with shared control to serve a market. Maintaining a relationship of trust reduces transaction costs, increases flexibility between companies, increases knowledge from working together and reduces risks (Fritz and Fisher, 2007).

Coordination between internal agents in the SAG can be understood as the ability to transmit information, incentives and controls throughout the system. The harmony resulting from these efforts is what is expected for this establishment of exchanges between the agents involved (Zylbersztajn and Farina, 1999). In this way, the SAG can be studied as an economic unit, whose analysis must be carried out in an integrated manner, considering the organizational interrelations throughout the system and its institutional environment. In view of the concept of the SAG as an economic unit to be analyzed, and the loss and/or waste are a characteristic of the various transactions that take place, it is necessary to check the frequency, place of occurrence and uncertainties involved in this process.

Zylbersztajn (2000) expresses that for the coordination of the SAG to be efficient, it is necessary to know in detail the characteristics of the transactions, to architect them so that their costs are saved. Zylbersztajn (2004) advances in his contribution to the concept of SAG by presenting propositions about the coordination of the company in the networks from the concepts of interconnectedness of transactions, trust of agents, reputation and social engagement. The first is that transactions cannot be considered isolated from each other (without influence), unless there are parameters of separation. In other words, once one of the agents has a flow of products and processes with another agent, its reputation is in the process of being built in the next N transactions. This not necessarily contractual

relationship is relevant for the exchange of information to take place efficiently, improving the resulting product flow.

The author explains that the coasean perspective of networks opens a window of research opportunities to explain the efficiency of complex contractual forms. However, he ponders how much the architecture of networks can explain strategic choices and how much is the result of the evolution of mechanisms and institutions (culture). The author also explains that if it is assumed that this architecture may be a result of strategic efforts, property rights and how they are distributed are the central point to be explained in the following steps (Zylbersztajn, 2004):

(1) Communication between specialized agents. Understood as the form of information exchange between agents throughout the system.
(2) Design of contracts that allow joint production efforts. The contracts define the production efforts and also the characteristics to be measured and priced. Losses and / or waste can be contractually predicted and studied.
(3) Definition of an agent to monitor, who has the power of decision and even exclusion. The measurement of loss and / or waste when measured may have worked to reduce it.
(4) Exclusion rules and mechanisms. Exclusion rules and mechanisms must be defined by both sides of the transaction.
(5) Feedback mechanisms, with which agents will share information among network participants.
(6) Conditions for the dissemination of a specific network architecture.

In this way, the efficiency of a SAG seen as an expanded Coasean firm results from its ability to reorganize itself in the face of external (institutional and technological changes) and internal shocks, such as changes in the behavior of internal agents, and the establishment of strategic plans through the creation of incentives for cooperation between agents. Among the external shocks considered institutional are changes in the legislation on the measurement and treatment of losses and waste exploited by Melo et. al (2018) about what happens in Brazil. Technologists are responsible for exploring mechanisms that can be applied to monitor the various stages of the systems, whether by temperature detection and their pricing as pointed out by Chung (2019), which results in internal transformations.

The objective of analyzing loss and waste through the SAG is to create and protect value based on the design of mechanisms to share what is generated with the purpose of minimizing transaction costs. In other words, the coordination of demand information between agents aiming to reduce losses and waste as the sole objective of all agents allows contractual, operational, technological adjustments to be made to minimize the costs resulting from such processes. In this sense, it is important to emphasize that the Transaction Costs Theory presents the embedded costs, and that these should be discussed in light of the problem, aiming at a greater understanding for effective coordination to occur.

Transaction costs are divided between *ex-ante* and *ex-post*, as mentioned, they arise from the costs of drafting and the difficulties of maintaining the contract or the relationships established. Cheung (1990) complemented them by exposing new dimensions to be considered (Azevedo, 1997): costs of preparation, negotiation and contract safeguards; contractual maladjustment costs; measurement and inspection costs of property rights; performance monitoring costs; costs of ensuring effective commitments - organization of activities.

These transaction costs implicit in internal contractual relations and between agents can be proposed as guides for possible solutions regarding loss and waste along the chain. Since the agent closest to the end consumer is retail or wholesale at SAG, it is understood that this holds a large part of the consumption and needs information, and can be considered the coordinating link due to the information power to be communicated to the rest of the chain depending on what is consumed, lost or lost sales, the determinants of supply and demand that occurred in its stores. This relationship will be worked from studies on retail and the possibilities of coordination that it can exercise to minimize the costs previously listed.

3 Waste and Loss in Retail

Retail is not considered the biggest contributor to food loss and waste in agribusiness systems. According to the survey by the Brazilian Supermarket Association (ABRAS) for the year 2019, it represents 1.89% of the sector's gross revenue, a total loss of R $ 6.7 billion. This percentage is higher in the fruit, vegetable and vegetable segments due to its perishability in Brazil and other countries (Eriksson, 2012; Chung, 2019). In the European Union, the indicator in 2011 was 10% (Gustavsson et al., 2011), in Brazilian

supermarkets, 8.76% (Fehr et al., 2002), while the 2019 ABRAS report presented 5.54%, indicating improvements resulting from the preventive actions and training proposed by the association.

Thus, loss prevention in retail is not an uncommon issue for retailers, since good control can generate significant gains for companies, thus becoming a strategic decision. The factors that justify retailers' concern with loss management are highlighted, which are lower profit margins and increased competition, the instability of the economy and the preventive and non-reactive character that preventing losses in companies (Piotto, Favero and Angelo, 2004).

According to Jarnyk (2008), the main causes of losses in retail are: (a) internal theft: actions taken inside the store by suppliers or employees, who omit the registration of the goods; (b) external theft: actions taken within the store by customers, who omit the registration of the goods; (c) operational breach: divergences generated through unregistered operations; (d) administrative errors: divergences in controls and inventories through employee actions; and (e) suppliers: error made by the retailer through the influence of the suppliers' actions. The results of the loss and waste report (ABRAS, 2019) endorse such causes, with 40% operating losses, 19.8% external theft, 13.5% inventory errors, 7.1% internal theft, 6.9 % problems with suppliers, 6.9% administrative errors and 5.7% considered as others. Among the main reasons for the loss of perishable products: 36.9% with expiration, 30% of products unsuitable for sale, 18.2% damaged products, 4.8% lost due to damage to equipment and 10.1% considered as others.

Other Brazilian authors explore operational and external issues to explain such losses: seasonal orders, excess purchases, testing of new products, sudden climate changes, lack of control and quality standards, market volatility, improper handling of food, poor quality of food. product packaging and extended retail exposure time (Caixeta Filho, 1996; Vilela et al., 2003).

Chen and Chen (2018) add that in addition to these factors related to the operation, foods called “perfect” in their visual attributes demanded by consumers are also a source. Other causes of loss and waste are pointed out in the study by Bilksa et.al. (2018), mainly regarding perishable foods:

> (1) The products do not meet the desired physical standards in terms of size, shape, weight and color between fruits and vegetables, and are rejected.
>
> There is a contract between suppliers, retailers and consumers with a specific product in terms of physical attributes. Even if the fulfillment of the contract between suppliers and retail occurs in terms of compliance, perishability is a factor that generates losses and waste resulting from the understanding of demand forecast x storage (item 2).
>
> (2) Storage beyond the need due to the forecast of not very accurate demand, this leads to the excess to be discarded for not having more conditions of sale.
>
> In this sense, waste is a consequence of the projected demand being made incorrectly and the purchase process consequently. This results in the loss of expired or damaged products in cases of unprocessed products. In general, retailers have stocks of additional products so as not to fail to serve the consumer, which would cost them in terms of sales and trust (Koester, 2014).
>
> (3) Damage to the products during transport, which affects the appearance, not being offered for sale, even if they do not have nutritional or health problems.
>
> (4) Constant flow of products internally to keep shelves and displays full. The increasing handling of products increases the risk of damage between the stock and the store.
>
> (5) Temperature, humidity and light conditions inside stores and also hygiene conditions and handling practices that can affect food safety, product quality and degree of acceptability.

All the causes listed above result from the analysis of information and processes directly in retail, attributing the forecast of demand, contracts and logistics to the link with producers and processors, which result in transaction costs for the links in dimensioning their operations to fulfill their contracts, contemplate operational and logistical errors. In these contracts, the costs of preparation, negotiation and safeguards of both parties can also be observed regarding the supply and guarantees of meeting demand, even if there is a percentage of losses included in the process.

The internal conditions of retail operations and facilities, listed in items 4 and 5 also influence demand forecast and the purchasing process, consequently the flow of information with other agents and are also other sources of internal losses related to lack of measurement and proposal for process and technological improvements to reduce it.

Other research besides exploring the causes, preventive measures also bring sustainability as an important dimension regarding the loss and waste of food (Pellegrini et al., 2019; Fiore et al., 2015; Fiore et al., 2016; Fiore et al., 2017), as they represent an irrational way of using resources. Studies show the role of retailers as “translators” of the sustainability discourse, that is, explaining the importance in the environmental, social and mainly economic aspect (Lehner, 2015). Supermarkets are “central nodes” between processors and producers with consumers. In this relationship, something common for sustainable consumption to be found, is “interaction, communication and trust that are indispensable dimensions” (Oosteveer and Spaargaren, 2013).

This position allows retailers to communicate with consumers in order to raise environmental concerns and also choose suppliers and producers who meet their corporate responsibility criteria (Eriksson, 2012). For the Swedish author, traceability, information flow in the supply chain and concern for environmental consequences are a reality in the country in his research. In Brazil, the coordination explained above is still a strategic-economic concept that is a reality for most establishments, when looking at existing publications.

A sustainable agrifood system is defined as one that manages to ensure food and nutritional security based on financial, social and environmental sustainability (Bilksa et.al., 2018). Reducing food waste and loss is one of the ways to have an efficient agribusiness system, ensuring food security and reducing pressure on the environment. A coordinated strategy to increase the efficiency of the entire supply chain is necessary (Garnett, 2009).

Even with all the research advances and application that are observed in some countries, other studies in developing countries show that there is a gap in data and information regarding the state of the problem of food waste. Kliaugaitè and Kruopienè (2017) presents problems in Eastern Europe and reports from associations, the Brazilian institutional environment also points to a similar problem, as the causes are explained at the macro level, making the understanding and possible proposal of preventive measures partial.

The gaps are large and are evident when the combination of understanding the demand and the use of technology becomes tools for preventing food loss and waste. Chung (2019) says that the development of actions to avoid the waste of perishable food in retail can be obtained through its pricing x time of freshness in a dynamic way. In this way, the consumer has information about the durability of the product to be consumed and pays according to this attribute. The suggested form aims at maximizing the use of food and retailers' profits and minimizing the losses and waste generated by this segment (Kincaid and Darling, 1963; Lazear, 1986; Subrahmanyan and Shoemaker, 1996; Panda et al., 2009). The models explored by the author's study are inspired by stochastic models of consumer demand and the pricing strategy.

These price models and the degree of freshness of the products can be applied, as long as they are accompanied by technology packages based on radio frequency identification and a time-temperature integrator for product evaluation (Li et al., 2006; Lin, 2003; Chung, 2019). Current studies on perishable products and waste reduction in retailers are related to shared pricing decisions, allocation on shelves and replacement strategy for maximizing profits (Yang et al., 2017; Xia and Yang, 2017), as well as models involving the supply chain and temperature control (Yang et al, 2017).

4 Challenges and Opportunities

There is no lack of research on food losses and waste along the agrifood chains, whether in Brazil or in other countries. Different stages of operational, strategic and institutional development can be observed regarding this worldwide concern. SAG's vision contributed to the development of food chains in Brazil and their strategic improvement and positioning in different markets. In international studies, the approach to promote preventive and corrective actions in the chains in search of sustainable agri-food systems was observed. As for Brazil, some challenges and opportunities can be indicated by changing how to see the loss and waste along the chain.

Among the challenges and opportunities, the issue of coordination through a more efficient flow of information between consumer-retail-suppliers can be highlighted. The transmission of demand information can influence the sizing of production, reconstruction of contracts as losses start to be measured and not included in the product price. Changes in purchase and sale policies among agents can be fostered internally by the retailers themselves, but also under the influence of political associations and institutions.

The measurement of losses and waste has costs, as highlighted and can directly influence internal contracts and also the technologies to be used to reduce them. One hypothesis to be tested is the low impact of losses and waste on retail, as evidenced in percentage terms and its low incentives for investment in measurement for better coordination. In this sense, the role of associations and institutions is essential for the chain strategy to be implemented. Among the challenges that do not compete in improving efficiency, structure and operations, we can also highlight the strategic measures of regional purchase to reduce transport distances, donations of products considered as not accepted, best pricing practices and discounts for products close to expiration and repackaging (Chen and Chen, 2018).

Institutional changes are also challenging as we learn about the slowness of internal processes in Brazil. The commitment to "zero loss and waste" involving an interministerial task force can influence the way in which chain agents commit themselves to coordinating and dealing with the problem based on the commitments made to global sustainability and also reducing hunger. Chen and Chen (2018) in their work highlight that such commitment can lead to the establishment of areas, processes, people engaged to work with the donation and also to control waste in the various departments; work the company's reputation through communication and social engagement with this cause.

Even though Brazil is one of the world's largest producers and exporters of food, the challenge of reducing food loss and waste is great and must be understood in a strategic and integrative way so that issues related to SAG agents are strengthened in their actions individuals with appropriate mechanisms and technologies to act in a preventive way and that their communication is recognized by the other agents of the chain, national and international institutions.

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