https://doi.org/10.32854/agrop.v13i11.

Waste of Fruits, Vegetables and Aromatic Herbs in the wholesale market of Xalapa, Veracruz, Mexico

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ABSTRACT

Objective: To estimate the waste of fruits, legumes and aromatic herbs in the Wholesale Market of Xalapa, Veracruz (CAX).

Design/Methodology/Scope: CAX local owners and carriers were surveyed and they estimated the information submitted herein.

Results: A daily waste of 1.7 t (0.7 %) of fruits and legumes marketed in CAX was calculated. Sellers do not know the factors that cause this waste.

Study Limitations/Implications: There are few reports on the waste of fruits, legumes, and aromatic herbs in central markets in Mexico. There is little conscience about this issue in the country.

Findings/Conclusions: The amount of waste produced daily in CAX indicates the need to review the applicable public policies to improve their coordination and market problems.

Keywords: food waste, retail, public policy, transportation

INTRODUCTION

In 2015, the General Assembly of the United Nations Organization established the 2030 Agenda for Sustainable Development, which contains 17 objectives endorsed by the member states to "look after the protection of persons, the planet and prosperity" (CEPAL, 2018). Goal 12 on Responsible production and consumption proposes: "Decrease food losses and waste" (12.3.1). A loss is defined as "the decrease in the amount or quality of food as a result of decisions and actions of suppliers in the food chain, excluding retailers, food service suppliers and consumers". Food waste is defined as "the decrease in amount or quality of food as a result of decisions and actions of retailers, food service suppliers and consumers" (FAO, 2020a). Loss and waste differ between the assessed goods and countries. In Mexico, like in other countries, food loss proportion is greater than that of waste, although waste proportion is not negligible (Benítez, 2018). In 2016, the Inter-American Institute for Cooperation on Agriculture (IICA) published an agri-food chain assessment methodology to identify problems and projects, in

Agroproductividad: *Vol. 13, Núm. 11, noviembre. 2020. pp: 69-74.*
Recibido: *mayo, 2020.* **Aceptado:** *octubre, 2020.*

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order to reduce food losses. In agri-food product chains, there is an information and planning analysis period, a pre-production stage, a production, harvest, transportation and assembly phases, one or more storage periods and finally another consumer distribution period (La Gra, 2016). Wholesale markets are an essential part of the agri-food chain in many countries and an important link between producers and consumers (Densley & Sanchez-Monjo, 1999; Dachs *et al*., 2016).

Both economic and food availability benefits provided by wholesale markets are widely known (Tollens, 1997; INAFED, 2010; Dachs *et al*., 2016), although their role in the reduction or generation of food losses and waste has not been widely studied (Tollens, 1997; García-Pérez *et al*., 2020). According to Tollens (1997), the storage and handling of foodstuffs in wholesale markets reduced waste in around 30% in European countries. IICA proposed an agri-food chain model based on food losses and waste, where the factors that generate losses in the larger wholesale markets (centrales de abasto) seems to be linked to the food losses during transportation (La Gra, 2016). In the case of Mexico, there are few studies that determine or estimate food losses in wholesale markets. García-Pérez *et al*. (2020) quantified the food loss of some fruits and legumes in the wholesale market of Mexico City and performed a follow-up to the weight of trucks transporting these fruits and legumes; they found an elevated amount of lost product and little care during the transportation. According to a review of these authors, food loss and waste in wholesale markets varies from 2 to 18%, depending on the type of food and the country. The knowledge of the food loss and waste in wholesale markets in Mexico may constitute an input for the re-definition of public policies aimed to increase the efficiency of agri-food chains in the country. These undesired food loss and waste affect both the availability of food, the economy of producers and marketers and the environment and health of society (Robles-Martínez *et al*., 2010). Therefore, the objective of this work was to estimate the waste of fruits, legumes and aromatic herbs in the Wholesale Market of Xalapa, capital city of the State of Veracruz, Mexico.

MATERIALS AND METHODS

The Wholesale Market of Xalapa (CAX) in Veracruz is located in the city of Xalapa de Enríquez, at 4.73 km to the southwest of the geographical center of the municipality of Xalapa (19° 34' 54'' N, −96° 51' 14'' W). It has an estimated area of 283 000 m^2 and comprises a parking lot, warehouses and four sections: A) Groceries; B) Fruits and vegetables; C) Miscellaneous goods, and D) Warehouses and cold storage (Figure 1). The estimation of food waste at CAX was performed through semi-structured interviews which were applied to sellers and carriers. The interview aimed to carriers included questions related to the origin of goods (fruit, legumes and aromatic herbs), the transportation time and the care taken during the transportation. Interviews to sellers included questions for the estimation of wasted goods, the use they gave to the goods that could not be sold, the main causes for the waste of goods, the resupply and the property of the vehicle used for transportation. We visited the market stalls where we could see vehicles for the collection of waste. We interviewed to 20 sellers and 10 carriers; the interviews included 15 questions. Figure 2 shows pictures of some CAX market stalls.

The current amount of marketed goods at CAX was estimated from the marketed goods volume data published by the National Market Information

Figure 1. Air picture of CAX (Source: Google Earth).

Figure 2. Fruit and vegetable area shops of CAX (Source: Authors).

and Integration System (SNIIM) in 2010. We calculated the current volume of marketed goods at CAX from the proportion of the market stalls registered in 2010 in the SNIIM and those we verified in the CAX. It is well known that there is a correlation between the number of shops/stalls and the volume of marketed goods (Dachs *et al.*, 2016).

The information of distances between CAX and the origin of the goods stated by sellers was obtained from Google Maps. In cases in which there was more than one arrival path, the closest was chosen. Descriptive statistics of information was performed with Minitab Statistical Software 16.

RESULTS AND DISCUSSION

Table 1 shows the waste of foods reported by the sellers and carriers from the 20 market stalls visited in CAX (CAX has approximately 147 market stalls dedicated to the trade of fruits and vegetables). The estimated waste ranged from 0.2 to 1 t per day. The last National Inventory of Wholesale Markets, Supply Modules and Wholesale Markets published by the SNIIM (2010) showed that CAX marketed a total of 150 t per day; 92% of the registered occupied warehouses was dedicated to the trade of fruits and vegetables. According to these data and the 2010 Government Report from the Municipality of Xalapa, (which considered an increase of the marketed volume of food at CAX in the subsequent ten years), we calculated that 248 t of fruits and vegetables per day were commercialized at the aforementioned wholesale market. With this information, we estimated that 0.7% of the fruits and vegetables daily marketed at CAX was wasted. This value is equivalent to 1.736 t of food wasted per day or 633.34 t wasted per year.

Table 1 also shows the relevance of CAX as a point of connection for the sale of foods coming from other cities within the state. Only nopal cactus and onion were produced at the recorded city of origin (Teziutlán and Oaxaca, respectively). The remaining products (potato, herbs, orange, tomato, grapefruit, lemon, papaya and mango) are not produced in the city of origin mentioned by the interviewees. This suggests that the mentioned cities are intermediate points for the collection of these foods. At current prices, it is estimated that waste equals to MX$2,135,250.00 per year.

There are few studies where the loss and waste generated at the wholesale markets levels were estimated. According to La Gra (2016), factors such as the conditions during transportation, the sanitization of the transport units, the distance and duration of the transportation, and the costs and benefits of the transportation should be also taken into account in the analysis of the main causes of the food loss and waste. Thusly, the analysis of the main causes that could explain the waste observed in CAX was made taking into consideration these points and will be presented subsequently. When we asked sellers about why food was wasted, 100% stated they did not know why. Likewise, when we asked them if they used the generated waste, 100% stated they did not know what to do with it. These findings are even more relevant upon considering that sellers estimated that these wasted goods had an economic value of more than 2.3 million pesos per year (Table 1). This suggests that a) there is a lack of knowledge of sellers about how food waste can be also generated during the transportation and marketing or b) the value of wasted food is perceived as low so that sellers have not addressed this issue. This panorama poses the need of strategies aimed at training sellers considering that 70% of the national agricultural production is distributed through main and wholesale markets in Mexico (SIAP, 2016). It is also critical that those involved in wholesale markets know about the importance of the reduction of food loss and waste, as

well as the added value of these loss and waste due to its transformation or processing.

When we asked sellers about the use of refrigeration in the transportation, no carrier stated neither to use refrigeration nor to take a special care of the transported goods (Table 1). Nevertheless, they stated to use wooden crates for the transportation of onions from Oaxaca and in the case of nopal cactus, papaya and mango. A national field study revealed that carriers in Mexico do not consider that refrigeration is relevant during the transportation of fruits and vegetables, however, this is a common practice in developed countries (World Bank, 2018). This fact has two major implications: carriers do not identify the use of wooden crates as a factor that may reduce waste. Also, the manner the goods are packaged for their transportation depends on their origin. This is evidenced in the transportation of onion, a good which is transported depending on its origin (Table 1). As for the sanitation of the units employed in the transportation, carriers reported to sanitize them. The frequency declared by the carriers was quite variable attributing this variability to the fact that units are used constantly which makes difficult to clean them often.

Regarding the transportation time from the cities stated by the carriers as the origin of the transported foods and CAX, we observed differences with the time calculated by Google Maps depending on the origin of the goods. As for the case of Oaxaca, the difference between the stated and calculated times was negligible, while for Veracruz, Teziutlán and Perote a 1-h difference was observed. These differences may be attributed to the condition of the route and the traffic. In the case of the goods transported from Veracruz, it is due to the use of the federal highway route instead of the toll highway. The federal highway is longer than the toll highway but represents no toll cost. The same trend was observed for the transportation times of the goods carried from Córdoba, Orizaba and Tlaxcala.

Lipinska *et al*. (2019) indicated that the reduction of the transportation times of foodstuffs contributes to the reduction of their waste. Aguilar (2020) obtained data for Mexico and argued that the main cause for the food waste is the enormous distances fruits and vegetables in the country should travel due to its transportation: "...In Mexico, some products need to travel hundreds of kilometers from production areas to reach consumption centers in great cities: tomato produced for marketing purposes travels an average distance of 454 kilometers to reach Wholesale Markets. This distance may reach 2,838 kilometers. Oranges travel 668 kilometers in average from its production area, but it may travel up to 3,191 kilometers to reach consumption centers. As for apples, these distances are of 710 and 1,645 km; while lemons travel between 794 and 1,428 km." In this sense, we also asked to the interviewed sellers whether the vehicle used for the transportation of food was of their own or leased. 95% of the respondents stated to have their own vehicle and only 5% leased one. It should be noted that 94.7% (18) of owned vehicles were pickup trucks and the rest were trucks. According to the resupply frequency declared by the transporters, they need to make several trips in a week. This also explains their preference to travel through federal highway roads. These routes are longer and have more traffic which contributes to the waste of foods (Lipinska *et al*., 2019).

The public policy that governs hygienic conditions of CAX is subject to the Regulations of Economic and Tourism Development of the Municipality of Xalapa (RDETX), (Chapter XII, section 2); the Internal Regulations of the Government of the Town Hall of Xalapa (Section 90, subsection III); and the Organic Law of the Free Municipality (Section 55, subsection III) (Town Hall of Xalapa, 2020). The last two mention that the municipality shall "seek that the handling of foodstuffs and beverages be made at adequate places and manners and that wholesale markets meet the necessary hygiene conditions." RDETX provides that CAX shall be located at a place of easy access have good roads. It also states that it should have basic utilities (Section 112, I), and shall have specific areas for refrigerators, among other needs (Section 112, II). The Section 115, subsection XIII, mentions the indications about the sanitation of the market which comprises not throwing away trash (including waste) outside the containers destined to such purpose and to have equipment installed for the transformation of goods or commodities at the wholesale market warehouses (Section 115, XIX).

According to Morales (2011), there are mechanisms for the use of the waste generated in some of the wholesale markets of Mexico (particularly the Mexico City Wholesale Market) such as the food banks and other social institutions. Food banks are civil associations devoted to gathering food in good conditions to bring them to marginalized families in different states

Table 1. Waste stated by the sellers interviewed in the Xalapa Wholesale Market (CAX) and other parameters related to the care given to the transported products.

Carrier	Product	Origin	Distance (km)	Transportation time (h)	Transportation care	Resupply (days)	Waste (t)	Money losses (MX$)	
								per day	per year
1	Onion	Oaxaca	463.0	6	Wooden crates	6	0.7	300	109,500
	Onion	Oaxaca	463.0	6	Wooden crates	6	0.6	250	91,250
	Onion	Veracruz	103.8	2	NC[1]	5	0.6	300	109,500
2	Potato	Veracruz	103.8	3	NC	4	0.4	180	65,700
	Potato	Veracruz	103.8	3	NC	4	0.4	280	102,200
3	Tomato	Córdoba	205.6	3	NC	3	1.0	120	43,800
4	Onion	Veracruz	103.8	3	NC	4	0.5	250	91,250
5	Prickly pear	Teziutlán	100.5	3	Wooden crates	4	0.2	600	219,000
6	Grapefruit	Orizaba[3]	210.5	4	NC	5	0.4	300	109,500
6	Lemon	Orizaba	210.5	4	NC	5	0.7	230	83,950
7	Orange	Orizaba	210.5	4	NC	4	0.6	290	105,850
	Orange	Córdoba	205.6	4	NC	4	0.8	270	98,550
	Orange	Córdoba	205.6	3	NC	4	0.6	250	91,250
8	Papaya	Perote	60.1	2	Wooden crates	5	0.3	600	219,000
	Papaya	Perote	60.1	2	Wooden crates	5	0.4	260	94,900
9	Mango	Tlaxcala[3]	228.7	4	Wooden crates	5	0.8	300	109,500
	Mango	Tlaxcala	228.7	4	Wooden crates	5	0.4	320	116,800
	Mango	Tlaxcala	228.7	4	Wooden crates	5	0.9	320	116,800
10	Herbs[2]	Veracruz	103.8	3	NC	4	0.7	250	91,250
	Herbs	Veracruz	103.8	3	NC	4	0.7	180	65,700

[1]No specific care is taken for the transportation. [2]Includes epazote, parsley, cilantro, chamomile. [3]All distances were calculated using Google Maps. In these cases, there was more than one route to arrive from the declared origin to CAX. MX$ = Mexican Pesos.

of the country (World Bank, 2018; Cáritas Food Bank of the State of Mexico, 2017). The donation of the food waste generated in the wholesale markets does not generate costs for the shop owners or managers. When they donate food waste, they can deduct up to 5% of their sales costs (SAT, 2012). Besides these social initiatives, there are other programs aimed to Wholesale Markets. Recently, FAO (2020b) and the World Union of Wholesale Markets (WUVM) renewed an agreement aimed at reducing food losses and waste globally. WUVM, of which the Mexico City Wholesale Market is part of alongside with other wholesale markets in the country, comprises wholesale markets from 160 different countries. Planned collaboration areas between FAO and WUVM include the knowledge, exchange, promotion and development of capacities to reduce the loss and waste of food in food markets and distribution systems. Until 2018, the National Entrepreneur Institute (INADEM, 2018) of Mexico had the campaign "Innovate your Wholesale and Retail Market" whose objective was to contribute to the increase in productivity through innovation, logistic and commercial practices in wholesale and retail markets through the investment in infrastructure, equipment, and human capital development. Thusly, awareness about the consequences of food waste at wholesale markets may contribute to have funds to train personnel in this subject as well as to equip the markets in order to reduce and utilize such waste.

CONCLUSIONS

In the wholesale market of Xalapa City in Veracruz, where a great amount of fruit and vegetable goods that arrive from different points of origin are marketed, both carriers and sellers stated that the transported and marketed good were wasted. There is little care with goods during their transportation and marketing. Sellers and transporters neither know the origin of generated waste nor how to reduce it. The review of municipal, state and federal policies, social initiatives and national and international programs showed there are proposals that should help to reduce food waste at the wholesale market level. The findings of the present work reflect problems in the coordination and marketing in wholesale

markets which generate the waste of fruits, legumes and aromatic herbs. This waste may be reduced through the application of the existing initiatives.

ACKNOWLEDGMENTS

The authors thank the editor, shop owners, sellers and carriers of CAX.

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