



Quantifying the Grapes losses and waste in various stages of supply chain

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ABSTRACT: The main purpose of this study was to quantify the amount of grapes losses and waste across the entire grape supply chain among small-scaled grape growers in Takestan city of Qazvin province. In order to estimate the amount of grape supply chain losses and waste we used mass flows of fruits and vegetables model and its special equations. According to this model, grape supply chain consists of agricultural production, post-harvest, processing, distribution and consumption. In this regard, grape losses take place at the first three stages and grape waste occur in two final stages. The required data were collected through government and private data sources with horticulture expert estimates, grape growers interviews, agriculture cooperation interviews, raisin factory estimates, seasonally markets consultations and own calculations. The results showed in total about 53% of the grapes produced in the Takestan city converted to losses and waste in various stages. Of course, a major part of its (about 46 %) takes place in processing stage (19%), agricultural production (17.6%), and postharvest (9%). While only about 7 percent of the grapes in the distribution and consumption stages are wasted.

Key words: grapes, losses, waste, food supply chain, small-scaled grape growers

INTRODUCTION

Annually, a large amount of food crops are lost or wasted during the food supply chain (Buchner *et al.*, 2012). This loss would be enough to feed around 1.9 billion people (Kummu *et al.*, 2012). Researchers believe reducing food crops losses would be an important way to improve food supply and food security not only in developing countries but also in developed areas (Gustavsson *et al.*, 2011). Beretta *et al.* said " The food value chain is the system of organizations, people, and activities involved in moving food from its producer (usually the farmer) to the consumer."

According to Parfitt *et al.* (2010) and Gustavsson *et al.* (2011) total losses and waste occurring within the different steps of FSC that these steps are production, postharvest, processing, distribution, and consumption. According to them, food losses occur in the production, postharvest and processing of crops where most losses are caused by mechanical, managerial, environmental, farming methods and more. On the other side, food waste as those removed from FSC during distribution and consumption which these occur due to wasteful behavior.

According to many experts, the amount of crops losses and waste and the stages of their occurrence should be determined to reduce losses and waste. In this way, the most recent study was carried out at a national and international level. Monier *et al.* (2010) estimates the losses and waste over all stages of the food value chain except agricultural production in EU 27 Member States. They found the major contribution is from consumers. Caronna (2011) emphasized in his study on the finding. He estimated the amount of food losses over all stages of the food value chain except agricultural production in Germany.

Gustavsson *et al.* (2011) analyzed amount of losses and waste in all of commodity group in seven regions, one of them being South and Southeast Asia (Iran is located in this region). Their findings revealed, for this region, agricultural production, postharvest handling, and processing are stages with relatively high food losses. Also, Beretta *et al.* (2013) quantifies food losses in Switzerland across the food value chain stages. 22 food categories are modeled in a mass flow analysis in their study. They found, most avoidable food losses occur at the household, processing and agricultural production stages.

In Iran, like other developing countries, food losses and waste are considered as a critical challenge. According to reports, annually around 15.3 Million tons from produced food crops in Iran are lost or wasted during the FSC (Shadan, 2007). In the meantime, Horticultural products with an average of 28% have the highest amount of losses and the lowest level (6%) is related to livestock and poultry. Moghaddasi *et al.* (2005) emphasized approximately 7.6 million tons of the 25 million tons of fruit and vegetables produced in Iran go to the waste. Roll (2006) found that fruit and vegetables losses and waste after harvesting were more than 35% in Iran.

Among horticultural crops, the highest rate of losses was attributed to grapes with 35-55 percent and on the opposite side the lowest rates were reported for walnuts and almonds with 8 percent (Mehr News, 2010). According to Moghaddasi *et al.* (2005) annual about 3

million tons of grapes are produced and approximately 640000 tons are processed in Iran. They also showed, in total, 30 to 38 % of the grapes in Iran at the various stages of the postharvest chain (include: harvesting, transportation, storage and sorting, wholesale, and retail sale) transformed in to losses and waste.

Therefore, Grapes were considered for further review and estimation of losses and wastes in each stages of FSC. It should be noted; Takestan city is the one of the main producers of grapes in Iran that due to this reason have been considered in this paper. We hope reduce the grape losses and waste with identification of significant steps (Steps with the largest losses and waste) with respect to causes and reasons. So, the goal of this paper was quantify the amount of losses and waste across the entire grape supply chain from agricultural production (harvesting) to final consumption (intake) (Fig. 1) in Takestan city of Qazvin province.

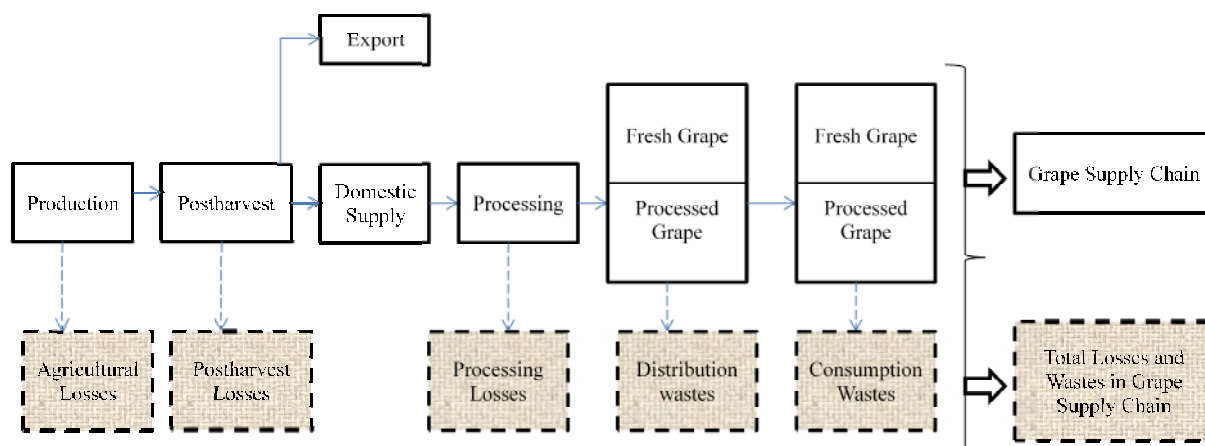


Fig. 1. Losses and waste across the entire grape supply chain.

MATERIAL AND METHODS

The main purpose of this descriptive survey study was to quantify the amount of grapes losses and waste across the entire grape supply chain among small-scaled grape growers in Takestan city of Qazvin province. In order to estimate the amount of grape supply chain losses and waste were used from Mass flows of food model and its special equations that have provided Gustavsson *et al* 2011. According to this model, grape supply chain consists of agricultural production, post-harvest, processing, retail (distribution) and consumption. In this regard, grape losses take place at the first three stages and grape waste occur in two final stages. This model consists of different groups of agricultural products (cereals, fruits and vegetables, dairy products, fish, root and tubers etc.) that each of them have its own equations.

Accordingly, in this study, we used the formula of fruits and vegetables for estimating grape supply chain losses and waste (Gustavsson *et al.*, 2011).

Because of limitation of systematic data about agricultural losses and wastes in Takestan, The required data were collected through government and private data sources with horticulture expert estimates, grape growers interviews, agriculture cooperation interviews, raisin factory estimates, seasonally markets consultations and own calculations. Finally after processing and categorizing, needed data are shown in Fig. 2.

In addition, Gustavsson *et al* (2011) in their study provided estimated or assumed waste percentages for each commodity group in all steps of food supply chain for 7 world regions countries. We use South and Southeast Asia (Iran is located in this region) fruit and vegetable waste percentages for estimates (Table 1).

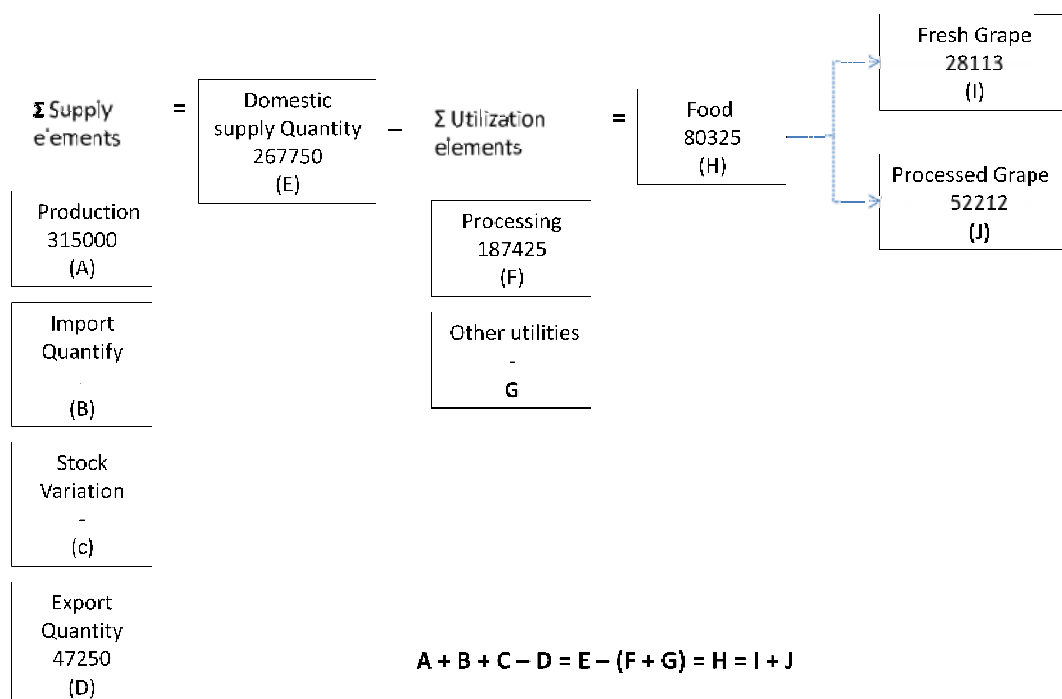


Fig. 2. Needed data for grapes losses and waste estimation.

Table 1: Fruit and vegetable waste percentages in various stages of supply chain.

	Agricultural production	Postharvest	Processing	Distribution	Consumption
South and Southeast Asia (Iran)	15	9	25	10, 10	1, 7

Gustavson *et al.*, 2013 Gustavson *et al.*, 2011;

RESULTS AND DISCUSSION

According to data in Fig. 2 and waste percentage in Table 1, we estimate the losses and waste in entire the grape supply chain. The results showed (table 2), in total about 53% of the grapes produced in the Takestan city converted to losses and waste in various stages of grape supply chain. Of course, a major part of its (about 46 %) takes place in processing stage (19% of total production), agricultural production (17.6 percent of total production), and postharvest (9% of total production) (Fig. 3). While only about 7 percent of the grapes in the distribution and consumption stages are wasted.

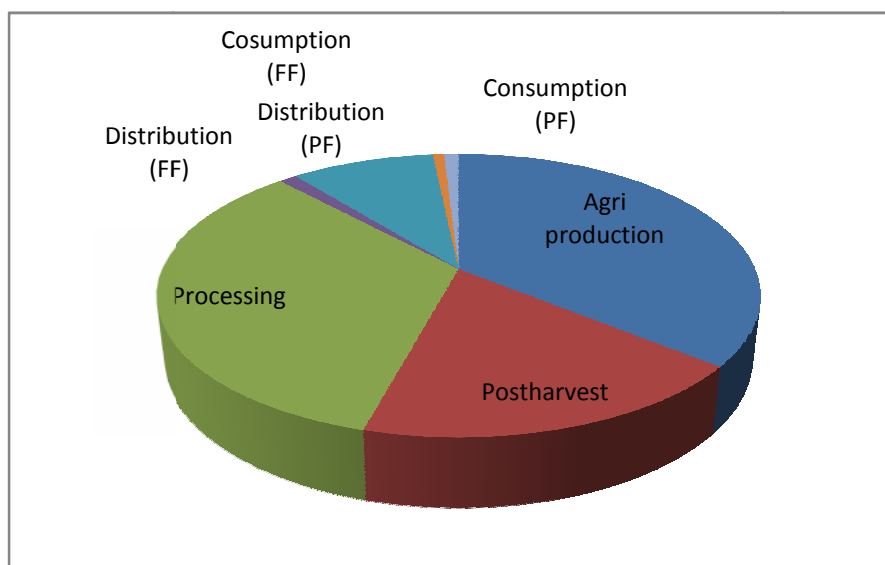
This is well in line with results of Gustavsson *et al.* (2011) in related to fruits and vegetables in South and Southeast Asia. It should be noted, we analyzed only grapes losses and waste in one city in Iran, but they

considered all of the commodity groups in around the world. Also our findings closed to results of Moghaddasi *et al.* (2005), Beretta *et al.* (2013), and Kummu *et al.* (2012).

According to results amount of the grapes losses (about 46%) in Takestan city, as one of the main producers of grapes in Iran, is considerable. However, due to physiological nature of grapes, part of the amount of losses to some extent justified. But it is clear that, by taking some principles can be largely prevented the occurrence of this level of losses (Of course this amount of losses referred to non-marketable and inedible to human directly). Obviously, should be investigated occurrence causes to avoid losses. It should be mentioned that this research was conducted among small-scale grape growers in Iran, whose have less than 10 hectares of grape.

Table 2: Estimated Losses and wastes in grape supply chain.

Stage		Equivalent	Estimated Losses and wastes	
			tonnes	%
Agricultural Production		$[0.15/1 - 0.15] * 315000$	55588	17.6
Postharvest		$0.09 * 315000$	28350	9
Processing		$0.25 * (187425 + 52212)$	59909	19
Distribution	Fresh	$0.1 * 28113$	2811	0.9
	Processed	$0.1 * (52212 + 187425 - 59909)$	17972	5.7
Consumption	Fresh	$0.07 * (28113 - 2811)$	1771	0.6
	Processed	$0.01 * (187425 + 52212 - 59909 - 17972)$	1617	0.5
Total			168018	53.3

**Fig. 3.** Losses and wastes in grape supply chain.

Often their grape farms are separated and it's located in different place. So, they cannot use modern technologies and mechanization in their production and harvesting process. Though, they have seriously financial problems too. Also, they cannot use mechanization in postharvest and processing due to lack of financial resources, limitation in equipments and facilities and poor knowledge and skills. So they do these stages traditionally and without any technologies. They do not have sufficient access to the equipment needed to harvest, handling, store, processing, and packaging of the products. They put the grapes on the ground or on the roof of their house to become raisin. Then they package them in big bags without considering packaging principles.

Perhaps these are main reasons of the high level of grape losses between small-scale grape growers in Iran. Therefore it is recommended that public sector in

cooperation with private sector provide the equipments, facilities, financial resources with easy access as well as grape growers needed knowledge and skills. It is clear that, considering small-scale grape growers conditions and wants will improve grape production efficiency.

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