

# Post-harvest losses of citrus fruits and perceptions of farmers in marketing decisions

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**Abstract.** Citrus is a non-climacteric fruit that breaks easily. Poor postharvest handling methods have resulted in severe losses to farmers. This research was conducted in 2017 at Dau Subdistrict, Malang Regency, East Java, using a purposive sampling method to understanding the losses of citrus fruits and perceptions of farmers in marketing decisions. A total of 177 citrus farmers participated in this study. Citrus farmers experienced food loss and waste is 34% in total all activity. From the value chain activities carried out by most citrus farmers: production and harvesting, handling and storage, processing, and packaging, as well as distribution and markets, farmers experience food loss and waste of 13%, 10%, 4%, and 7% respectively. Postharvest losses were influenced by farmers' perceptions of selling citrus fruits, especially prices, cash payments and the frequency of delivery of citrus fruits. By knowing the critical point most detrimental, farmers can take action to minimize losses.

## 1 Introduction

The global challenge in the world of agricultural research and development today is how to meet the food needs of 9.1 billion people in 2050 (Parfitt et al., 2010). [1] What is being done is to increase food production by 50-70%, but the important thing that must be complemented and should not be forgotten is reducing food loss and food waste [2]. Studies generally find that as much as one-third of the world's food production is lost or damaged [3,4,5].

Studies that various international and national organizations have carried out show that between 30 to 50% (1.2-2 billion tons) of all food produced on the planet is lost and not consumed. Food loss occurred at the stages of production, storage, packing, retail and consumption [6]. The tendency is that food losses that occur in developed countries are more at the retail and consumption stages while developing countries are more in the production stage [7, 8].

In Indonesia, lost fruit can be easily found in gardens and markets, one of which is Citrus. Citrus is the most profitable crop for the community in the Dau sub-district, Malang Regency, East Java. There are at least 1000 hectares of citrus plants which are the primary commodities for the livelihoods of local farmers. Recently, citrus planting in this area continues to increase

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from year to year with an independent program. The types of citrus planted are Keprok Batu 55 (mandarin) and Manis Pacitan (orange).

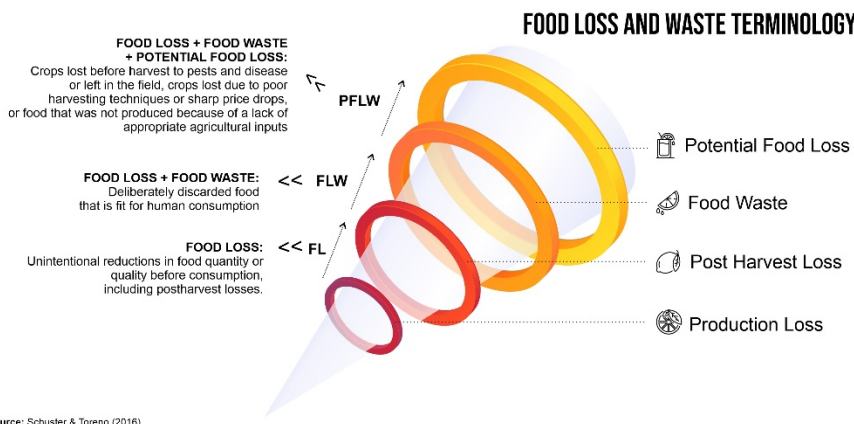
The farmers began to plant the mandarin citrus because it has a higher selling price than the orange citrus. The selling best price of the orange citrus at farm level is ranged from Rp5000-7000 while the selling price of mandarin citrus farm level is ranged from Rp10000-13000. With almost the same maintenance, mandarin citrus generates higher profit for farmers [9]. Although the prices obtained are good, due to inaccuracies in handling harvest and postharvest, farmers suffer losses [10].

Mustapha and Yahaya [11] reported that the complex and long chain of marketing systems between farmers adds to the level of damage to agricultural products. In shorter supply chains such as selling citrus farmers in Tuban, the actors involved are few but the main factor for farmers choosing the sales channel is not only because of price but other factors such as getting direct incentives and avoiding crop failure [12]. The adoption of modern technology is still low, causing the results obtained from farming products unstable [13].

How much loss of citrus fruit in the farmers in this study was answered by using a purposive sampling method survey conducted on 177 respondent farmers from the stage of the harvest to sale. The selection of sales models by farmers is expected to affect the amount of fruits losses experienced by farmers. In this study, farmers' control over harvest loss activities is still high. By knowing the critical point most detrimental to farmers starting from production and harvest, handling and storage, processing and packaging, and distribution and market losses, actions to minimize losses can be taken.

## 1.1 Definition of food loss and waste

Definitions of food waste are not universally agreed upon [14,15]. Different categorizations are generated based on what materials are included, means of production, and management approaches [16]. Multiple terms have been used interchangeably, such as food loss, food waste, biowaste, and kitchen waste [17].



**Fig 1.** Food loss and waste terminology

## 2 Methodology

The survey was conducted in 2017 to citrus farmers in Dau District, Malang Regency East Java. Total 198 citrus farmers filling out the questionnaire, 177 respondents filled out the questionnaire completely. This study uses a purposive sampling method to understanding the losses of citrus fruits and perceptions of farmers in marketing decisions. Farmers who are the object of this survey research are farmers who carry out citrus gardening business activities in Dau Sub-district and sell citrus either individually or to collectors. The collector comes from a member of a farmer group in his village so that farmers still know and have access to information on how far their citrus fruit products are handled to the market.

## 3 Results and discussion

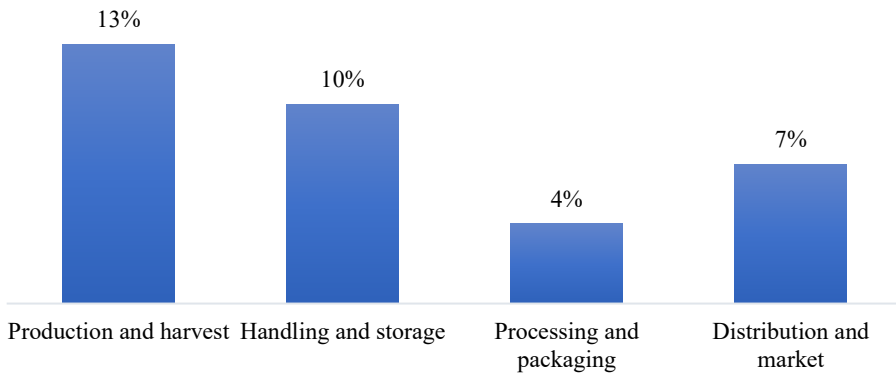
Table 1 shows a summary of the demographic information of participants in the study. Most citrus farmers are men. A total of 6 female citrus farmers who participated in the survey represented other family members (husband and parent) when the survey was conducted in groups. Currently, young citrus farmers are starting to emerge, even though more than half of citrus farmers are over 50 years old with 72.9% primary school education. Because it is considered profitable, they make citrus farmers their main job.

**Table 1.** Demographic information of all participants (*n* = 177)

Variable	Frequency	%
<i>Gender</i>		
Male	171	96.6
Woman	6	3.4
<i>Age</i>		
11 - 20 year	0	0.0
21 - 30 year	24	13.6
31 - 40 year	45	25.4
41 - 50 year	57	32.2
> 50 years	51	28.8
<i>Education</i>		
Primary School	129	72.9
Junior High School	39	22.0
Senior High School	9	5.1
College degree	0	0
<i>Marital Status</i>		
Married	168	94.9
Single	9	5.1
<i>Family expenditure/month</i>		
< Rp 1000000	18	10.2
Rp 1000000 - Rp 2500000	63	35.6
Rp 2500000 - Rp 5000000	30	16.9
> Rp 5000000	66	37.3
<i>Job</i>		
Full citrus farmer	150	84.7
Citrus with another plant	18	10.2
Citrus with others job	9	5.1

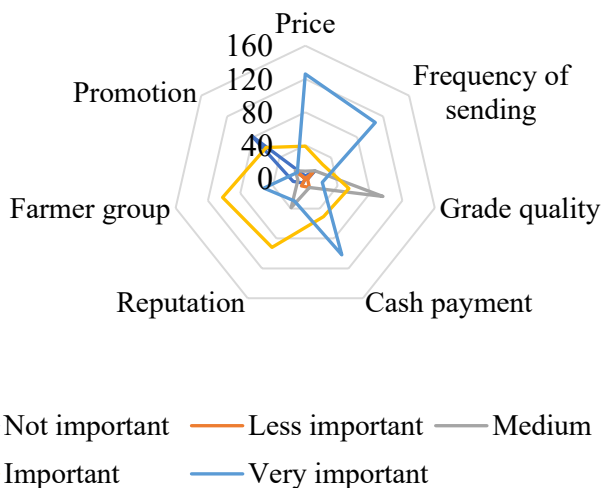
Figure 2 shows that citrus farmers experience food loss and waste is 34%. From the value chain carried out by most citrus farmers activity: production and harvest, handling and storage, processing and packaging, and distribution and market, respectively, farmers experience food loss and waste by 13%, 10%, 4%, and 7%.

Anticipation of losses in the production and harvest phase can be done by applying healthy citrus garden technology, which includes citrus cultivation to pest and disease control. The fall of citrus fruits before harvest is caused mainly by fruit fly attacks. Fruit that is attacked by fruit flies is no longer suitable for consumption and is wasted. Control of fruit fly attacks must be carried out simultaneously in one area. This can be done only by farmer groups and between farmer groups. Meanwhile, in the handling and storage phases, the application of harvesting with pruning shears and plastic fruit baskets can reduce fruit damage. The packing and storage houses are only owned by large collectors who are very limited in number. Larger packing and storage houses are needed and contain all the citrus fruit products during the harvest season so that all the citrus fruits harvested can be stored and handled better.



**Fig. 2.** Share of total food loss and waste by stage in the citrus value chain

Factors influencing farmers to sell citrus fruits are price, cash payment and frequency of delivery of citrus fruits (Figure 3). If the price is good or a collector offers a higher price; the farmer will sell it. Likewise, when getting an offer for cash payments, farmers are more likely to choose it. Farmers are less likely to deal directly with supermarkets or modern markets because of delayed payments by 3-4 months. On the other hand, with more weekly deliveries, the guarantee of smooth sales is certainly pleasing to the farmers.



**Fig. 3.** Important factor in selling the fruit

Farmers' choice in selling fruits directly affects the amount of fruits loss, especially in farmers' gardens. With the tebasan system that farmers generally take, traders prioritize pick citrus with grades A and B and tend to ignore citrus fruits outside the desired market specifications in terms of appearance and shape. In fact, with proper postharvest processing, citrus fruits that do not pass these specifications can still be processed to consume. Citrus fruits that are physically unfit for sale but are still fit for consumption can be used as raw materials for citrus juice drinks.

Citrus fruits sold by farmers with the tebasan system are harvested by buyers by prioritizing aspects of the speed of harvest time and the cleanliness of the trees from citrus fruits. It is often seen that workers break some branches and climb the branches instead of using ladders to facilitate harvesting. All grades of citrus are harvested, but the best grades are prioritized for the premium market. Grade C-D will be sold in traditional markets. In contrast to farmers who harvest themselves and sell per kilogram, they will harvest more carefully and, in some cases, harvest in stages while adjusting to the highest selling price of citrus.

Loss and wastage in citrus fruits can be avoided if farmers are able to apply recommended technology. In developed countries such as the United States [6] food loss and waste are more common in consumers or retail stores, successively in supermarkets, fresh food loss in lemons, limes, tangerine and orange is 5.3% in a row; 14%; 14.7% and 14.8%. Economically, they are equal to a wasted investment that reduces the economic wellbeing of actors in the food value chain.

## 4 Conclusions

Efforts to reduce food loss and waste in citrus farmers can be starting from the garden, during the production process by guarding against pests and diseases, especially before harvesting, and during handling harvesting citrus fruit according to the procedure. Food loss and waste in citrus fruits are still quite high at 34%. The figure will be higher if we trace the data after

the citrus fruit reaches the market and consumers. Future research needs to be held in other citrus center areas in Indonesia.

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