A Study of Marketing Losses in Deciduous Fruit Trees in Baghdad Governorate: Economic Effects and Causes

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Abstract

Deciduous fruit trees are among the agricultural products most susceptible to spoilage and post-harvest loss due to their inability to withstand environmental conditions and inadequate marketing services. The study aimed to estimate post-harvest losses of deciduous fruits and then identify the most important factors causes leading to losses. Descriptive statistical and quantitative mathematical equations methods were used to analyze data collected from a random sample of fifty apricot and peach plantation growers, and a random sample of fifty wholesale traders of the two crops in local markets in Baghdad Governorate. The estimated results indicated that the monetary losses from marketing losses in the two crops apricot and peach at the level of plantation owners were estimated at approximately 39 and 28 thousand dollars for each, respectively. At the wholesale market level, the marketing loss rate for apricot and peach crops was estimated at approximately 22% and 10% for each crop, respectively, while monetary losses were estimated at approximately 55 and 10 thousand dollars for each of them, respectively. It became clear that the most vital elements causing post-harvest losses at the level of plantation owners are the falling of fruits during the picking and harvesting process and the failure to utilize them, while it was found that the most important factor causing post-harvest losses at the wholesale level is exposure to unsuitable environmental conditions in the market because of exposed supply of fruits. Therefore, farmers should be encouraged to be choosing appropriate dates and environmental conditions for harvesting fruits.

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Introduction

Losses of several agricultural harvests are a common factor between the two kinds of agricultural development pillars in Iraq: vertical and horizontal development (Alnagar and Kadhim, 2021). Perpendicular development is done by increasing the yield of the planted area using various scientific techniques, while parallel development is done by increasing the planted area through the reclamation and farming of new acreages (Al-Fahle and Kabeel, 2021). Maintaining the quality and quantity of output contributes to realizing the objectives of

agricultural development of both types, and is equally important as the use of modern technology and the expansion of the cultivated area in terms of its contribution to the development process (Arab Organization for Agricultural Development, 2022). It can be argued that reducing the loss of agricultural crops in general, and horticultural crops in particular, whether during the production phase or the subsequent post-harvest and marketing processes, could be as economically feasible as reclaiming and cultivating large lands that gutter significant economic and water wealth (Rizk, 2021). However, this aspect has not yet received satisfactory care from agricultural policymakers or agricultural development projects.

In the context of nutrition availability, which is one of the most important problems that ranking first place in all countries of the global (Food and Agriculture Organization of the United Nations, 2022b), wastes of food and agricultural products occur at various stages of the production and marketing chains. They can be attributed to poor agricultural practices, administrative and technical constraints in planting and harvesting operations, fluctuations in post-harvest handling, and a lack of storage facilities (FAO, 2022a). While post-harvest losses of fruit and vegetable crops have reached high percentages of the total global production by weight, these losses have been measured in most Arab countries and recorded rates ranging from 45% to 50% (Food and Agriculture Organization of the United Nations, 2022b). There are also climate changes that lead to temperature differences and water shortages during the planting periods, in addition to poor post-harvest practices that have resulted in an increase of waste in agricultural products that undesirably influence the marketing stages of these products (Kadhim *et al.,* 2021). With these high levels of losses in developing Arab countries, farmers, traders, small-scale agricultural entrepreneurs, and marketers of fruit and vegetable crops should have better access to technical information, guidance on the use of new technologies, and the necessary tools to utilize best practices in production and post-harvest handling (ESCWA, 2024).

With the increasing demand for agricultural crops in most countries of the world, especially with the continuous increase in population and consequently an increase in consumption (El-kblawy and Abdul Galil, 2020), the actual production of these crops is decreasing due to several factors, including the decrease in agricultural areas and the high percentage of loss during the various stages of crop production, starting from harvest until it reaches the consumer, through the processes of sorting, grading, packaging, transportation and storage (Morsi *et al.,* 2021; Thapa *et al.,* 2024). Among the most important factors that lead to the increase in the percentage of lost and damaged crops is the lack of knowledge and awareness of some farmers about the appropriate time to harvest the crop and the time to market it to sales centers, in addition to the exposure of the crop after harvest to the sun and during transportation to wholesale and retail markets, and the exposure of the fruits to adverse weather conditions such as high or significantly low temperatures, and the lack of attention to sorting and grading processes during the fruit preparation processes for marketing (Al-Najjar and Kadhim, 2020).

Horticultural crops, including deciduous fruit trees, are the most vulnerable to post-harvest losses, especially since greatest of them are highly unpreserved and have a restricted marketing and storage time (Sehgal and Kumar, 2022; El-Eshmawy *et al.,* 2022). Post-harvest losses in horticultural crops occur in the form of quantitative losses, the percentage of which varies depending on the crop and the application of modern cultivation, harvesting, and handling technologies (Tawk *et al.,* 2022). Post-harvest losses also include qualitative losses, which are represented by a general decline in product quality, for example, wilting, loss of luster, color worsening, and waste of a significant portion of the produce's distinctive taste (Awad, 2023). Fruit crops occupy a key position in Iraq's agricultural production

structure and are a staple food in the basket of the Iraqi consumer that requests consideration for the wastes of these products.

Even though the problem of harvest losses is a worldwide one, it is particularly prominent in states with a developing agricultural sector, including Iraq (Al-Najjar and Kadhim, 2020). This is due to the lack of technical and technological means. This aspect is attracting increasing and growing interest in political and scientific circles, especially in the context of economic development (Arab Organization for Agricultural Development, 2022), where it is the driving force behind economic progress and cultural development, amidst scientific and technological developments that can reduce this loss to a minimum (Rizk, 2021; FAO, 2022a).

Based on the problem under study, the research assumes that the weakness and difference in marketing operations of collecting, storing and transporting horticultural crops from their collection points within the orchard to the points of receipt and sale in local markets, causes loss and waste in the produced quantities, which negatively affects productivity and subsequently the net orchard return achieved per dunum of those crops. This research generally aims to study and analyze the marketing loss of the produced quantities of deciduous fruit trees (apricot and peach) in Baghdad Governorate, by achieving the following specific objectives:

1. Estimating post-harvest marketing losses in apricot and peach fruits at the level of orchard owners and wholesale market sellers in Baghdad Governorate for the 2024 summer season.
2. Analyzing the economic influence of post-harvest wastes at the level of plantation owners and wholesale market sellers.
3. Evaluating the most vital elements that led to the losses at the level of orchard owners and wholesale markets.

Materials and Methods

Theoretical Framework

Quantitative losses from horticultural crops in general, and from vegetables and fruits in particular, take different forms (Tawk *et al.,* 2022; Gharde *et al.,* 2018; Food and Agriculture Organization of the United Nations, 2018). In general, quantitative losses in agriculture can be divided into the following types (Awad, 2023; Kadhim *et al.,* 2021):

1. Quantitative production loss: This loss occurs during the production process. This type of loss can be attributed to several factors, the most important of which are:

a. Poor weather conditions and unfavorable weather conditions such as temperature, irrigation, wind, and humidity.

b. Negligence in the performance of agricultural processes, such as inadequate fertilization, irregular irrigation intervals, poor seed quality, and poor mechanical performance.

2. Quantitative marketing loss: This includes loss from the producer to the final consumer, and drying during the agricultural season, including:

a. Loss during the collection and packaging processes on the farm.

b. Loss during transportation to local markets.

3. Losses during crop sales in wholesale markets, including**:**

a. Losses resulting from failure to calculate fractions of a kilogram in each weight**.**

b. Losses resulting from overweighting empty containers**.**

c. Losses resulting from deducting a percentage of the crop in favor of the wholesaler to cover sales risks.

4. Losses during storage, which occur as a result of**:**

a. Loss of moisture content in stored fruits**.**

b. Exposure to infestation by storage insects, rodents, and attacks of birds.

Figure 1 illustrates the Conceptual Framework of causes of losses in horticultural crops during the production, harvest, post-harvest, and marketing stages (from agriculture to harvest and then post-harvest procedures). This figure shows that post-harvest loss occurs during the period between the end of the harvesting process and the final consumption or use of the crop for processing, which it is the part of the food that does not reach the consumer and is lost during the stages of handling, storage, processing and marketing (Rizk, 2021).

There are factors that cause farm-level losses of vegetable and fruit crops, including (Shaheen *et al.,* 2021; Ghazzawy *et al.,* 2019)**:**

1. Biological and biotic factors: This group includes various types of pests, insects, nematodes, rodents, weeds, and viral diseases**.**
2. Technological and technical factors: This group includes the use of modern machinery in agricultural services, as well as the use of modern methods in all marketing services, including collection, sorting, packaging, and storage, especially for vegetable and fruit crops**.**
3. Economic and social factors: This group includes low farm prices, the inability to use modern methods in production and marketing, low individual savings, limited credit facilities necessary to introduce scientific agricultural innovations, and the inadequacy of agricultural extension services in rural areas**.**
4. Natural factors: This group includes natural factors that have an impact on increasing the rate of crop loss, such as temperature, wind, and rainfall. High temperatures increase the rate of respiration, which affects the quality, freshness, and vitality of the crop, and consequently reduces its weight by increasing its metabolic rate.

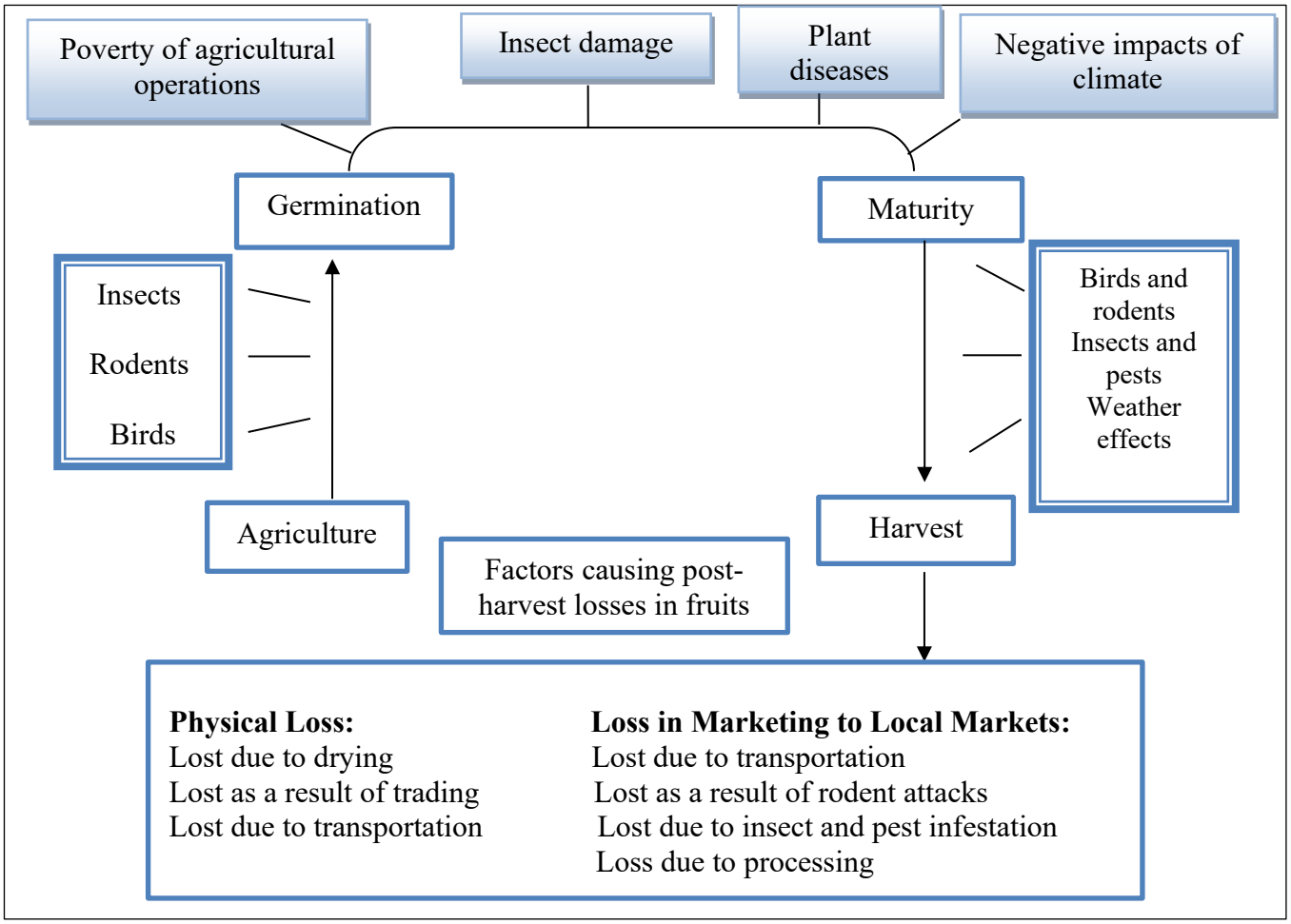

Figure 1. Diagram of the elements causing post-harvest losses in agricultural harvests fruits

Source: (Awad, 2023; Rizk, 2021).

Source of Data for the Study

The study depends on primary data from information in the State designed by the researchers. The field survey data included horticultural farmers in Baghdad Governorate, who were randomly selected during the 2024 summer production season. The study sample was drawn according to stratified randomness and data were obtained through personal interviews with fifty orchard owners distributed across the governorate's agricultural units. Personal interviews were also conducted with fifty summer fruit sellers in wholesale markets in Baghdad Governorate.

Questionnaire and Method of the Study

An ended structure questionnaire was designed that included three main sections: demographic factors of the orchard owner, characteristics of the orchard, and study variables. Each section contained a set of open and closed questions that were aimed at achieving the study objectives. Both methods; descriptive statistical and quantitative mathematical to estimate the loss of horticultural crops, including apricot and peach trees, and studying the factors affecting it. The lost quantities and the resulting the marketing losses were calculated according to the following equations (Ali *et al.,* 2025; Chapai *et al.,* 2024; Kadhim *et al.,* 2021; Al-Fahle and Kabeel, 2021):

1. Loss percentage at level of the orchards owners = (Total losses ÷ Total actual production) × 100
Where: The total losses are estimated at the various marketing stages of the fruits (collection, sorting, packaging, and transportation).

2. Rate of loss value = Average amount of loss × Average selling price per ton marketed
Where: The average selling price represents the prevailing selling price of fruits in the study area.

3. Rate of wasted area = Average amount of loss ÷ Average productivity
Where: The average productivity represents the prevailing level to production of one dunum of fruit in the study area.

4. Amount of water lost = Average area wasted × Average water requirement of the crop
Where: The average water requirement represents the water quota for the crop.

5. Total marketing costs per dunum = (Collection costs + Sorting costs + Transportation costs + Sales agent commission costs).

6. Marketing costs for total area = Total marketing costs per dunum × Total area planted with crops
Where: The total areas planted with crops are: (apricots = 157 dunums, peaches = 67 dunums) in the study area.

7. Total marketing costs per ton production = Total marketing costs per dunum ÷ Average productivity per dunum

Where: The average productivity per dunum is: (apricots = 2.7 tons, peaches = 3.2 tons) in the study area.

8. Total lost marketing costs = (Amount of marketing losses x Cost of production per ton of marketing costs).

9. Percentage of lost marketing costs = (Total lost marketing costs ÷ Marketing costs for total area) × 100.

10. Average selling price per ton marketed after deducting lost marketing costs = (Average selling price per ton marketed - Average marketing costs to produce one ton).

11. Amount of losses at level of wholesale market = Total quantity purchased - Total quantity sold of the crop

Where: The quantity of fruit purchased is the quantity that the wholesaler obtained from the orchard owner at the farm gate price, while the quantity of fruit sold is the quantity that the wholesaler disbursed to retail sellers at the prevailing wholesale market price.

12. Percentage of loss at level of wholesale market = (Amount of losses ÷ Total quantity purchased) × 100.

13. Loss value at level of wholesale market = (Average loss quantity × Average selling price per ton in wholesale markets).

Most mentions report that the amount of fruit lost in orchards and retail outlets is higher than in wholesale markets. This is because wholesale markets work as a link between farmers, brokers, and intermediaries, while the exchange process requires a reasonably short time to complete. However, due to the perishable nature of fruit and other reasons, there are losses of fruit at the wholesale market level due to exposure to unsuitable environmental conditions, delays in the disposal and sale of the fruit to retail markets, and other reasons (Alnagar and Kadhim, 2021).

Results and Discussion

Analysis of the marketing loss of apricot and peach fruits at the level of the orchards owners of the study sample

Estimation of post-harvest marketing losses in apricot and peach fruits at the level of the study sample plantation owners

Via estimating the amount of apricot and peach fruit losses according to the various marketing stages of the study sample, starting from harvesting to transportation to local markets, the results presented in Table 1 indicate that the amount of apricot and peach fruit losses reached its highest amount in the first post-harvest marketing stage, which is the fruit collection stage, at a rate of 8% and 8.5% for each crop, respectively, amounting to 33.7 and 18.6 tons, respectively. This was followed in second place by the quantities lost in the sorting and grading stages, at a rate of 6% and 4% for each stage, respectively, with a total amount of approximately 41.87 and 21.25 tons for apricot and peach fruits, respectively. While the amount of loss in the transportation stage came in last place, constituting the lowest percentage, amounting to approximately 2% and 3% for each crop, respectively, with quantities amounting to approximately 8.4 and 6.4 tons, respectively.

Table 1. Total amount of loss in the collection, sorting, grading, packaging and transportation stages of apricot and peach fruits

Fruit	Total actual production/Ton	Percentage and quantity of loss during harvest/Ton		Percentage and quantity of loss during sorting/Ton		Percentage and quantity of loss during grading and packaging/Ton		percentage and quantity of loss during transportation/Ton		Total quantity of loss/Ton	Percentage of loss
Apricot	421.8	%8	33.7	%6	25	%4	16.87	2 %	8.4	83.993	20%
Peach	212.5	%8.5	18.06	%6	12.75	%4	8.5	3 %	6.4	45.701	21.5 %

Source: Calculated by authors based on field survey data.

From the results of Table 1, it is clear that the plantation owners of the designated sample lost, according to their practical estimates, approximately 20% and 22% of both fruits, respectively, as a loss from the total actual production estimated at approximately 422 and 213 tons for each crop, respectively. The total lost quantities of the apricot and peach fruits amounted to approximately 84 and 46 tons, respectively, while the total marketed production for the study sample amounted to approximately 337.827 and 166.799 tons for each crop, respectively.

When comparing the percentages of losses in both crops shown in Table 1, a slight difference can be observed between the two percentages, perhaps due to the almost identical nature of the marketing services provided to the two fruits during and after harvest at the level of farm or orchard. These results are similar to many studies that addressed the issue of losses in deciduous fruit trees at the level of farm, such as studies (Ali *et al.,* 2025), (Awad, 2023), (ESCWA, 2024), (Sehgal, and Kumar, 2022), (Tawk *et al.,* 2022), and (Thapa *et al.,* 2024).

Financial losses resulting from post-harvest losses of apricot and peach harvests at the level of plantation owners

The outcomes obtainable in Table 2 illustration that the average value of apricot fruit wastes is estimated at approximately 39 thousand dollars, with a total marketing loss of approximately 84 tons. This amount of waste represents the average output of a wasted area estimated at approximately 31 dunums. Based on the average water requirement per dunum of apricot fruit, the average amount of irrigation water wasted in cultivating this area is estimated at approximately 26.5 thousand cubic meters. This represents material losses of scarce resources, namely capital, land, and irrigation water, which could have been utilized in the production of other fruit or horticultural crops.

Table 2. Physical losses of post-harvest wastes of apricot and peach harvests in the study sample of plantation owners

Fruit	Marketing loss amount/ Ton	Average selling price of marketed ton/ dollar	Average productivity/Ton per dunum	Average value of loss/ dollar	Average wasted area/dunum	*Average water requirement /m3 per dunum	Amount of lost water/ m3
Apricot	83.993	461.3	2.7	38748.77	31.11	850	26444
Peach	45.701	612.61	3.2	27996.83	14.3	850	12155

Source: Calculated by authors based on field survey data.
*Ministry of Planning (2024).

Regarding peaches fruits of study sample, the outcomes obtainable in Table 2 also show that the average value of peach wastes is assessed at approximately 28 thousand dollars, with a total marketing loss of approximately 46 tons. This amount of losses represents the average production of a wasted area estimated at approximately 14 dunums. Based on the average water requirement per dunum of peaches, the average amount of irrigation water wasted in cultivating this area is estimated at approximately 12.2 thousand cubic meters. This represents economic losses of important production elements, namely acreage, irrigation water, and capital, which could have been utilized in the production of other fruit or horticultural crops in the study area.

Marketing costs due to post-harvest wastes of apricot and peach harvests in the study sample of plantation owners

Data in Table 3 indicate that the total marketing costs for producing one dunum of apricot fruit were estimated at approximately 23.3 thousand dollars during the 2024 agricultural season in the study sample. These costs are distributed across the various marketing operations of the crop at 8.9, 5.1, 4.1, and 5.1 thousand dollars for each of the stages of collection, sorting, transportation, and sales agent commission, respectively. The total marketing costs for producing one ton of apricot harvest were estimated at approximately 8.6 thousand dollars during the same agricultural season. The percentage of the total lost marketing costs borne by the farmer out of the total marketing costs due to spoilage and loss of apricot fruits amounted to approximately 19%, while the amount of lost farm revenues resulting from this loss amounted to approximately 58.548 thousand dollars.

Table 3 also indicates that the total marketing costs for producing one dunum of peaches were estimated at approximately 6 thousand dollars during the 2024 agricultural season in the study sample. These costs are distributed across the various marketing operations of the crop at 2.6, 0.9, 1.6, and 0.7 thousand dollars for each of the stages of collection, sorting, transportation, and sales agent commission, respectively. The total marketing costs for

producing one ton of peaches were estimated at approximately 1.8 thousand dollars during the same agricultural season. The percentage of the total lost marketing costs borne by the farmer out of the total marketing costs due to spoilage and loss of peaches amounted to approximately 21%, while the amount of lost farm revenues resulting from this loss amounted to approximately 6.289 thousand dollars.

Table 3. Marketing costs of apricot and peach production in the study sample

Marketing costs / Fruits	Apricot	Peach
Collection costs/dollar-dunum	8956.7	2633.3
Sorting costs/dollar-dunum	5133.3	946.7
Transportation costs/dollar-dunum	4143.3	1673.3
Agent commission costs/dollar-dunum	5163.3	780
Total marketing costs/dollar-dunum	23396.7	6033.3
Marketing costs for total area/dollar	3673276.7	404233.3
Total marketing costs/dollar-ton	8665.4	1885.4
Total lost marketing costs/dollar	727835.6	86165.4
Percentage of lost marketing costs	0.19	0.21
Average selling price per ton marketed after deducting lost marketing costs/dollar	288.02	574.9
Farm revenues before deducting lost marketing costs/dollar	155850.856	102182.513
Farm revenues after deducting lost marketing costs/dollar	97302.517	95892.8
Loss in farm revenues due to marketing losses/dollar	- 58548.338	- 6289.71

Source: Calculated by authors based on field survey data.

Reasons for post-harvest losses in apricot and peach harvests at the level of plantation owners

Table 4 shows the results of a survey of orchard owners' estimations and perspectives on the reasons for this loss in apricot and peach crops and their relative importance. The results shown in Table 4 point to that there are several causes of this loss, which can be summarized as follows: The cause of fruit falling during the picking and harvesting process and not being able to utilize it ranked first as the cause of this loss, accounting for 80% of the sample farmers, with approximately 40 out of 50 farmers citing this cause. This was followed by bad weather conditions during and after the harvest, poor picking by workers, and lack of attention to crop maintenance and harvesting schedules, accounting for 74%, 60%, and 54% of each, respectively. Placing the produce in unsuitable containers ranked last as the cause of this loss, accounting for 2% of the sample farmers, with only one out of 50 farmers citing this cause.

Table 4. The analysis of the reasons of losses in apricot and peach harvests according to the estimations of the owners of the sample orchards

No.	Reasons for losses	Frequency	Relative importance (%)	Ranking of causes
1	Poor harvesting practices by workers	30	0.60	3
2	Lack of attention to crop maintenance and harvesting schedules	27	0.54	4
3	Lack of attention to post-harvest storage and sorting	14	0.28	9
4	Disease and insect infestation	26	0.52	5
5	Overripe fruit	14	0.28	9
6	Placing produce in unsuitable containers	1	0.02	12
7	Poor weather conditions during and after harvest	37	0.74	2
8	Loading problems and failure to transport produce to wholesale markets on time	17	0.34	8
9	Fruit falling during harvesting and not being used	40	0.80	1
10	Incorrect packaging	18	0.36	7
11	Lack of progressive and appropriate storage facilities and equipment in the plantation	10	0.20	10
12	Deformed and small fruit	9	0.18	11
13	Lack of training and guidance courses on harvesting	22	0.44	6

Source: Calculated by authors based on field survey data.

Estimation of post-harvest marketing wastes of apricot and peach fruits in the study sample of the wholesale sellers

The outcomes presented in Table 5 indicate that the total quantities of apricot and peach crops purchased by wholesale sellers in the study sample during the study season amounted to approximately 214 and 168 tons for each, respectively. The loss rate for both crops amounted to approximately 22% and 10%, respectively, of the total quantities purchased at the wholesale level.

Table 5. Quantity and percentage of post-harvest wastes of apricot and peach harvests in the study sample of the wholesale sellers

Fruit	**Total purchased** (quantity/ton)	**Total sold** (quantity/ton)	**Marketing loss** (quantity/ton)	**Loss percentage** (%)
Apricot	214.385	168.318	46.067	21.5
Peach	91.700	82.320	9.38	10.2

Source: Calculated by authors based on field survey data.

Comparing the percentages of losses in both crops shown in Table 5, it can be noted that there is a significant difference in favor of the apricot crop. This is due to the inability of this fruit to be stored for long periods in the wholesale market environment and the need to sell it to retail sellers and dispose of it as quickly as possible. These results are similar to some studies that addressed the issue of loss in horticultural crops at the wholesale market level, such as studies (Awad, 2023; El-Eshmawy *et al.,* 2022; Food and Agriculture Organization of the United Nations, 2018; Kadhim *et al.,* 2021; Rizk, 2021; Shaheen *et al.,* 2021).

Estimating the economic impacts of post-harvest wastes of apricot and peach harvests in the study sample of the wholesale sellers (wholesale markets)

The results obtainable in Table 6 illustration that the average value of apricot and peach crops losses was estimated at approximately 55.2804 and 10.4224 thousand dollars for each, respectively, with an average loss amounting to approximately 46, 9 tons for each of the apricot and peach crops, respectively. This loss represents economic losses of an important production element, specifically the money that could have been recycled to buy additional fruits or increase the quantities obtained of existing fruits.

Table 6. Quantity and percentage of post-harvest wastes of apricot and peach harvests in the study sample of the wholesale sellers

Fruit	Loss amount/ton	Average sales price per ton/ dollar	Value of losses/ dollar
Apricot	46.067	1200	55280.4
Peach	9.38	1111.13	10422.4

Source: Calculated by authors based on field survey data.

Reasons for post-harvest wastes of apricot and peach harvests in the study sample of the wholesale sellers (wholesale markets)

Table 7 shows the outcomes of a survey of wholesale sellers' estimations and views on the reasons that led to this loss in the two crops. It was found that there are ten main reasons that can be reviewed according to their importance, as shown in Table 7. The reasons for exposure to unsuitable environmental conditions in the market because of exposed supply of fruits, delays in the sales practice for shops (retail sellers) because of high prices, and high costs of storing crop boxes and containers are the most important reasons for the loss according to the estimations of wholesale sellers, with percentages reaching approximately 96%, 82%, and 72% for each of them, respectively. While the reasons for sorting the crop containers by retail sellers, and the reason for the large quantities imported from the two crops, came in last place according to the opinions and views of brokers and wholesale sellers, with percentages reaching approximately 38% and 36% for each of them, respectively.

Table 7. The analysis of the reasons of losses in apricot and peach harvests according to the estimations of wholesale sellers in the study sample

No.	Reasons for losses	Frequency	Relative importance (%)	Ranking of causes
1	The use of inappropriate packaging by orchard owners	23	0.46	6
2	The plantation owner's lack of interest in sorting and grading operations	23	0.46	6
3	Improper packing and dropping of fruits during transportation	30	0.60	5
4	Poor transportation network	34	0.68	4
5	Transportation is carried out by open-topped vehicles not equipped with modern and advanced storage methods	34	0.68	4
6	exposure to unsuitable environmental conditions in the market because of exposed supply of fruits	48	0.96	1
7	Delays in sales to shops (retail sellers) because of high prices	41	0.82	2
8	Sorting of crop containers by retail sellers	19	0.38	7
9	Large quantities of imported crops	18	0.36	8
10	High costs of storing crop boxes and containers	36	0.72	3

Source: Calculated by authors based on field survey data.

Conclusions

The study results showed that marketing losses in deciduous fruit trees have a direct and negative economic effect on the incomes of farmers and wholesalers alike. Many orchard owners, especially those with small holdings, face difficulties in managing the risks associated with post-harvest operations due to the numerous problems that cause this loss. The value of the monetary losses due to post-harvest losses for apricot and peach crops was estimated at 39 and 28 thousand dollars, respectively. This represents a physical loss of important elements that could have been used to plant other orchard trees or expand existing tree cultivation in the study area. The loss of both crops also caused material and economic losses at the wholesale level, amounting to approximately 55 and 10 thousand dollars for each of them, respectively. This represents an important production element, specifically the money, that could have been recycled to buy additional fruits or increase the quantities obtained of current fruits. Therefore, the study recommends that a modern technology in the collection, sorting, grading, and packaging processes should be adopted, instead of manual and primitive methods, to preserve fruit quality and reduce fruit waste. Farmers also should be encouraged to choose appropriate dates and environmental conditions for fruit collection. As well, it is important to avoid collection in unfavorable weather conditions, and ensure that the fruit is transported to local markets immediately after collection.

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Conflict of interest

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Author Contribution

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