

Estimation of Economic Value of Gardening Produces Hidden Harvest (Case Study: Prunus Persica)

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Abstract: Due to growing population and needs more food supply, increased productivity in agricultural production have been more considered and for this purpose, different strategies such as increasing acreage, yield per unit area, achieving superior cultivars, field operations management and the like have been suggested by the researchers. One of the ways (strategies) is that lower hitherto been considered, reduce postharvest losses, or "hidden harvest". Plant produces are living systems: due to doing postharvest biological processes that concluded to be ruined quickly. Harvesting and postharvest handling of crops, play a critical role in assuring their price and quality. Peach is perishable produce and after harvest a high percentage of it is useless immediately. Improvement of postharvest quality and efficiency in the marketing system necessitates improved harvesting methodologies, training of farmers, as well as the use of appropriate facilities and equipment for transportation, packaging and storage. So in this study for estimation the economic value peaches hidden harvest was used benefit-cost method. The required data were collected with through a questionnaire from 45 peach growers of east Golestan province. The results of this investigation disclosed that use of appropriate facilities and equipment for transportation, packaging, storage and increasing the awareness of farmers will be increased peach produce with reducing losses till 40 percent in the region. It is suggested measures such as precooling and cool keeping till the time of selling or processing, using refrigerated vehicles, equipping sales centers to refrigerators, proper packaging and maintenance of fruit at a temperature of 2 to 3 ° C should be implemented.

Keywords: Estimation, economic value, hidden harvest, Prunus persica

1. Introduction

A great percentage of agricultural products are strategic and consumption commodities used by millions of people daily as the most important food material. The improvement of economic situation, changes in dietary pattern and the increase of public awareness about food values of garden products have helped to increase the consumption and production of garden and land produces especially fruit and vegetable. Therefore, vegetable and fruit market plays a great role in increase of income, reducing the farmers' poverty and improving the food safety and is considered a measure of sustainable agriculture in developing countries. Yet, these products are confronted with some postharvest losses (Rolle, 2006), because they need high humidity to remain safe causing more than half of the products to become decayed. Official statistics show that 25 to 80% of fresh

fruits and vegetables are wasted from harvest to market dependent on the type, number and duration of process (Panahwar, 2006). Experts regard the reduction and minimization of waste in post-harvest process as hidden harvest and believe increasing the measures and arrangements to keep the products safe is among the main factor in providing the food security. Different factors are influential in pre and post harvest periods on the intensity of this phenomenon, such as suitable cultivation operations like selection of suitable species and soil management and fertilization (Forsythe & Evangelou, 1993). Success of post-harvest operations on the product depends on physiological nature of products and the type of cultivated species. The physiological nature of products is in turn influenced by growth conditions and plays an important role in determining quality and quantity of product longevity (Wang, Zhang, Pi, & Gao, 2003). As an example in desirable lighting, the physiological abnormalities decrease and the resistance of fruits to disease making agents increases, or the shortage of water causes the sweetness of peaches to increase so that they lose their qualities of marketing due to shrinking. There must be paid much attention to choose the kind of product as its unsuitability can affect other horticultural operations in reducing the wastes of post-harvest for sensitive products such as strawberry, cherry and peach. Some other post-harvest features such as lasting duration and edibility quality are dependent on suitable time of harvesting through which we can recognize the product quality. The manner of harvest and displacement of garden products play a role in guarantee of price and quality. There have been little attempts to use and spread the modern technics of harvesting fruits which cannot satisfy the gardeners' needs and the geographical conditions of Iran gardens. Consequently, all these factors cause the fruits to be harvested manually and traditionally. In this condition, educating farmers to be aware of harvest manner and suitable time, the most effective ways of using equipment available to transport, package and store the fruit can lead to the improvement of post-harvest quality of fruits and increase of productivity. The researches in Iran show that reduction of post-harvest waste and increase of product quality are less costly than increasing the quantity of products (Rolle, 2006). Therefore, specialists' advice concentrates on the increase of fruit quality, due harvest, suitable storage and reduction of waste during displacement and transfer, the result of which will be safer fruit, supply and demand adjustment of garden products. In recent years, fruit and vegetable production has increased remarkably in developing countries but most importantly, post-harvest operations and infrastructures must be improved to provide the best conditions for products. Based on the latest agriculture ministry statistics, the cultivation area of peach in 28 provinces in Iran was 56563 hectares and 444223 tonnes were produced showing an average of 10207 tonnes. The provinces of mazandaran, tehran, ardabil and Golestan ranked first to fourth, respectively, in producing peach Golestan the cultivation area of productive and non-productive seedling of peach equaled to 3594 and 4173 tonnes in 1387 and 1388, respectively. From which 37381 and 50113 tonnes of peach were obtained. Harvest performance in these years was 12217 and 15820 tonnes showing an increase of 30% in harvest efficiency with a growth of 34% in producing peach (Ministry of Agriculture, 2010).

Prunus persica (*Prunus persica* L. Batsch) is a climacteric stone fruit species. Abundance of water in its texture, high speed of respiration in post-harvest period and rapid loss of hardness in ripening period cause some decays and physiological disorder that high perdurable of product and limitation of storage potentiality and its marketing (Robertson, Meredith, Horvat, & Senter, 1990). After all, the limitations in developing country increase wasted of this product. due to the importance of issue, a questionnaire was developed to investigate the research aims and compare the experiences and theories in the world for the longevity of peach distributed among the gardeners of eastern Golestan province in which the important factors of pre and post-harvest period, the cost of raising the product, its waste and sale profit were calculated and presented as economic value of hidden harvest.

2. Research Methodology

This is a quantitative and qualitative research in nature, non-experimental in terms of controlling variables and applied in aim, with a sample of all peach gardeners of east Golestan province totaling 150, based on a simple random sampling, 45 persons of who were questioned by Morgan table. The data were collected by questionnaire, the reliability of which was confirmed by horticulture experts of Tehran University, agriculture ministry experts and gardeners of the areas of consideration. To compare the economic value of hidden harvest of peach, we used the (BCR) where B stands for profits of production and C shows the cost of production (Forsythe & Evangelou, 1994). If the ratio is equal to or greater than one, the project is economical (Mikesell, 1991).

$$BCR=B/C \quad (1)$$

3. Results and Discussion

Based on table 1, 86% of gardeners participating in the study were older than 36 years and less than 14% were under 36. About 64% of the gardens were under 2 hectares, 33% between 3 to 5 hectares and 2% greater than 5 hectares in area. 57 % of gardeners had 6-10 years of experience and 20% greater than 10 years of experience. 35 % were illiterate or could only read and write a little, 13% had high school studies while 51% finished high school or university studies.

Table 1. Personal features of gardeners

Features	frequency	%
Age groups		
<25	3	6.67
26-35	3	6.67
36-45	19	42.22
46+	20	44.44
Garden space (hectar)		
0-2	29	64.44
3-5	15	33.33
5>	1	2.22
Gardening experimental		
1. <6	29	22.22
2. 6-10	15	57.77
3. 10>	1	20.00
Education levels		
Illiterate	16	35.55
High school	6	13.33
Diploma and higher	23	51.11

To investigate the correlation between the gardeners' awareness and their tendency to use preventive tools of post-harvest loss increase, correlation tests were done the results of which are in table 2, which shows a significant relationship between these two items meaning with higher degrees of education and larger gardens, the gardeners have higher tendency to use modern methods and experts' suggestions.

Table 2. Correlation coefficient between gardeners' awareness and individual variables

variables	Correlation coefficient	Significant
Age	0.449**	0.000
Education level	0.659**	0.000
Garden area	0.491**	0.000
Years of experimental	0.448**	0.000

In the next stage, the influential factors in prevention of postharvest loss increase and their age by gardeners were investigated as the following.

3.1 Selection of Type for Cultivation

As part of problems in cultivation and raising of peach trees begins from the selection of suitable type, there has been much attention to genetic modification of gardening products, postharvest physiology-related attributes which has caused transferability capability and reduction of softening, resistance to freezing in storage, resistance to storage in controlled atmosphere, high concentration of CO₂ and low concentration of oxygen (Mitchell, & Kader, 1989). Therefore, we measured the gardeners' awareness of type attributes (disease and pest resistance, freezing, mechanical damage, storage life) and their importance. The survey shows that 46.5% of gardens knew the market deserving as the most important factor of choosing type following premature (26.5%), cooling resistance and good storage (18.3%) and disease and pest resistance (8.7%) cultivating premature and medium mature types is more common due to high of premature products.

3.2. Use of Chemical and Animal Fertilizers

The correct feeding of gardening products plays an important role in reducing over wastes, improving product quality and increasing storage life. Fertilizing or nutritional shortage has a negative impact on product quality and its storage life. Adequate fertilizing based on soil analysis test and plan organ analysis help to increase the quality. In this relationship, the study of the sample showed that gardeners pay more attention to the cost of chemical fertilizers than plant requirements in that if chemical fertilizer has reasonable cost, they use it on due time. (Chemical fertilizers are in priority due to distribution by cooperatives). Therefore, all gardeners use animal and chemical fertilizers regardless of the soil need. Soil test is performed in setting up the garden and fertilizing is performed without attending to the real requirement of soil and tree.

It was shown that 50% of cultivation area was irrigated in leakage form and 42.84% in flooding irrigation form. The method of under pressure irrigation was not applied widely due to high costs of setting up and, of maintenance.

3.3 Pruning Trees

The best fruiting branch of peach trees are one-year ones which requires the pruning operations more heavily and skillfully. A supervisor engineer is sent to the gardens by agricultural ministry to teach the gardeners the correct pruning but it was observed that only a few used the correct pruning

while those who spent more cost for pruning obtained better yielding (average of 19 TN in hectare) which confirms the importance of pre harvest operations.

3.4 Determining the Due Time of Harvest

The correct time of harvesting gardening products plays an important role in the increasing storage life and reducing wastes. This phenomenon is clearly observed in climacteric products. If the products are harvested prior to due time, they will not have suitable quality and be out of use. The correct time of harvesting is determined by texture hardness test, sugar to acid ratio, the number of days after flowering and thermal units, the change of fruit flesh (in white types), flesh hardness and thermal storage are suitable indices for peach fruits. The fruits had better be harvested hard mature to be sent to the far markets or be canned.

Fruit flesh hardness is of importance in terms of storage life and depends on climatic conditions (temperature and humidity) in addition to genetic properties. The types with hard fruit flesh are more resistant to storage conditions and are less inflicted to diseases.

The gardeners, based on survey do not consider the correct standards and set the experience as the criterion to harvest. Only 14.2% of gardeners take the correct trend of harvest into consideration.

Lack of cooling storage is the most important problem which forces the gardeners to distribute their product immediately after its harvest and leave some on the tree to find the purchase agent. Determining the harvest time during the day affects the quality in that the products harvested early morning (6 A.M) had more recessions than those harvested at 9 A.M.

Most gardeners do the harvest operations in the morning as they used female workers with low wage. Only a few stated they postponed the harvest to the afternoon to use the cool temperature of night for transportation to far distances.

Social security is another important factor for gardeners so that they harvest their products before they are physiologically matured in theft-inflicted areas.

This affects the production quality. Harvesting in the stage of prematurity may lead to more strength for displacement but these fruits do not increase organoleptic features and their acceptability decreases remarkably (Lurie & Crisosto, 2005).

Doing horticulture operations traditionally, inadequate education of workers during harvest and lack of attention to experts' points result in incorrect harvest of this sensitive fruit, in turn, accelerating the vulnerability to pests and diseases. Presenting instruction and education to worker and correct harvest of products can be considered most important. The data collected shows that gardeners did not supervise the workers (95%) and left the operations to be done by workers. The reduction of product price, of quality and value results in worsening of quality in storage period.

3.5 Reduction of Ethylene Synthesis through Cooling

Reduction of ethylene synthesis in fruits can be considered an important factor. Initial cooling and keeping it in suitable temperature, separation of contaminated products and damaged fruits from perfect fruits using stores with controlled atmospheres or low pressure stores are using stores with controlled atmospheres or low pressure stores are influential factors of reducing the effect of ethylene. The products harvested from the field and garden has high temperature which increases respiration and reduction of storage life. Precooling consists of operations done during 24 hours after harvest to reduce the product temperature. This keeps the quality and reduces the postharvest damages. Choosing precooling method consists of Hydro cooling, air cooling, ice cooling and vacuum cooling is dependent on physiological nature of product which affects seriously on the amount of waste and storage life (Budde, Polenta, Lucangeli, & Murray, 2006). Unfortunately, none of gardeners pay attention to these methods and try to launch their products to market.

3.6 Packing

Consumers' taste is in favor of products with the similar shape and size; therefore, packing the products is a key factor. Sorting in Iran is done on the field manually. As our county is one of the most important regions of producing gardening products, keeping international standards, sorting and transportation are very critical (Rolle, 2006). This study focused on the costs and manner of sorting. Peach is sensitive to the vibration of transportation and damages due to compression (causing scratch, erosion or separation of flesh from skin) leading to great damages fruit skin and flesh become brown due to the tannin oxidation. Therefore sorting must be performed in suitable sizes (in fields and immediately after harvest or after transportation to far distances) and fruits are so places that there is no possibility of movement. Cooling transportation by refrigerated vehicles can reduce the damages by designing suitable space and adequate ventilation. According to rules, there are some standards for precooling, ventilation and air circulation. The gardeners in the region did not use frigid vehicles and sometimes use open roofed vehicles. 33.25% of gardeners launched their products to far cities (Mashhad and Tehran) without any cooling device.

All researches have shown that keeping peach in cold storage can increase the trade life of this product but it is not used in the region due to the lack of enough cold storages and adequate equipped vehicles making the transportation uneconomical.

3.7 Sales and Processing

The sales and maintenance of product were other factors to be rated. According to gardeners, the products were transported to market directly and bought by the brokers. (Since the price difference between fruit in the garden and at the retail level is very high) As there is a great margin of product price at garden and retailers, the brokers gain a lot of benefits and they do not feel any necessity to invest on transportation, sorting and keeping fruit in favorable conditions. Therefore, they don't improve the post-harvest conditions. On the other hand the price of purchasing a kilogram of product which makes the gardeners' loner the costs through unreasonable operations or imperfect routines pre and post-harvest. All in all, the produced fruit is consumed fresh and a little is sent to companies due to problems of transportation.

3.8 Training

Table 3. Estimated Level of Losses in each stage (%)

Stages in post-harvest	Waste %
Training growers for correct operation, planting, harvesting, and especially harvest correct time	6
Maintenance operations in the garden until the transition to market or storage (such as precooling, removing damaged fruit, etc.)	4.5
Improper containers for the transportation	3
Limited availability of packing equipment	2.5
Limited availability storage facilities	4.5
Limited availability of transportation	7
Limited crop processing facilities	8
brokers	4.5
Total	40

Training of farmers for improvement of quality and prevention from waste is necessary. The Ministry of Jihad-e-Agriculture, The agriculture organization of jihad has set some training courses (Rolle, 2006) that this issue has also studied in this paper. Results showed that only 53/3 % of

farmers participated and they have told that is because of lack of time, inappropriate time for the class and no need to attend to the Class. The waste estimated in each stage is shown in table 3. Provision of suitable facilities of transportation, equipped cooling storage and increase of gardeners' awareness about correct time of harvest and precooling operations can lead to increase yield to 40% in region.

It is assumed that if gardeners consider the influential factors to prevent the post-harvest loss increase, the amount of yield in hectare will increase 40% more. To determine the economic value of hidden harvest of peach the rate of net gain and BCR index were calculated in two with and without the influential factors and margin (differences) was introduced as the economic value of hidden harvest of peach. As in table 4, this value was estimated to be 27 million Rials, meaning the peach profitability increases to 20%.

Table 4. Economic value of peach hidden harvest

variables	With hidden harvest	Without hidden harvest	Harvest economic value
Benefits (millions Rials)	136	163	
Costs (millions Rials)	8	8	
Pure benefits (millions Rials)	128	155	27
BCR	17	20.375	

4. Suggestions

Peach is a highly perishable product and a high percentage of it will be useless if it is not launched to factories or cooling storage. This study concentrated on the factors influencing the prevention of postharvest waste increase and estimation of economic value of hidden harvest of peach by cost-benefit. Based on the results, one important factor of high percentage of waste and quality loss in consumption period of peach is incorrect harvest of peach from tree, undue time of harvest, unsuitable transportation and (improper maintain) in favorable storage. Feeling the necessity to have education can help the gardeners to apply methods to increase the quality and longevity.

It is suggested that cooling storage with world standards such as controlled atmosphere storages and low-pressure storages or equipped storages can increase the shelf life of peaches. The government can play an important role in setting up and establishing such places. In micro level retailers must have suitable equipment to keep and store peaches correctly for at least 2 weeks in best conditions. The rapid consumption and transformation of peach is critical. There can be established two or more processing units for peach to become juice or concentrated so that a remarkable amount of fruit can be processed.

Horticulture studies about variables and development of cultivating species compatible with climate, especially for resistant and long lasting can be effective in increasing quality of peach.

Intervention of intermediaries in purchasing peach results in increase of wastes due to unsuitable methods of transportation and storage weak sorting, packing and in adequate distribution. The cooperation of governmental agencies and cooperation's can reduce the waste.

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