Original Article

Economic Analysis of Horticultural Crop Production at Various Levels of Mechanization (Case Study: Ghazvin Province)

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A R T I C L E   I N F O

A B S T R A C T

Objective: Economic analysis was performed for the main horticultural crops in Buin Zahra (pistachio, peach, nectarine, and apple). There were dependent and independent variables in this research. **Methods:** The independent variables were planting method (mechanized and conventional), land area used for fruit production, and land ownership. The maximum energy used, mostly in the form of fossil fuels, was in peach production. The two-stage simple random sampling method was employed. Random sampling is, in fact, the easiest sampling method, and the obtained results are reliable and generalizable to the whole society if the sampling principles are followed. **Results:** Results showed the best economic performance indicator (2.55 with the profit to cost indicator of 2.93) belonged to pistachio orchards, while apple, peach, and nectarine (with economic performance indicators of 1.83, 1.67, and 1.27, respectively) ranked second to fourth. The maximum ratio of profit to cost (2.93) was that of pistachio, which also had the largest energy ratio (with apple and peach ranking second and third with 2.15 and 2.08, respectively).

1.Introduction

In our country, the agriculture sector is the most important foodstuff producer, and it is not only an energy consumer but also the major energy producer. Considering this sector faces shortages of production resources on the one hand and is the provider of food security for a growing population on the other hand, a balance must be established between utilization of production resources and agricultural production. In fact, production resources should be used in a way that food needs of the present generation are satisfied without endangering those of future generations. This forms the basis of what is nowadays called sustainable agriculture

(Ghahdarijani, 2007). The energy balance in an agricultural system is determined by analyzing and comparing its energy inputs and outputs. Biermann et al. (1999) classified energy budgeting in the following two general methods:
-The economic method
-The eco-energetic method
In their studies on energy use, Kalk et al. (1996) concluded that energy use, energy use pattern, and energy output must be considered in achieving energy balance in agriculture. The model they proposed for energy use involved energy inputs, energy use pattern, and energy outputs. Agriculture is one of the important sectors in the Iranian economy, has potential natural advantages, and plays a sensitive role in the food security

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of the country. Therefore, it requires more attention than the other sectors of the economy. Considering the capital, climatic, and technological limitations the agriculture sector faces, it is very important to act in accordance with the principle of relative advantage. Although the relative advantage of agricultural products is somewhat influenced by advancements in technology, it is the existing climatic conditions and the flavor, taste, color, and other unique features of agricultural products of every geographical region that determine its relative advantage and makes it superior to other regions that produce agricultural products. In any case, identifying the potential relative advantage of the agriculture sector can facilitate the presence of our country in global trade (Jaafari, 2000). Energy use in various systems of agricultural production includes inputs employed in different activities. The total energy input per unit area in each agricultural production system is determined by adding up the energy inputs per unit area of all the inputs utilized in production. The energy used in the agriculture sector consists of various renewable or non-renewable fossil or non-fossil resources. In this research, the effects of orchard size and mechanization on horticultural crop production (peach, nectarine, pistachio, and apple) in Buin Zahra were studied. The purposes of carrying out the study were to:

1. Study the situation regarding energy use in the production of horticultural crops (peach, nectarine, pistachio, and apple) in the region

2. Determine the share of each utilized input with respect to the energy used per unit of produced horticultural crops (peach, nectarine, pistachio, and apple)

3. Determine the amount of energy used to produce one kilogram of horticultural crops (peach, nectarine, pistachio, and apple) and compare it with those of other regions

4. Compare and evaluate the efficiency and productivity of the energy used in horticultural crop production (peach, nectarine, pistachio, and apple)

Singh et al. (2004) reported the use of high-yielding varieties in intensive cropping systems has increased application of fertilizers and chemical pesticides, and that high mechanization levels have led to increased use of energy in modern agriculture.

The relationship between farm size and productivity is one of the important subjects in farm management and agricultural development policy, and knowledge of this relationship can help agriculture policy makers and farm managers make decisions regarding the size of agricultural units, and guide them in making plans that are more correct from the economic point of view. For example, if there is an inverse relationship between farm size and productivity, redistribution of land among landless people, and movement towards smaller-sized farms, may be useful. Conversely, if there is a direct relationship between farm size and productivity, land

consolidation and co-ownership of land seem to be desirable policies (Abdollahi, 2000).

Pender et al. (2002) studied agricultural land management reforms and showed that these reforms could guide us towards achieving greater yields and preventing loss of land fertility. In their study in Russia, Coster (2003) concluded that establishment of very large farms and emphasis on their growth in size did not considerably raise economic efficiency.

2. Materials and Methods

Buin Zahra, located in Ghazvin province, consists of six counties (the central, Abgarm, Avaj, Dashtabi, Ramand, and Shal) and 16 rural districts with 320 villages where villagers live. Buin Zahra, with an area of about 5088 square kilometers, borders on Ghazvin to the north, the Central and Hamadan Provinces to the south, Tehran Province to the east, and Takestan to the west. Its main crops are pistachio followed by walnut and grape (onion and cotton are also grown). Of course, due to its very favorable weather conditions for growing pistachio, substantial investments were made during the past few years by the private sector to develop land under pistachio production. Buin Zahra is at the intersection of the Ghazvin to Saveh and Karaj to Hamada roads, has a cold and dry climate (with the minimum temperature of -25℃ recorded on January 17, 2008, and the maximum temperature of +45℃ recorded in the summer of 2011), average annual temperature of +15.3℃, and mean yearly rainfall of 190 millimeters. It has longitude of 40˚50́ east, latitude of 35˚46́ north, and altitude of 1225 meters. According to statistics published by the Agriculture Jihad Organization of Ghazvin Province and Agriculture Jihad Services Center of Buin Zahra, and considering the completed preliminary questionnaires, two levels of orchard size were considered for apple, nectarine, peach, and pistachio orchards: smaller than one hectare, and larger than one hectare. Land ownership was divided into privately owned orchards and rented orchards. Farmers in the region are mostly engaged in animal husbandry and agriculture in addition to producing horticultural crops. The agriculture system in Buin Zahra was divided into four classes: horticulture, horticulture and animal husbandry, horticulture and farming, and horticulture, farming, and animal husbandry. The statistical population consisted of the 3846 fruit growers in Buin Zahra (anonymous). The simple two-stage random sampling technique was employed, which is actually the simplest sampling method that yields results generalizable to the entire population. Another reason for selecting this sampling technique was to follow the sampling method employed by the Statistical Center of Iran and the Management and Planning Organization in their surveys. In this method, all units of the society have the same probability of being selected at each of the two stages (Mansoorfar, 1997). In the first stage, a number of villages in Buin Zahra were randomly selected. Names of fruit growers in each selected village were listed in the

second phase, and random sampling and proportional allocation were employed for distributing the questionnaires among the fruit growers. Cochran' formula for sample size was used to determine sample volume. Cochran introduced the following formula for calculating the number of samples (n) (Mansoorfar, 1997):

$N = Nt^2s^2/Nd^2 + t2s^2$

In the above formula, N is the size of the statistical population (number of fruit growers), and t, the acceptable confidence coefficient, was obtained from the student t distribution table (assuming the related feature was normally distributed). Moreover, s^2 is the estimated variance of the studied feature in the society (which was the variance of energy efficiency in this study), d the desired probability accuracy (half the confidence interval), and n the sample volume. The above-mentioned formula was used to obtain the sample volume.

3. Results and Discussion

Results of the research, shown in Figure 4-7, indicate that the best economic performance (with the profit to cost ratio of 2.55) was that of pistachio orchards, and that apple, peach, and nectarine orchards (with ratios of 1.83, 1.67, and 1.27, respectively) ranked second to fourth in this respect. One of the main reasons for the difference in these ratios is the fact that horticultural crop losses and horticultural waste are not economically valuable, with pistachio orchards having minimal waste and losses and apple and peach orchards the maximum losses and waste**.**
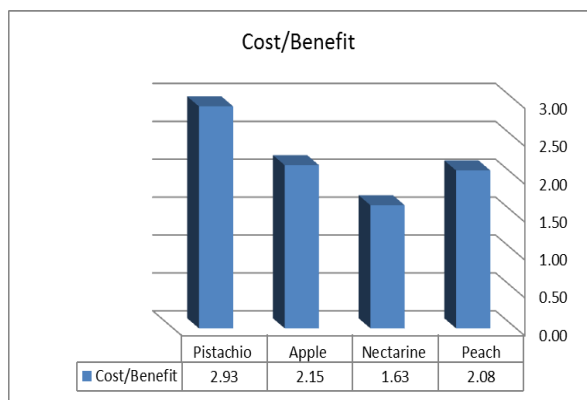

Figure 1: The profit to cost ratios of various horticultural crops in orchards smaller than 0.5 hectare in Buin Zahra

If the economic indicator is considered the main criterion for planting fruit trees in orchards smaller than 0.5 hectare, pistachio and nectarine orchards have the

highest and the lowest priority, respectively. Figure 2 reports the profit to cost ratios for various horticultural crops in orchards larger than 0.5 hectare. The highest ratio (2.93) was that of pistachio orchards, and pistachio orchards also had the highest energy ratio. Moreover, apple and peach orchards with ratios of 2.15 and 2.08, respectively, ranked next to pistachio orchards in this respect.
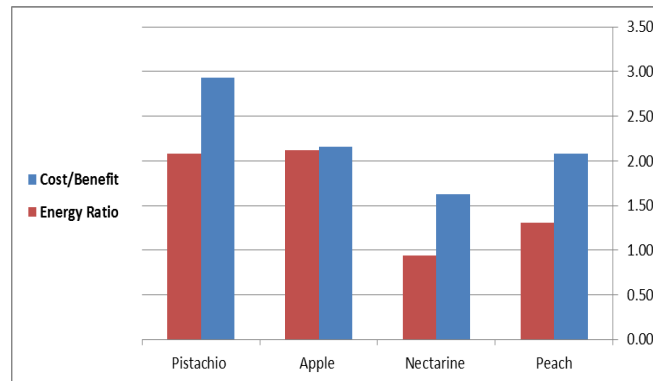

Figure 2: Average energy and profit to cost ratios for various horticultural crops in Buin Zahra orchards

3.1.The effects of fruit growers' experience in horticultural crop production and of their education levels on energy efficiency in the studied fruit crops

As shown in Table 1, fruit growers' levels of education had no significant effect on energy efficiency.

Table 1:

ANOVA of energy efficiency at four experience levels and five education levels

Source of variation	Sum of squares	Degree of freedom	Mean squares	F
Experience level	11.70	3	3.90	16.72*
Education level	3.21	4	0.804	3.44 ns
Experience level * education level	2.88	12	0.240	1.02 ns
Replication	23.93	129	0.186	0.795
Error	58.55	251	0.233	
Total	754.49	400		

The symbols ns, *, and **, stand for not significant, significant at the 5% level, and significant at the 1% level, respectively**.**

As shown in Table 1, the effects of experience on energy efficiency were significant at the 5% level. Table 2 lists results of Duncan's test on means of energy efficiency for the various levels of experience. As shown in this table, the maximum energy efficiency (1.4 on average) belonged to farmers with 5-20 years of experience in fruit production, while mean energy efficiency was less than one for fruit growers with more than 25 years of experience. Among the main reasons for this difference are that the more experienced fruit growers lack knowledge of new developments in fruit production, and that they have not adapted themselves to new horticultural practices.

Table 2:

Comparing the means of energy efficiency at various levels of experience using Duncan's test at 5%**:**

Experience in growing fruit trees	Frequency	Subset		
		1	2	3
More than 25 years	90	0.99		
15 years	79		1.23	
5-15 years	121			1.40
15-25 years	110			1.40

Fruit growers with less than five years of experience are not usually sufficiently experienced in producing horticultural crops, but they seem to be more efficient than the experienced fruit growers (of level four experience who follow conventional practices) in applying new improved horticultural techniques, in using machinery, and in cooperating with supervising engineers.

4. Conclusions and Suggestions

Results of this research show the best economic performance indicator (2.55) belonged to pistachio orchards, while apple, peach, and nectarines orchards with economic performance indicators of 1.83, 1.67, and 1.27, respectively, and ranked second to fourth in this respect. One of the main reasons for this difference in energy and profit to cost ratios can be the fact that horticultural product losses and horticultural waste do not have economic value, with pistachio orchards having the minimum losses and producing the least waste and apple and peach orchards suffering the maximum losses and producing the most waste. The highest ratio of profit to cost (2.93) was that of pistachio orchards that,

incidentally, had the maximum energy ratio, with apple and peach orchards ranking second and third with profit to cost ratios of 2.15 and 2.08, respectively.

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