

Evaluation of effective factors on pistachios production (a case study in city of Damghan)

Ali Ghorbani^{1,*}, Seyed Nematollah Musavi²

¹PhD student of Agricultural Economics, Islamic Azad University, Marvdasht Branch, Researcher of Damghan Pistachio Research Station

²Associated Professor of Department of Agricultural Economics, Marvdasht Branch, Islamic Azad University, Marvdasht, Iran

Abstract: Pistachio is a plant which has been cultivated as a non-commercial product in the Middle East and Mediterranean countries since centuries ago. But from the last half century and due to the welcoming of its fruit, is considered as a commercial plant. The greatest danger that threatens Iranian pistachios is reducing of comparative advantage due to increasing of production costs and its low function per unit area. The requirements to improve production and product quality and reduce the production costs are having information about water, capital, and inputs, personnel and production functions. In this research, 94 people of pistachio producers from Damghan city were selected by random sampling method and have been completed the questionnaires. After collecting and coding data and required tests, the factors were evaluated; then comparing with statistics of R, F, t and Camera-Watson test, transcendental production function was selected as the best model. The factors used in the model, explain 70% of the changes of dependent variable. And animal manure, tree age, type of soil texture, financial management and executive skills have had a significant effect on performance of gardens.

Key words: Production function; Pistachio; Damghan

1. Introduction

Pistachio is a plant which has been cultivated as a non-commercial product in the Middle East and Mediterranean countries since centuries ago. But from the last half century and due to the welcoming of its fruit, is considered as a commercial plant. So that our country is currently one of the oldest and largest producers and exporters of pistachios in the world, and the history of its culture in Damghan goes back to 1500 years ago.

This tolerant and patient tree with its tall and green stature cover the desert areas where other plants can no longer stand in difficult environmental situation and has an important role in stylized air and prevention of flowing sand attacks to the social and economic life of desert dwellers. For example, it is caused only about one million jobs and 10 trillion rials revenue (Gheibi & Javadi, 2006). Today, the greatest danger that threatens Iranian pistachios is reducing of comparative advantage due to increasing of production costs and its low function per unit area. The total production cost of dry pistachio per kilogram between years 2010-2012 has increased about 39% (Iranian Pistachio Forum Website). But the requirements to improve production and product quality and reduce the production costs are having information about water, capital, and inputs (fertilizer, pesticide, ...) and personnel (management of gardens) and production technology. Increasing of

production and productivity in the country is in knowing of the structure of production and application of new techniques in the context of a suitable production system. To achieve this purpose, understanding of some production factors including capital, human resources, land, suitable technology, on time use of inputs of pistachio production (pesticides, fertilizers, ..) are considered.

1.1. Background of research

Arabnejad (1996) has evaluated the economic issues of pistachio production of Kerman province. The results of this study indicate that use of machinery, chemical fertilizers and pesticides are in the second area of production and animal manure and worker are in the third region of production.

Mehrabi Bashir Abadi (1996) in his research, evaluated the productivity factors of pistachio production in city of Rafsanjan. The results showed that some farmers have low productivity regarding the use of some inputs like labor and chemical fertilizer and the performance improvement to 52% is possible with allocation of optimal resources and without increasing acreage.

Fattahi Ardakani (1997) in his study, analyzed the productivity of effective factors on pistachio production (case study in Ardakan City). In this research, the effect of effective factors on production such as labor, water, fertilizer, pesticides and agricultural management was evaluated by one-way variance analysis. Average, final and total

* Corresponding Author.

productivity was calculated by transcendental function and it is observed that the productivity of production factors in the region is not high. Many farmers do not use inputs well and reallocation of resources can be increased to a great extent.

Fattahi Ardakani and Musanejad (1999) showed that except water, the other inputs are used in the third region and the final productivity of these inputs are lower than their optimums. So, the productivity of production factors is relatively low and the potential to increase production (growth) is possible, which increased production by increasing acreage and yield is possible. If we replace the optimum use of inputs to the function, the yield would be increased to 61% compared with the current situation.

Chizari and Mirzaei Khalil Abadi (2008) in a study with the subject of management of inputs in pistachio production said that if market is competitive, the farmers will choose profit maximization method and in that situation the optimum amount of water, animal manure, chemical fertilizer, labor, pesticides and machinery would be 7793 m³, 13 tons, 178.5 kg, 37.5 persons/day, 7.1 liters and 14.3 hours, respectively. Also, if the farmers do based on minimization of the costs due to the restrictions, the optimum amounts of water, animal manure, chemical fertilizer, labor, pesticides and machinery would be 7294 m³, 11 tons, 173.8 kg, 37.5 persons/day, 6.95 liters and 13.9 hours. Therefore, if farmers use water based on the optimum amount, in the first case (profit maximization method) an average of 1400 m³/hectare of water will be saved and extra water harvesting from underground sources which is now about 154 million cubic meters, will be reduced to 10 million cubic meters. In the second case, 1800 cubic meters of water per hectare will be saved and the problem of extra water harvesting would be solved completely as the result and the region will go towards sustainability.

Tahamipour (2009), in a study with the subject of evaluation of the effective factors on the risk of pistachio production in city of Zarand, showed that the inputs of labor, the area under cultivation, machinery work and pesticides have a positive effect on the risk of production and this effect is significant only for labor. Inputs of chemical fertilizer, water and animal manure also have negative effects on the risk of production and this effect is significant at one percent level for each input. Also, except of machinery, the effect of other inputs on the mean of production is positive and this effect for other inputs except the area under cultivation are significant at one percent. However, the negative effect of machinery is not significant.

Rashid Ghalam et al (2013) with evaluation of pistachio production structure in city of Damghan, showed that own-priced desire of input demand is negative and cross desires in all cases except cross-desire of two inputs of chemical fertilizer and labor as well as two alternative inputs of chemical fertilizer and pesticides, indicate a complementary

relationship. The numerical values of own-priced desires also indicate that demands of labor, pesticides and animal manure compared to changes in their prices in pistachio production in this city are not desirable. Also, the returns related to the scale is decreasing and equal to 72% which indicates that farmers faced with the problem of lack of savings resulted from the size. So, the executive and research policies to improve the effective factors of production of pistachio such as fertilizer, pesticides and labor are recommended.

Erdogan et al (1992) evaluated pollen dispersal in pistachios and based on the research results, one of the major factors in reducing the products of pistachio orchards is insufficient numbers of pollinizer trees, male and female trees at the same flowering time, dispersion of male trees in the garden and wind speed.

Glass & Mckillop (1998) studied the agricultural structure of north-Ireland. They estimated the translog cost of this part and obtained the substitution desire between production inputs, price desires and cross-desires of input demands and profit of scale. The results indicate that demand of capital is desirable and animal feed, seeds and livestock imports are non-desirable.

Geravais et al (2006) studied the economy of food industries scale of Canada. The results of this study showed the increasing returns to scale in production units of bread, meat and milk.

Kavoi et al (2009) evaluated the production structure and input demand in small fields of milk producing in Kenia by using cost dual approach. Results indicate the lack of profits comparing with the scale of milk producing in Kenia.

According to the differences in gardening conditions and methods and using inputs, different results were obtained which causes the evaluation of pistachio production statue in Damghan gardens because of the basic differences in gardening method and using inputs.

2. Hypothesis

The below hypothesis are considered in the present study:

- 1) The factors such as animal manure, the age of tree, the soil texture, the executive and financial management skills are effective on pistachio production in city of Damghan.
- 2) The factors such as animal manure, the age of tree and soil texture have the greatest effect on pistachio production of Damghan city.

3. Methodology

This research is based on a practical purpose, with respect to the cross time, survey research and library method and a questionnaire completed by face to face interview is used. To evaluate the available situation, some of pistachio producers (a sample of 94 pistachio producers) of the study area (city of Damghan) are selected by random sampling

and questionnaires were completed through interviews. To select the studied samples by two-steps method, first with considering of effective factors on the research subject, to eliminate the role of environmental factors with a homogeneous environmental selection from 5 villages of Damghan city, 4 villages were selected which are: Damankuh, Hume, Ghahab Rastagh, Ghahab Sarsar which the most pistachio gardens of Damghan city are in these areas. According to the statistics, 4160 pistachio gardens are in these areas. After coding of data, meanwhile results extraction, the distribution of independent variables (garden characteristics, input consumption, and management properties) were determined. Also, Pearson-Spearman correlation coefficient was determined and by use of multivariate regression analysis and testing of hypotheses, the significance of the factors were examined. Finally, to achieve the correct form of the final model, various forms of production functions (Cobb-Douglas, transcendental ...) cases were analyzed. Then, by comparing the statistics of t, F, R and Camera test - Watson, transcendental production function, was selected as the best model. Transcendental function was the modified Cobb-Douglas production function form which its logarithmic format is mentioned in the written form as below. The pistachio production function was estimated by the SPSS software. The general format of function is as below:

$$Lny = \alpha + \sum_{i=0}^n \alpha_i LnX_i + \sum_{i=1}^n \beta_i X_i$$

The estimated production function is transcendental. In this type of production function, the dependent variable is the natural logarithm of pistachio yield per hectare. Also, the right-hand side

variables include the logarithmic part and input consumption without logarithm.

In this regression analysis of dependent variable, the performance in addition to be affected by the quantitative variables with the current scales, the qualitative variables such as suitable soil quality for culture and ... also follows it. Since the most qualitative variables indicate the presence or absence of the quality or trait, one way to quantify these traits, is considering of synthetic variable (dummy variable) with accepting of both Zero and one that in this case, zero indicates the absence of an objective and one indicates its presence. And after the evaluation, the management factors and finally for the individual skills, each variable inserts to the production function. After recognition of excess and non-relevant variables, they were excluded from the model.

4. Data analysis

Analysis of effective factors of pistachio performance:

What is examined in this section, after several tests including: regression, correlation analysis (Pearson-Spearman) identified the factors affecting the performance of pistachios and then considered through variance analysis and were classified by Duncan's grouping method.

1-The age of trees:

F-test was used to examine the effect of tree age on the performance. Trees are classified into 5 classes based on their average age. So, considering of tree age is necessary and important, because very young trees have low power of production and the rate of production is raised by increasing age of trees.

Table 1: study of the effect of tree age on performance of pistachio orchards in city of Damghan (kg fresh pistachios)

| Group (year) | Numbers | Performance mean | Grouping | Explanations |
|--------------|---------|------------------|----------|-------------------------------|
| ≤ 10 | 14 | 86.78 | A | Calculated F= 5.5553 |
| 11-20 | 58 | 1927 | Ab | F Significant level=0.000 |
| 21-30 | 13 | 4938 | B | Freedom degree among groups=4 |
| 31-40 | 6 | 4592 | B | Freedom degree of group=89 |
| >40 | 3 | 4664 | B | Total freedom degree=93 |

Reference: research results

2-Animal manure:

Near to 32% of farmers of the area are engaged in animal husbandry. So, the manure for pistachio gardens are mostly included cow, sheep and poultry manures. Because of the limitation of this research, all types of these manures are assumed to be uniform. The average of fertilizer is 23.52 tons per hectare. Farmers have divided the samples into 5 classes for the variance analysis, the obtained F value is 2.947 which indicates that use of animal manure has a significant effect on increasing performance. On the other hand and statistically, it can be said that increasing use of animal manure can increase the performance.

3-Numbers of irrigation:

The distribution of irrigation frequency was low, however the important subject is the rate of water intake per each period, for example the farmer whom has irrigated 8 times may consume half of the amount of water which is used by a farmer whom has irrigated for 4 times. Therefore, it is necessary to measure the amount and quality of water for more accurate evaluation of effect of water on performance, but it was not possible because of the research limitations. Also, the farmers who are not familiar with how the instruments accurately measure flow rates or because of economic reasons, they do not have any chance to provide these devices, do not know about the volume of water intake. As long as we do not have adequate and accurate information about the amount of water

which is irrigated to the trees, proper irrigation management will not be possible. It is possible for trees to be under drought stress because of the low irrigation or due to excessive irrigation, water can be

wasted by us. According to the above mentioned, the measurement of water flow rate is the first step in proper management of irrigation.

Table 2: Effect of animal manure on yield of pistachio orchards in city of Damghan (kg fresh pistachios)

| Group (tons) | Numbers | Performance mean | Grouping | Explanations |
|--------------|---------|------------------|----------|-------------------------------|
| 0-5 | 11 | 474 | A | Calculated F= 2.947 |
| 6-10 | 20 | 2445 | A | F Significant level=0.024 |
| 11-20 | 25 | 2271 | A | Freedom degree among groups=4 |
| 21-40 | 29 | 2038 | A | Freedom degree of group=89 |
| 40 < | 9 | 5411 | B | Total freedom degree=93 |

Reference: research results

4-chemical fertilizers:

Chemical fertilizers which are used by farmers were included phosphate fertilizer, nitrate and potassium fertilizers and the statue of using of chemical fertilizer and its effect on crop yield is given in table 3. As it is observed, the chemical fertilization statue has been divided into 5 groups. Despite of

different performance status among different groups, there is no significant difference among them. And it is showed that the most farmers are still using the traditional ways for their gardens fertilization and do not use of scientific methods which are analyzing of soil, leaf or even the fruit.

Table 3: the effect of macro fertilizer on the yield of pistachio orchards in city of Damghan (kg fresh pistachios)

| Group | Numbers | Performance mean | Grouping | Explanations |
|----------|---------|------------------|----------|-------------------------------|
| ≤ 200 | 20 | 4091 | A | Calculated F=2.349 |
| 201-400 | 32 | 1808 | A | Significant level of F=0.06 |
| 401-800 | 28 | 1635 | A | Freedom degree among groups=4 |
| 801-1200 | 7 | 3528 | A | Freedom degree of group=89 |
| 1200 < | 7 | 1217 | A | Total freedom degree=93 |

Reference: Research results

5-Pesticides:

To investigate the effect of pesticide, the pesticides were separated in 5 classes and the calculated F-value (2.349) was higher than the F of table. And concluded that using pesticides at 99% has a significant effect on the mean of classes.

However, it should be noted that the spraying time, type and rout of using pesticides have a great effect on the performance. In table 4, pesticide status and its effect on performance are discussed.

Table 4: the effect of pesticide on performance of pistachio orchards in city of Damghan (kg fresh pistachio)

| Group (lit/hectare) | Numbers | Performance mean | Grouping | Explanations |
|---------------------|---------|------------------|----------|---------------------------------|
| ≤ 0-10 | 61 | 2226 | A | Calculated F=3.123 |
| ≤ 10-20 | 24 | 1883 | A | F Significant level=0.019 |
| ≤ 20-30 | 3 | 3166 | A | Freedom degree between groups=4 |
| ≤ 30-40 | 3 | 1733 | A | Freedom degree of group=88 |
| 40 < | 2 | 10250 | B | Total freedom degree=92 |

Reference: Research results

6-Soil texture:

Soils in the study area are very diverse, sometimes the soil texture is very light with low water and nutrient holding capacity and some soils are heavy with high holding capacity of water and nutrients. To evaluate the effect of soil texture on 5 separated classes, the average performance of classes show the gardens with heavy soils, have high performance that the texture status of garden soils and their effects on the performance are mentioned in table 5. So the soil texture at 99% has no significant effect on the mean of classes. However, it should be noted that soil quality (salinity, ...) and use of animal manure has many effects on soil characteristics.

Table 5: evaluation of the effect of soil texture on the performance of pistachio orchards in city of Damghan (kg fresh pistachios)

| Row | Class | Numbers | Performance mean |
|-----|------------|---------|------------------|
| 1 | Sandy | 2 | 1000 |
| 2 | Sandy clay | 2 | 1010 |
| 3 | Loamy | 36 | 2386 |
| 4 | Loamy clay | 34 | 1995 |
| 5 | Clay | 20 | 3047 |

Reference: Research results

5. Pistachio production functions

The criteria for selection of inputs were significance of t-statistic. In other words, the other inputs with very low t-statistic value and non-

significant, were removed. So, the obtained results of the model are mentioned in the table 6.

Table 6: pistachio production function

| Name of variable | Coefficients | Error of Standard Deviation | t-statistics | Significant level |
|-----------------------------|--------------|-----------------------------|--------------|-------------------|
| Stable | -33.623 | 3.929 | -8.56 | 0.000 |
| Tree age | -0.476+++ | 0.084 | -5.69 | 0.000 |
| Animal manure | -0.07++ | 0.034 | -2.07 | 0.042 |
| Water quality | -1.466++ | 0.642 | -2.28 | 0.025 |
| Machinery | -0.018++ | 0.008 | -2.32 | 0.023 |
| Logarithm of tree age | 13.342+++ | 1.691 | 7.89 | 0.000 |
| Logarithm of animal manure | 1.541++ | 0.634 | 2.429 | 0.018 |
| Logarithm of machinery | -0.112+ | 0.064 | -1.75 | 0.084 |
| Financial management skill | 0.006++ | 0.003 | 2.435 | 0.017 |
| Executive management skill | 0.027+++ | 0.007 | 4.041 | 0.000 |
| Dummy variable of loam soil | 1.786+++ | 0.573 | 3.116 | 0.003 |
| Dummy variable of clay soil | 1.181+ | 0.665 | 1.775 | 0.080 |
| R=0/840 | | R square=0/706 | | D-W =1/944 |

+++1% significant ++5% significant +10% significant

Reference: Research results

F statistics shows that overall regression is significant at the level of 1%, R^2 value has been equal to 0.706, on the other hand the used factors in the model, explain 70% of changes of dependent variable. It shows that 30% of production changes are related to unknown variables including water intake, pistachio types and etc. However, according to the results of this regression, positive, negative and no significant effects of the inputs can be estimated.

As the table-6 shows both variables of logarithm of tree age and the tree age (without logarithm) are significant at the level of 1%. On the other hand, the variable of logarithm of tree age is positive and 1% significant. It shows the positive effect of the age of tree on pistachio production. Also, the variable of tree age (without natural logarithm) is negative and 1% significant. It means that increasing age of the tree above a certain level will have a negative effect on the production of pistachio. Using the derivative, the optimum economic age of tree can be determined.

Table 6 shows that both variables of logarithm of animal manure and animal manure (without logarithm) are significant at the level of 5%. On the other hand, the variable of natural logarithm of animal manure is positive and 5% significant. It means that using of animal manure has a positive effect on the production of pistachio. Also, the variable of animal manure (without natural logarithm) is negative and 5% significant. It means that increasing use of animal manure above a certain level has a negative effect on the production of pistachio. Using the derivative, the optimum amount of animal manure consumption can be determined.

According to table-6, the variables of natural logarithm of machinery are negative and significant at the level of 10%. On the other hand, pistachio production function shows that using machinery is more than optimum and its negative effects get started. Generally, it can be said that the farmers in the region 3 of production are using this factor.

While, the results show that consumption of inputs such as macro chemical fertilizers, micro chemical fertilizer, pesticides and human resources have no significant effects on production. It may resulted from the similar use of the mentioned inputs by the studied farmers. So, here it is clear that because of the lack of attention to the economic use of agricultural inputs, their use does not have a significant effect on performance of the gardens.

As table-6 shows, both variables of financial and executive skills are significant. On the other hand, the variable of financial management is positive and 5% significant. It means the positive effect of this skill on the production of pistachio. Also, the executive skill is positive and 1% significant. In addition, two dummy variables of soil texture are significant. In other words, the variable of loam texture is positive and 1% significant. It means the positive effect of soil texture on the production of pistachio. Also, the clay soil is positive and 5% significant and it indicates that at the same conditions, the orchards which are cultivated on the heavy soil have higher performance than the orchards with light soil.

6. Discussion and conclusion

According to the age of area trees that 61% of them are between 10-20 years old, it seems that the most gardens are new and they can produce at a high level by solving problems. Also and according to the results of this research, the production rate per unit area increases with increasing age and the age of trees has a significant effect on increasing production of the gardens. One reason for the low average of performance of this area to average of other areas is that 76% of gardens are young trees (76% are lower than 20 years old) while the maximum production is in 20-30 years old which causes the low average of the area.

According to the results of this research, the average of pistachio performance in this study is

2326 kg fresh pistachio per hectare and almost 83% of farmers produce lower than 3000 kg fresh pistachio per hectare. The most farmers have very low performance and the gap between minimum and maximum is very large. The maximum yield of the area is 20000 kg per hectare and it indicates that the area production can be improved by solving problems.

Results show that the soil of 95% gardens is suitable and there is not a problem in this viewpoint, but the quality of the soils needs to be study more accurately.

According to the obtained results, animal manure is an important factor in pistachio performance and has a significant effect on it. Against, macro and micro chemical fertilizers had no significant effect on increasing performance. It can be due to the indiscriminate use of chemical fertilizers and no attention to the plant needs. Also, the right mix of used ingredients impact on their effectiveness and most gardeners, regardless to this matter, consume certain elements each year. So, it is recommended that the principles of proper management of soil fertility by education and extension services to farmers to be trained. Due to the indiscriminate use, in addition to polluting the environment has somewhat negative effect on the performance of gardens. Because, as the results of variance analysis between groups suggests that more consumption has a negative effect on the performance and the records of this study confirm that the use of chemical fertilizers is placed in the third region of production.

Based on the obtained results from the production function, the considered independent variables explain 70% of the performance of dependent variable and animal manure, age of trees, soil type and financial and executive skills have a significant effect on the performance of gardens.

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