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Production and marketing management of walnut in Kohgiluyeh-va-Boyerahmad Province, Iran

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ABSTRACT

Walnut (Juglans regia L.) is one of the important and multipurpose trees in horticulture and commercial dried fruits in Iran. In this study, effective factors on producing walnut and the investigation of walnut marketing issues have been studied using functional analysis and marketing margin model estimation methods. The data required for the present study has been collected through filling 70 questionnaires by walnut growers and also 30 questionnaires by walnut retailers and 20 questionnaires by its wholesalers in Kohgiluyeh-va-Boyerahmad Province, in 2012. Using transcendental production function estimation, the results revealed that the explanatory variables including the number of fruitful walnut tree and labor have statistically been significant and have a positive relationship with walnut production. The elasticity of inputs' production of the number of fertile walnut tree and labor are 1.782 and 0.282, respectively indicating that these inputs have a significant effect on walnut production. Also, the rate to return is equal to 2.064 which show that with increasing production factors, the rate of production will be increasing. Using the mark-up model, the marketing margin calculation indicated that marketing margin has a direct and significant relationship with retailer price in the way that a unit increasing in the retail price causes 0.97% unit increasing in marketing margin. Wholesalers and retailers margin are 18 and 20.3 thousand Rails, respectively that indicates the existence of total marketing margin in the rate of 38.3 thousand Rails. The share of producers, wholesalers and retailers from the final consumer price is about 62, 20.1 and 17.9 percent, respectively.

Keywords: Elasticity of production, Iran, Marketing, Production function, Walnut

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INTRODUCTION

Due to their important role in human nutrition, dried fruit products such as walnuts, almonds, pistachios, hazelnuts have been considered by many experts in Nutrition Science. Therefore, the cultivation and production of such products have been considered by agricultural policymakers in various countries. Walnut (*Juglans regia* L.) is one of the important dried fruits in the world which its area under cultivation and production is increasing every year in the way that the rate of its export was about 1.17 billion dollars in 2008 based on the statistics of Food and Agriculture Organization (FAO) [1]. Iran has been known as a walnut origin among the main countries producing dried fruits and is the fourth producer country in the world. Although, Iranian share is just 0.153% in the global production market of walnut, over 8% of the world area under fruitful walnut cultivation and 6% of the world walnut production rate are allocated to Iran. In 2008, only 0.137% of the export value of walnut kernel and 0.029% of the exportation value of walnut with hard bark was allocated to Iran [1]. While the price of Iranian export shipments is also lower than its world's average price. Such conditions are certainly not appropriate for the fourth world walnut producer. The most important barriers to export Iranian walnut shipments are the lack of uniformity in the size and quality of walnut kernel and its other morphological characters that is due to planting trees by seed origin. Most importer countries like nuts with uniform and bright kernels and it is clear that big and small or colorful commercial shipments will be unable to compete with products of competitive countries where their shipments are

offered under titles and specific standards. To produce products with high quality and uniformity and also increase the production rate, reforming old orchards, creating new orchards with superior varieties, using modern gardening methods and developing systems of post-harvest and walnut process should be considered. To do this, an accurate and codified schedule in which all aspects of walnut production be studied and measured is necessary so that increasing the competitive power of walnuts produced in the country can find an appropriate and suitable status in the global markets in near future. Northern regions of Kohgiluyeh-va-Boyerahmad (KB) Province located in ranges of the Zagros Mountain have provided a good climate condition to cultivate and develop walnuts that based on the existing official statistics and the progress of development plan in the province orchards in recent years, most orchard area of this province is dedicated to cultivating walnuts [2].

Many studies have been conducted in the field of production and marketing dried products in Iran and all over the world that we briefly mention a few cases. Hassanpour [3] economically assessed the production and marketing of dried fig which is a dried product in Iran. In his study, production functions estimation, studying channels, marketing margin and marketing efficiency were used. Sedaghat [4] examined the marketing margin and efficiency of pistachios in Fars, Iran. Using translog production function, Mehrabi *et al*. [5] economically studied the production and technical efficiency of pistachio producers in another study in Iran. In a study, Bonianian and Zangeneh [6] estimated and analyzed walnut production functions in Iran using Cobb-Douglas (CD) production function. Boajun and Yonghong [7] studied the situation of walnut marketing and export in China. Salem and Zare [8] surveyed almond marketing situation in Yazd, Iran and Moradi [9] investigated functions of almond production in another study using CD model in Kerman, Iran. About Iranian raisins being a dried product, Ghorbani and Drijany [10] studied raisins marketing efficiency and marketing factors share in the Iranian market. Wongnaa and Ofori [11] assessed the input's consumption and production function estimation of cashew which is an important dried product in Ghana. Using mark-up function estimation, Abbasian *et al*. [12] studied date marketing margin. Hassan Shahi *et al.* [13] investigated salmon marketing margin in KB Province using mark-up model. Reviewing the conducted studies shows that to economically investigate a product, it is necessary that all features of its production and marketing be examined using suitable models such as functional analysis and the estimation of marketing margin models so that the research objectives can be provided. In the present study, the research objectives are (a) to estimate and evaluate the production function, (b) Studying walnut marketing margin model in the main marketing routes, (c) determining effective factors and variables on the walnuts production; and (d) Providing appropriate solutions to improve the situation of walnuts production and marketing in Iran.

MATERIALS AND METHODS

Both methods of survey research and also completing questionnaire through interview technique were used to assess requiring statistics, information and data. The production function is usually used in economic analyses to demonstrate the relationship between inputs and outputs of a product. It should be noted that the physical rate of inputs and outputs is entered in the production function. The production function describes the conversion process of inputs and production factors to a specific product at a given time [14]. However, this function expresses the technical rate in which one or more inputs are converted to a particular product. The production function is visible as a graph, table, or mathematical form like any other functions. If the production inputs are shown by x_i ($i = 1, 2, ..., n$) and the production rate is shown by y, then the general form of the production function will be as the following:

$$y = f(x_1, x_2, ...x_k | x_{k+1}, ..., x_n)$$

That in this relation, x_1 to x_k are as variables input and other inputs are as the fixed factors of production. With these conditions, since in the above function, the production factors are divided into two fixed and variable categories and all inputs are variable in long-term, it can be said that the above function is a long-term one and is shown as the following:

$$y = f(x_1, x_2, ...x_n)$$

Value of marginal product is shown by *VMP* and includes the Rial value related to the product resulting from the application of the final unit of variable input and is calculated through multiplying price by margin product, $VMP_x = P_y \times MP_x$

Partial elasticity of production is the percentage of change in product compared to the percentage of change in variable input that the comparison of various inputs with each other can be done using this case. *e* shows the partial elasticity of production input. Since in the margin subject, we said that MP_x is equivalent to dy/dx and the average production is $AP_x = Y/X$ the elasticity of production of each input can be calculated as the following.

$$e_x = MP_x \times \frac{1}{AP_x} = \frac{MPx}{AP_x}$$

Transcendental production function is another type of Cobb-Douglas generalized functions that has firstly been proposed by Halter *et al*. [15]. The mathematical form of this function is as the following:

$$y = a_0 \prod_{i=1} x_i^{a_i} .e^{b_i x_i}, \qquad i = 1,..., n$$

where $b_i \neq 0$, $a_0 = 0$. Also, converting it into a simple linear form is necessary to estimate the function coefficients. By taking logarithm from both sides of this function, the issue becomes quite true. Logarithmic form of the function is:

$$Logy = Loga_0 + \sum_{i=1} \alpha_i Logx_i + \sum_{i=1} b_i x_i, \quad i = 1,..., n$$

It is observed that the logarithm of dependent variable or *Logy* is not only a function of the logarithm of independent variables or $Logx_i$ but also is a function of various levels of those variables (*i.e.* production inputs) or x_i. It should be noted that the coefficients b_i are equivalent to zero in the transcendental production function. Then, the general form of CD function will be emerged [16, 14].

In the above-mentioned production functions, the dependent variable is the rate of walnuts production and independent variables are the number of fruitful walnuts trees (x_1), labor (x_2), irrigation frequency (x_3), the area under cultivation (x_4), fertilizer (x_5) and pesticide (x_6), respectively.

Restricted Least Squares F test (RLS) can be used to choose the best model of the production function in the way that the amount of variables in CD model; for example, have been assumed zero; however, this provision does not exist in the transcendental model. Using the F ratio, determining the better model is done. Here, the relation F will be as follows:

$F = [(R^2_{ur} - R^2_r)/m] / [1 - R^2_{ur}/n-k)]$

where R^2_{ur} and R^2_r are the determination coefficients of estimated regression of restricted (smaller) and unrestricted (larger) models, respectively. It is obvious that the restricted model has fewer variables than the unrestricted one. Letters *n*, *k*, *m*, are the number of observations, parameters and variables added to the unrestricted model, respectively. If the value of the calculated F is significant (based on table F and freedom degrees), the transcendental model is accepted; otherwise CD model is accepted as a better production function [17]. Marketing margin has been defined as the price difference between the marketing chain rings; accordingly, three types of wholesale, retail and total marketing margins are distinguishable [18]. Marketing channels are responsible for the distribution of the product. Delivering desired product to customer in desired time and place has a great significance. The breadth of distribution domain and its role in marketing have caused scholars in the field to pay particular attention to it. This process is done through various marketing channels [19]. Wallen and Turner [20] defined the total cost in the marketing channels of products, from farm to consumer as the total marketing margin. In studying marketing margin, mark-up model is considered as the most famous models of marketing margin analyses of agricultural products [21]. This model was firstly introduced by Waugh [22]. He believed that the consumer demands are the determining factors in identifying prices on farm and retailing, in the way that the price of products on farm is equivalent to retail prices minus the total marketing margin. Later, this model was extended by Gardner [23]. Gardner emphasized that relationships between prices on farm and in retail can be expressed based on changes occurred in the supply or demand stage. Also, in this model, the relationship between marketing margin and retail price has been considered as a fix relationship. In this model, marketing margin is considered as a function of retail price and marketing costs.

$M_m = f(P_r, Z)$

$$M_m = \alpha_1 + \alpha_2 P_r + \alpha_3 Z + e_i$$

In these relationships, M_m is the cost difference between the walnut price on farm and being ready to supply in the retail level. In the above model, P_r is the price of the product in the retail level and Z is the cost of marketing.

Marketing efficiency is an index that shows the added value of available marketing system against 100 Rial service costs of walnut marketing. In the study, Shepherds *et al* method [19] was applied to determine marketing efficiency. The related formula is expressed as the following.

$$Efficiency = (M_{va} / M_c) \times 100$$

where M_{va} is the value-added of marketing and M_c is cost of marketing services. The value-added of one kg walnut is calculated as the following.

M_{va} = *Retail price - (M_c + Farm gate price)*

Based on the obtained number, the more the rate of efficiency is closer to 100, the more the market is efficient in the way that the value of 100 reveals the maximum efficiency. Also, if the obtained number is greater than 100, it can be said that the market efficiency is low.

RESULTS

Based on the aforementioned production functions, both walnut production functions including Cobb-Douglas and transcendental were estimated using multiple regression. The results of the aforementioned functions are listed in Table1. In the above production functions, the dependent variable is the amount of walnuts production and independent variables are the number of walnut fruitful trees (x_1), labor (x_2), the number of irrigation (x_3), the area under cultivation (x_4), fertilizer (x_5) and pesticide (x_6), respectively. Given the F statistics, in walnut production functions, both regressions are statistically significant in the probability level of (P = 0.01). This issue indicates that the hypothesis H_0 is rejected based on rejecting all estimation coefficients in each production function. Also, the behavior of residuals was studied in the aforementioned regressions; the hypothesis of heteroscedasticity among residuals was reviewed. Restricted least squares F-test was used to select the best production function (Cobb-Douglas or transcendental) and it was determined that F-value is greater than critical value (*i.e.* F=28.461>3.349). Thus, the test is significant in the probability level of (P = 0.01). Therefore, the transcendental production function is preferred to Cobb-Douglas production function. The R^2 value of transcendental functions producing walnut was estimated equivalent to 0.857 in KB Province. So, it indicates that 85.7% of changes in the value of walnut production in the province (dependent variable) are explained by the abovementioned independent variables. Durbin-Watson (DW) test was used for autocorrelation test. According to the value of DW=2.33, the lack of existing autocorrelation is confirmed in the probability level of (P = 0.01) because the condition of $[d_u<DW<4-d_u]$ or 1.74<2.33<2.67 is accepted.

Table1: The regression results of Cobb-Douglas and Transcendental walnut production functions in KB Province

Variables	Transcendental Model			Cobb-Douglas Model		
	t-value	Standardized Coefficients	Coefficient	t-value	Standardized Coefficients	Coefficient
Constant	4.273	-	3.707	1.100	-	1.337
x_1	10.357	0.684	0.013	-	-	-
x_2	-0.221	-0.013	-0.007	-	-	-
x_3	1.279	0.085	0.026	-	-	-
x_4	-1.305	-0.071	-0.037	-	-	-
x_5	0.065	0.005	-2.405	-	-	-
x_6	-1.278	0.067	-0.031	-	-	-
lnx_1	4.425	0.303	0.521	8.587	0.745	1.284
lnx_2	2.007	0.122	0.282	-0.252	-0.023	-0.052
lnx_3	0.191	0.013	0.030	0.418	0.036	0.085
lnx_4	-0.684	-0.036	-0.072	-0.270	-0.023	-0.046
lnx_5	-1.134	-0.078	-0.143	-0.167	-0.014	-0.026
lnx_6	-0.019	-0.001	-0.002	0.886	0.076	0.166
R^2		0.857			0.560	
F		28.461			13.358	
DW		2.33			1.953	
N		70			70	

(-) Non-estimated values

The results of descriptive analyses in the study of walnut marketing channels show that walnut growers sell their produced walnuts in four ways: pre-sales, cash-sales, cheque-sales and installment-sales that in terms of frequency, cash-sales with 9.42% has the highest frequency and installment-sales with 2.9% has the lowest frequency. The

experience of beneficiary's activities and production show that 50% of beneficiaries have an experience between 1 to 15 years. Also, 35% of them have chosen horticulture profession as their first career and are still doing their job.

Calculating the share of marketing factors i.e. producer, wholesaler and retailer is obtained from the final price of product that is the same retail price using the following relations:

$$\text{Producer share} = \frac{\text{Farm gate price average}}{\text{Retail price average}} \times 100 = \frac{62643}{101000} \times 100 = 62.02$$

$$\text{Wholesaler share} = \frac{\text{Retail price average} - \text{Wholesaler price average}}{\text{Retail price average}} \times 100 = \frac{101000 - 80700}{101000} \times 100 = 20.1$$

$$\text{Producer share} = \frac{\text{Wholesaler price average} - \text{Farm gate price average}}{\text{Retail price average}} \times 100 = \frac{80700 - 62643}{101000} \times 100 = 17.88$$

These results indicate that the share of walnut producers, wholesalers and retailers from the retail price is 62, 20.1 and 17.9%, respectively. Based on the obtained results, the retail share from the final walnut price is lower than that of producer and wholesaler.

Table 2: Value of margin and the share of walnut marketing factors (kg-Rial)

Description	Producer	Wholesaler	Retailer	Total Marketing
Margin (Rial)	-	18057	20300	38357
Share (%)	62.02	20.1	17.88	100

Source: Research findings

Table 3: Results of the estimation of walnut marketing margin function using mark-up model

Variables		Mark-up Model	
Variable	Variable Description	Coefficient	Statistic t
C	On farm sale	-6985	-1.76
P	retail price	0.97	2.73
Z_1	transportation cost	19.4	2.02
Z_2	packaging cost	-6.44	-0.89
Z_3	Marketing price	-1.55	-0.43
R^2=0.77	, F=21.49	,	P=0.01

Source: Research findings

The empirical form of the model presented in this study is as the following:

$M_m=\alpha_1+\alpha_2 Pr+\alpha_3 Z_1+\alpha_4 Z_2+\alpha_5 Z_3+e_t$

In these relations, M_m, P_r, Z_1, Z_2 and Z_3 are total marketing margin, retail price, transportation cost, packaging cost and other marketing costs, respectively. Results obtained from marketing margin function estimation using Mark- up model is shown in Table 2. Marketing margin has a direct and significant relation with retail price in the way that a unit increase in the retail price causes 0.97 unit increase in marketing margin. The coefficient of determination (R^2) in this model indicates that about 77% of variations in the walnut market margin are explained by variables entered in the model.

As it was previously said, the marketing efficiency is resulted from marketing value-added divided the total marketing cost multiplied by 100. Since according to table 4, walnut marketing efficiency is 138 and this number is greater than 100, it can be acknowledged that walnut marketing has not efficient in KB Province.

Table 4: Walnut marketing efficiency in KB Province

Description	Value (Rial)
Added value	35643
Marketing cost	25713
Marketing efficiency	138.6

Source: Research findings

DISCUSSION AND CONCLUSION

In studying the effective factors on fluctuations of walnut production, in the view of producers, results of descriptive analysis in the priority order include frost, drought, the lack of government support, being poor walnut with a very low price in the market, fluctuation in the supply and demand, increasing in the cost of production inputs, the shortage of capital and liquidity and the lack of proper management of marketing and production. These abovementioned factors are the most important factors affecting fluctuations in walnut production in orchards of KB Province. Given the estimation of the best walnut production function, averagely 0.87% of changes in walnut production in orchards have been explained by variables such as the number of fruitful walnut trees, labor, and irrigation frequency, the area under cultivation, fertilizer and pesticide. According to the calculating t values of coefficients of the explanatory variables, out of other results of the research, it can be said that the number of fruitful walnut trees and labor are statistically significant and have positive and direct relationship with walnut production.

Other production factors including irrigation frequency, the area under cultivation, fertilizer and pesticide that have not statistically significant relationship with the production value were eliminated from the model. Rate to return can be determined from total elasticity of production in production function. Results show that the elasticity of fruitful walnut input is twice more than the elasticity of labor input and shows the importance of the number of fruitful walnut in the province orchards. Returns to scale is about 2.064 in the studying samples which is an indicative of increasing return to scale (IRS) in walnut orchards. That is if the production factors are increased 100 units, the rate of production will increase 2.064 units. In their findings, Banaeian and Zangeneh [6] also concluded that labor has a positive relation with walnut production and also estimated the increasing return to scale in their production function. In the next section of the research, studying the walnut marketing channels showed that in terms of frequency, cash-sales with 42.9% has the maximum frequency and installment-sale with 2.9% has the lowest frequency. The experience of beneficiaries' activities and production show that 50% have experience between 1 to 15 years. Also, 35% have chosen the horticulture profession as their first career and are still doing their job. Calculated marketing margin showed that the share of producer from the final walnut is more than the share of wholesaler and retailer and the share of wholesaler is more than the share of retailer. Given that the wholesaler does little marketing services, wholesaler receives the maximum net profit. The efficiency of walnut marketing path has been determined as 138% in the province after calculating, that this issue is contrary to the theory of social welfare and is the indicative of weakness of walnut marketing system from production stage to consumption stage in KB Province. Hassanpour [3], Sedaghat [4], Salem and Zare [8], Ghorbani and Darijany [10], and Hassan Shahi *et al.* [13] studies have confirmed the existence of low marketing efficiency and also unconventional marketing margin in their studying products. Given the results of this study, the following recommendations can be considered:

1. It is recommended that continuous trainings be provided by state for walnut growers on the management of using inputs, controlling pests and fight with them and identify desirable and improved species.
2. In order to increase income and improve the situation of walnut producers, it is suggested that government (*i.e.* Departments of Commerce and Jihad-e-Agriculture) enter into the market as observers and controllers and inform the producers about various conditions of the market and increase the market efficiency by improving the flow of information and market transparency.
3. Due to the low quality of packaging, net profit marketing factors such as packaging units is highly unfair. Although the presence of these elements in marketing is essential in marketing, it is suggested that each of the elements of marketing benefit based on services which they provide.

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