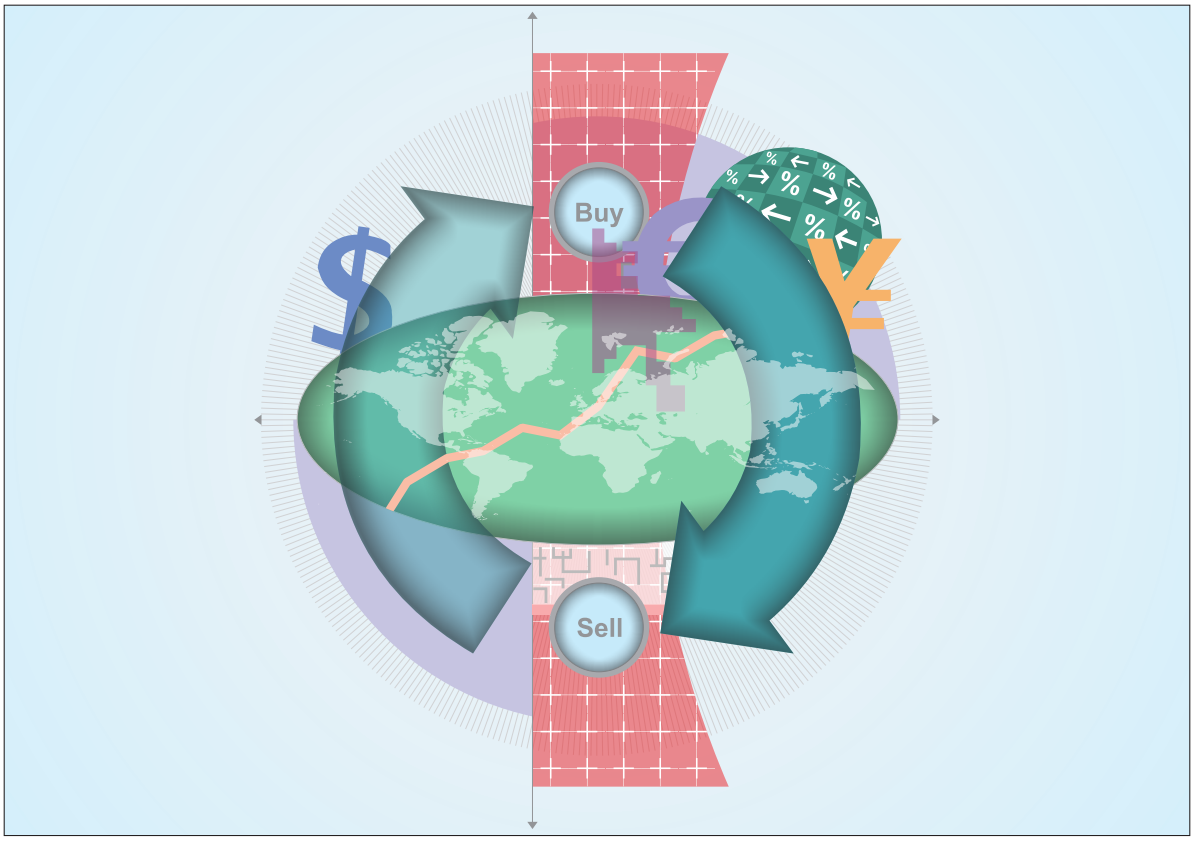

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The Econometrics of Investment in Date Production in Saudi Arabia

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ABSTRACT

Date palm is an important fruit crop in the Kingdom of Saudi Arabia and bears a lot on the national economy. Therefore, the government is paying special attention to date production through price support of low grade variety and providing subsidies to the most important production variables. The main objective of this study was to optimize the net present value of revenue to build a structural function of planting new date trees to explain and measure the investment decision. Because of inadequate information in this area, only the past investment period was considered to determine the effect of past decision on new decision of investment. The government policies, which directed to low grade varieties probably, led to inefficiency as the domestic consumption of dates is very high and growing high quality will lead to higher revenue to farmers with almost the same cost of production. To deal with investment in date palm production locally, Saudi Arabia needs to estimate a very high discount rate to observe any value related or based on the discount rate. The Durbin Watson parameter is significant for both the varieties (Khalas and Ruzaiz) at 95% confidence interval ($LSD_{0.05}$). The past investment appeared very significant for its effect on planting new date trees due to the fact that farmers who planted new trees in the past is continuously carrying with date industry and investing in future. Overall, the investment in tree plantation like date palm is not an easy decision by the farmers, because it needs couple of years spending without revenue. The farmers in the date growing areas were hesitant in providing information about the date variety, number of trees per hectare, tree age, fertilizers, pesticides, land ownership, intercropping, cost of production, total yield, quantity sold and price received. The study suggested further investigations on growing high quality date palms, date production and marketing aspects to harvest maximum profit by the farmers as well as support by the government for facilitating proper market and subsidies to date growers.

Key words: Net revenue, date variety, cost of production, price fluctuation, domestic consumption, marketing, farmer's profit, government subsidies

INTRODUCTION

Date palm is an important fruit crop in the Kingdom of Saudi Arabia. Its production ranged from 0.941 million tons (2004) to 0.986 million tons (2008) in different regions of Saudi Arabia. There are more than 15 millions date palm trees in the whole kingdom which produce date fruit valued at $2.12 billion according to the base price of 2006 (MOA, 2008). The government is paying special attention to date production through price support of low grade variety and providing subsidies to the most important production variables. However, the nature of investment in planting date palms, characterized by long term investment crop beside structural changes, is playing an important role in Saudi's Economy. Many factors play an important role in the decision

making of such investment. Among these, the most critical are the expectation about price of each verity, farmer's expectations and believes about government policies, tree age, operational cost and revenues. Therefore, the nature of growing date palms for date production is of a dynamic rather than static structure. Hence, this type of study needs to focus on some distributed lags about prices of this product. Nerlove (1958, 1986) used dynamic analysis model to estimate field crop investment function and short run supply function using expected prices and simultaneous equations of prices and production function. Wiknes and Greenfield (1973) applied Nerlove's model to estimate the coffee supply in Brazil. They used different strategies to test and analyze the adhoc of the model. Date Palm trees have similarity with the coffee production. Because in this case, it is a tree which takes long run investment. The only difference between these two crops is that the date palm takes about 5-6 years to grow without bearing fruits and hence no revenue in this period. Therefore, the application of Nerlove's model may not be appropriate and consistent with their findings due to the effect of local government's policies and also due to the domestic consumption of the total dates production which amounts to about 93% (MOA, 2009).

Osman and Al-Besher (1986) studied the econometric analysis of date palms production cost in Al-Hassa. They found that labour was the most important input in date production. Also, growing citrus with palms, quantity sold and the received price were significant variables in the econometrics analysis of date production cost. Also, Othman (1986) studied the econometric of cost function in date palm production and its impact on farmer's decision". He concluded that date production and its price are subjected to variety, cost of production and the intercropping in date orchard.

Abdul Razak (2010) studied the economics of date palm agriculture in the Sultanate Oman, current situation and future prospects. He emphasized the importance of specialized research programs, improving production, tissue culture propagation, best agricultural practices, integrated pests management, gene banks, processing, marketing, storage, capacity building and promoting date palm and its products in date palm agriculture towards sustainable development. Alseleem (1998) worked on econometric analysis of dates cost functions in the Kingdom of Saudi Arabia. He stated that optimal scale of operations (economic efficiency) would be achieved at 25.19 metric tons of dates per farm, profit maximization would be achieved at 36.91 metric tons per fadan. He also calculated supply price elasticity (Es,p) of dates which was very Iow. Al-Hebshi (2010) concluded based on the feasibility study of net revenue \$ ha^{-1} for a farm in Wadi Hadramout during 2002 to 2006. He found that the net revenue is negative for the farmers. In 2006, the farmer's loss was 233 \$ ha^{-1}. While the middlemen gained a profit of about 4,256 \$ ha^{-} ,^{1} for the same year which means that the net marketing margin was 244% for the middlemen profit. OECD (2006) studied the primarily dynamic models of crop investment. The province of Manitoba was selected as an example of Canadian prairie crop production and investment was defined as current expenditure on machinery and equipment for Manitoba crop production. Econometric results were used to simulate impacts of agricultural programmes on crop investment. Azhar (2007) reported that to attain national economic development on the road to maximizing income through optimum utilization of resources, the national policies should focus on crop diversification and value added agro-based industrialization. A study by Mohammad *et al.* (2001) investigated the impact of government rural development expenditure, a proxy for government policy, particularly, public investment on the supply response of three major perennial export crops. The response of cocoa producers to government expenditure is elastic in the long run, while yield has remained fairly stable. According to Sekhar (2003), "the essence of structural equation model is an explanation of

the movement of endogenous variables in terms of the exogenous variables. To gauge the impact of increasing the cocoa bean area a simulation exercise was conducted to find out 'what if' the declining trend in the cocoa area since the early 1990s is replaced with an increase of the area at an assumed annual growth of 10%.

Keeping in view the current date production and its local consumption, it is important to study the date production and its effect on national economy. The main objective of this research was to develop a model that will explain the most important and significant factors that affect the decision of progressive date growers to plant new trees using new land or replacing the old date palm orchards. Also, the study investigated the effect of prices and distributed lags of past investment on decision making for planting new date palms.

Statistical analysis: The data was analyzed by following ANOVA and regression analysis between different variables according to the procedures given in Statistical Analysis System (SAS) User's Guide (SAS, 1984).

MATERIALS AND METHODS

The data for this investigation was collected from the Ministry of Agriculture (MOA, 2008, 2009). The study used the current prices and current product to estimate the gross margin of specific date palms of specific variety which survived over a long period of time. According to the recent estimates, the cost of one kg date ranged between $ 0.8 to more than $ 5 per kg (MOA, 2009). The net revenue will be discounted from the current discounted rate. Because when the farmer invest in planting new palm trees, it means that the product will be received within 40 years. A part of the date palms planting investment was used in the estimation and the government policies were considered and used as dummy variables. Because these were directed mostly to low grade variety i.e., the government must purchase only specific percentage of low grade at good price (higher than the market price).

A total of 200 farms were surveyed to obtain information about the farm size of various date growing areas, ownership, number of palms, tree age, fertilizers, pesticides, labour, operational cost, quantity sold, price achieved and irrigation water applied etc., in Al-Hassa Oasis. There was a great deal of difficulty and inconsistency in obtaining these information for various functions of the model while interviewing the farmers.

Presently, there are many varieties being sold at different prices. In order to construct investment model in date production, two main date varieties of high quality (Khalas) and low quality (Ruzaiz) dates were selected. The average price per kg of these dates ranged from $ 4.0 and $ 0.75 for khalas and Ruzaiz, respectively (MOA, 2009).

Investment and production function: The net present value of revenue was derived to maximize the farmer's profit in order to include in the model. Initially, the total production or the investment of potential product was considered using the following equation according to Smith (1959):

$$\zeta_t = \Sigma^{t}_{i=0}\mu_i * T_t$$

where, ζ_t is total production of growing palm trees from planting time to the time of survival for a specific variety which is either high quality or low quality. μ_i is the average productivity of the number of trees planted at full time t.

Therefore, the production of the dates depends only on the number of trees. Because, the labor and land were assumed to be components of the numbers of trees which represent the capital investment.

Further, to calculate the net present value of revenue from one hectare, the operational cost of producing date including the harvesting cost was considered from the information provided by the date growing farmers about the specific variety of palm trees. Additional factors such as land preparation, fertilizer use, irrigation water applied and other inputs were incorporated that affect the tree planting cost (fixed), the subsidy and other incentives given from the government on production of dates. So the expected net present value (discounted) of revenue of producing dates in one donnum (1000 square meter) will be as follow (Nerlove, 1986):

$$\Re_t^e = \sum_{t=0}^{t} \frac{1}{(1-r)t}\left[(p_t^e - C_t^e)\delta_t + g(T_t) - f(T_t)\right]$$

where, p_t^e is expected price of specific variety of date based on the average of 10 years prices, C_t^e is expected cost of production include harvesting cost, g (T) is some function of number of trees which represents the subsidies and incentives provided from government. (dg/dt)>0 and (df/dt)>0 and f (T) is the planting cost and is a non-linear function.

RESULTS AND DISCUSSION

The total area under date palm cultivation ranged from 141,421 hectares to 157,074 hectares during 2003-2008 growing season (Table 1). There was a marginal increase in the area under date cultivation. The slight increase in area under date cultivation could be attributed to the incentives provided by the Government to small farmers in terms of subsidies such as fertilizers, short term loans, pesticides, high price and market facilities. Similarly, the total date production ranged from 884,088 metric tons to 986,546 metric tons during 2003-2008 growing season (Table1). The slight increase in total date fruit production could be due to the slight increase in total area brought under date palm cultivation.

The results showed the effect of age on date production with respect to high quality and low quality date cultivars (Fig. 1). It was observed that initially, young palm trees with less than 15 years of age, the production of dates is low, then started increasing substantially and reached to peak production of 78 kg per tree with an age of 25 years which then declined with increasing age of date palm trees. The decline in date production with increasing age could be due to the age factors and, possible reduction in the fruit bearing capability of the old palm tree subjected to varying environmental conditions.

Table 1: Estimated area and production of dates in the Kingdom of Saudi Arabia from 2003-2008

Year	Total area (hectares)	Date production (metric tons)
2003	141,421	884,088
2004	148,8019	941,293
2005	150,744	970,488
2006	152,402	977,036
2007	155,734	982,546
2008	157,074	986,409

Source: MOA (2008) and MOA (2009)

Fig. 1: Effect of age on the production response of high and low quality variety (MOA, 2009)

Therefore, the net value of revenue per donnum could be maximized by selecting optimal numbers of palm trees per donnum and the high yielding date palm trees. The First Order Condition (FOC) of the above function with respect to g_t and T_t implies that it is important to explain the mechanism of date production and the nature of productivity expected from the farmers should continue by growing new palm trees in specific land (say one donnum) till the net present value of marginal cost of that tree equals the net present value of marginal revenue from the future production expected from that tree.

It was observed from Fig. 1 that the palm tree started to produce dates after fifth years of age with very low production and increased over time till reaching the maximum production between 25-30 years of age, then the production went down dramatically after 40 years old. Later on, the date tree continued to produce very little up to the age of fifty. This suggested that the net present revenue value goes up as the farmers has mid-age trees. It is further interesting to note that if farmer has commonly very young trees, he is not going to invest any more and will have enough income to do so. But on the other hand, if the farmer has middle aged and old trees which produce less, then the status will encourage the farmer to invest more for high date production for two possible reasons. 1): He is rich enough and has the resources to invest and 2): He is much concerned that old trees will bring his net revenue down continuously. These functions: $\partial f/\partial t_t$ will represent the date of growing as a function of capital prices of the current season (2008) and past prices were used as approximation in predicting expected price for each variety in the net present value of revenue.

Hence, the study developed a model to represent the area to be planted by new date palm trees of each variety as a function of net present value of revenue expected, the past investment in planting palm trees and the government policies which were used as dummy variables.

Overall, 200 farms were surveyed to obtain this function having different sizes of date growing areas and the number of trees planted in the past. The model is given below:

$$\Pi_t^i = \alpha 0 + \beta_1 It-1 + \beta_2 R_t^* + \beta_3 Gt$$

where, i represent different varieties, b_1 is the past investment in planting old trees, b_2 is the net present value of revenue from planting palm tree and b_3 represents the subsidy provided by the Government to support date palm cultivation.

As mentioned above, two varieties namely Khalas (high grade) and Ruzaiz (low grade) were used and reported in this model. The result was summarized as follows:

$$I_t^H \text{ (highgrade)} = -42.074 + 0.173\, I_{t-1} + 1.03\, R_t^e - 2.7\, G_t$$
Standard errors (-2.7) (0.088) (0.945) (-1.670)

$$R^2 = 0.65,\ \text{D.W.} = 1.89$$

$$I_t^L \text{ (lowgrade)} = -18.27 - 0.849\, I_{t-1} - 2.1\, R_t^e + 3.546\, G_t$$
Standard errors (-4.25)(-0.138)(-1.705)(1.297)

$$R^2 = 0.59,\ \text{D.W.} = 2.1$$

where, R^2 is coefficient of determination and D.W. is Durbin Watson parameter which indicate level of significance and the figures in parentheses represent the standard errors.

Some coefficients were significant at 5 % level of significance ($LSD_{0.05}$) while the others were not significant at 95% confidence interval. The Durbin Watson parameter is significant for both the varieties (Khalas and Ruzaiz) at 95% confidence interval. The past investment appeared very significant for its effect on planting new date trees due to the fact that farmers who planted new trees in the past is continuously carrying on with date industry and investing in future. Also, the Government policies involved in date production providing incentive in terms of subsidies were significant at 95% level of confidence which is very surprising.

Since most of the support from government is directed to low grade date cultivars and this lead to a kind of uncertainty in the decision making of planting new trees. For example, the farmers who decided to get involved in government program, he will avoid planting high grade date cultivars and vice versa the net present value of revenue seems to be insignificant due to the use of discounted rate on low grade date cultivars and is misleading. Because, there is no interest rate in the Kingdom and farmers get loans from government (Agricultural Bank) without interest. Above all, the use of current and past prices as approximation led to different values of revenues.

The study findings highlighted the importance of date prices, yield obtained, date variety and date quality, farm inputs, incentives provided by the Government in terms of inputs, past investment in growing date palms and the financial status of date growing farmers on the investment in date palm cultivation. Similar results were reported by Osman and Al-Besher (1986) who reported that labour was the most important input in date production. Also, growing citrus with palms, quantity sold and the received price were significant variables in the econometrics analysis of date production cost. Similarly, Othman (1986) concluded that date production and its price are subjected to variety, cost of production and the intercropping in date orchard. Also, Abdul Razak (2010) emphasized the importance of specialized research programs, improving production, tissue culture propagation, best agricultural practices, integrated pests management, gene banks, processing, marketing, storage, capacity building and promoting date palm and its products. Whereas, Alseleem (1998) stated that optimal scale of operations (economic efficiency) would be achieved at 25.19 metric tons of dates per farm, profit maximization would be achieved at 36.91 metric tons per fadan. Al-Hebshi (2010) concluded that the net revenue is negative for the farmers. Because, in 2006 the farmer's loss was 233 \$ ha^{-1}. While the middlemen gained a profit of about 4,256 \$ ha^{-1}, for the same year. OECD (2006) studied the primarily dynamic models of crop investment and the econometric results were used to simulate impacts of agricultural programmes on crop investment. Azhar (2007) stated that to attain national economic development on the road to maximizing income through optimum utilization of resources, the national policies

should focus on crop diversification and value added agro-based industrialization. A study by Mohammad *et al.* (2001) stated that the response of cocoa producers to government expenditure is elastic in the long run, while yield has remained fairly stable. According to Sekhar (2003), the essence of structural equation model is an explanation of the movement of endogenous variables in terms of the exogenous variables for increasing the cocoa bean area.

CONCLUSIONS

Optimization of net present value of revenue was applied in this study to build a structural function of planting new date trees in order to explain and measure the investment decision. Because of inadequate information in this area, only the past investment period was considered to determine the effect of past decision on new decision of investment. Government policies which directed to low grade varieties probably led to inefficiency as the domestic consumption of dates is very high and growing high quality will lead to higher revenue to farmers with almost the same cost of production. To deal with investment in date palm production locally, Saudi Arabia needs to estimate very good discount rate in order to observe any value related or based on the discount rate. The Durbin Watson parameter is significant for both the varieties (Khalas and Ruzaiz) at 95% confidence interval. The past investment appeared very significant for its effect on new date tree planting due to the fact that farmers who planted new trees in the past is continuously carrying in the date industry and investing in future. Investment in tree plantation like palm date is not an easy decision by the farmers, because if needs couple years of spending without getting revenue. The study laid special emphasis for further investigations on date palm cultivation, date production and marketing aspects to harvest maximum profit by the farmers as well as support by the Government for facilitating proper market for date growers.

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