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Investigating the factors affecting the tendency to greenhouse organic cucumber production in Yazd, Iran

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Abstract

The primary greenhouse product in Yazd Province, both in terms of cultivation area and production, is cucumber. The area under cultivation for greenhouse products in the province is more than 1000 hectares producing more than 300 tons per year. However, the increasing greenhouse production in this province has been accompanied by a rise in the use of fertilizers and pesticides. Therefore, it has become necessary to reduce the reliance on chemicals in greenhouse cucumber production. The objective of this study was to investigate the factors influencing the transition to organic agriculture among greenhouse cucumber producers in the province. This research employed a descriptive-survey methodology, collecting data through questionnaires and face-to-face interviews with 144 greenhouse cucumber producers. Data analysis included descriptive statistics, t-tests, and a logit econometric model. Among the 144 greenhouse cucumber producers, 59 expressed a positive inclination toward adopting organic farming practices, while 85 displayed no such interest. The findings revealed that the primary obstacles to organic product production include a lack of knowledge among producers regarding organic farming practices, insufficient government support for organic farming, the perceived high risks associated with organic farming, the absence of a dedicated market for organic products, and limited knowledge and skills in this domain. The results from the logit model indicated a significant positive relationship between the desire to transition to organic farming and factors such as production history, age, education level, sanitation practices, a positive environmental attitude, and the inclination towards organic farming. Conversely, there was a significant negative correlation between the use of chemical fertilizers and pesticides and the desire to switch to organic farming. Given the lack of information on technical, managerial, and sales aspects of organic products, it is imperative for the government to provide support and oversight in this sector.

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Introduction

The Problem

The overarching objectives of organic farming encompass the production of high-quality food that aligns harmoniously with nature and the environment, fortifying environmental cycles, enhancing soil fertility, conserving genetic diversity, and fostering a safe and healthy ecosystem. While numerous countries have embraced organic farming practices, the absence of a well-established market for organic agricultural products in Iran has led to significant risks, discouraging farmers from engaging in organic production. Consequently, it is imperative to gauge farmers' interest in organic production through rigorous scientific analyses, such as an econometric approach.

In this context, exploring the factors that influence the inclination of greenhouse cucumber farmers in Yazd Province toward organic production can be instrumental in potentially establishing a market for organic products. Despite the Iranian government's efforts to promote organic farming awareness among farmers and professionals, provide subsidies for bio-fertilizers, encourage biological pest control, and support non-governmental organizations involved in this transition, several obstacles hinder the sector's development. These challenges include the absence of a dedicated organization for official support of organic production, the lack of regulatory frameworks for organic production, the absence of scientifically accredited certification agencies adhering to European and global standards, insufficient cultural promotion to encourage the consumption of organic products across various segments of society, including producers and consumers, inadequate support for research and implementation, and a lack of well-equipped laboratories for assessing chemical waste (Ghorbani, 2008).

Increased greenhouse production in Yazd Province has been associated with increased use of fertilizer and pesticides in such a way that according to the studies each year at least 250 tons of Vapam, 20 tons of fungicides, 20,000 liters of insecticides and acaricide and 400 tons of chemical fertilizers are used in greenhouses of the province. The increased use of chemicals leads to environmental degradation and pollution, loss of biodiversity in ecosystems and also will reduce the food quality and cause accumulation of harmful substances in the foods and human exposure to a variety of diseases. Hence, to reach a sustainable agriculture and production of healthy organic greenhouse products, it is necessary to reduce the use of chemicals in the province greenhouses. In recent years, the relatively appropriate price of organic products in the market, a relatively high yield per unit area, payment of substantial banking facilities and use of limited agricultural resources have provided reasons for more development of the greenhouse production in Iran. Greenhouse development, especially in the central and southern parts of the country affected by drought, could be a solution to increase income and employment in the agricultural sector.

Due to the presence of abundant domestic resources, high efficiency and profitability of greenhouses, high rates of return on investment, relative simplicity of production technology and the possibility of innovation in greenhouses, their consistency with environmental conditions, the possibility of inclusive participation of women and youth in their development process and direct and indirect job creation, the greenhouse production in our country have been more seriously considered by authorities leading to significant greenhouse development. Yazd Province with 3697 greenhouses covering 1037 hectares is ranked third (about 18.2%) among the provinces of Iran (Ministry of Agriculture, 2015). From this area, 687 and 279 hectares are located in tow cities, Yazd and Ashkezar, respectively. Two other cities, namely Taft and Mehriz rank third and fourth respectively (Yazd Agriculture Organization, 2015). According to the studies, the important factors involved in greenhouse development and activity can be divided into economic and non-economic factors (Acs, 2006). Some studies have focused on financial and economic

issues of converting to organic agriculture. For example, organic dairy farms were investigated and the results showed that the high cost of combination fertilizers and concerns about the environment are the main reasons farmers choose organic methods (Sholubi et al., 1997). In order to investigate how farmers, choose between conventional and organic farming in New Zealand, 83 farmers were interviewed and using decision tree reached the conclusion that incentive policies should focus on attitudes, technology and financial issues (Fairweather, 1998). A study entitled bio-economic modeling of conversion from conventional agriculture to organic farming in the Netherlands concluded that for risk-averse farmers, conversion is not desirable unless incentive policies such as subsidies on fertilizer and pesticides used in organic production or sales prices of organic products become more stable (Acs, 2006). In another study to determine the factors affecting the choice of organic methods in a fresh products section in California 175 farmers chose fresh products and using logit regression analysis concluded that the variables of total sales, direct marketing, yield and area under cultivation, farmers' age and computer use were significant (Anderson et al., (2005). In order to evaluate how interested are farmers of corn and wheat in organic and non-organic farming methods in Ohio, a number of 320 farmers were interviewed and their responses showed their positive interest in non-organic methods and a negative interest in organic farming methods (Hall et al., 2009).

The factors affecting potential demand for agricultural credit in favor of organic greenhouse cucumbers, a study was conducted in Khorasan Razavi Province. The results showed that average financial requirement to invest in organic greenhouse cucumbers is 30 million IRR, the funding required for the adoption of organic greenhouse cucumber production is 328 million IRR (in a greenhouse with an average area of about 2,700 square meters) and the proposed interest rate is 82.4 percent. Around 66.7% of farmers invested in the credits for purchasing organic fertilizers, 66.7% of farmers invested in the credits for purchasing biological control services, and 86.7% of them for creating an appropriate agricultural environment while 53.3% of farmers purchased the mechanical combat services. Also, the relationship between variables such as the main profession of farmers, farming experience, agriculture monitoring, financial power and marketing information for investment and potential demand for the production of organic cucumbers was negative and the relationship between farmer's age, crop insurance, average current yield of conventional cucumber farming, information about organic cucumber, extension classes and potential demand for credits was positive. According to the findings, creation of organic product marketing information system, encouragement to fulltime farming, increase in farmers' income towards better investment, hiring agriculture monitors and promoting their role in greenhouse production and insurance are proposed (Ghorbani et al., 2011). In a case study on tomato farmers in Alborz Province, the factors affecting the transition to organic farming were examined and the results showed that conventional farmers have little information about technology, management, laws and regulations related to cultivation and processing of organic products. High risk of organic farming and the lack of sufficient support by the government were the major barriers to the activities related to the organic farming (Sadeghi et al., 2011).

The aim of this study was to investigate the factors influencing the interest in the transition to organic agriculture in greenhouse cucumber producers of Yazd Province. Also, producers' information on organic farming, barriers and major factors influencing the tendency to produce organic products was studied.

Materials and Methods

This research employed a descriptive-survey methodology, utilizing questionnaires and face-to-face interviews as data collection instruments. The study's target population encompassed all greenhouse cucumber producers in Yazd Province. To ensure representative sampling, the cluster-

weighting sampling method was adopted. Among several variables, such as cultivated area, utilization volume, and production rate, the choice of cultivated area per city was based on its stability and data availability. Subsequently, Cochran's correction formula (1977) was applied to estimate sample sizes for each city, proportional to their respective cultivated areas, with the condition that each city had at least one sample. Producers were then selected through systematic random sampling within each city. By referencing the Yazd greenhouse licensing system, their contact information and addresses were obtained. A total of 144 greenhouse cucumber producers were selected for face-to-face interviews and questionnaire administration. The majority of the samples were drawn from Yazd city (86 individuals), followed by Ashkezar (32 individuals) and Taft (14 individuals).

A t-test was used to compare the mean of the two groups of producers with willingness and unwillingness to produce organic products. The null hypothesis of the study stated that there is no significant difference or relationship between the mean of two mentioned groups, however the hypothesis (1) stated that there is a significant difference between the groups. In some regression models, dependent variable or function may be qualitative; and in our study, the qualitative variable represented the two groups with a value of 0 and 1. The goal of the study was evaluating the interest in organic farming considering variables such as age, experience and education level, and willingness to organic farming, or lack thereof. In other words, the dependent variable here is the willingness and it could have two values, 1 for a person who is willing to adopt organic farming and 0 who is opposed to organic farming. For analysis, we could use three models of Linear probability (LPM), logit and Probit. Due to the advantages of logit model, we used this model in our research to estimate the model as follows. If X is the level of education as the independent variable and Y is the tendency to do organic farming as the dependent variable, Yi is divided into two groups: Y = 1 if producers are interested in organic cultivation and Y = 0 if producers are not interested in organic cultivation. In such models in which Yi is divided into two groups, the logit model is appropriate. If we consider the following model:

$$Pi = E(y = 1) = \frac{1}{1+e^{-(\beta_1+\beta_2 X)_i}} \quad (1)$$

where, e is the natural logarithm base. For convenience, the above equation can be rewritten as below:

$$P = \frac{1}{1+e^{-z_i}} \quad (2)$$

where $z_i = \beta_{1+}\beta_2 X_i$. The above equation is known as cumulative logistic distribution function. As it is noticeable, P_i is non-linear not only in terms of X but also in terms of β. This means that the usual OLS method cannot be applied to estimate the parameters of the mentioned model, anymore. But it is easy to convert it to the following equation which has a linear relationship based on the chosen parameters.

If Pi or the probability of willingness to organic farming, is expressed by equation (2), then (1-Pi), the probability of not willing to organic farming, is expressed as follows:

$$1 - P_i = \frac{1}{1+e^{z_1}} \quad (3)$$

Thus:

$$\frac{P_i}{1-P_i} = \frac{1+e^{z_1}}{1+e^{-z_1}} = e^{z_1} \quad (4)$$

Simply, $\frac{P_i}{1-P_i}$ is the incident possibility on its alternative that represents a level of probability of interest in organic farming or no interest. If we take the natural logarithm from the equation (4), we obtain the following result:

$$L_1 = \ln\left(\frac{p_i}{1-p_i}\right) = z_i = \beta_{1+}\beta_2 X_i \quad (5)$$

Equation (5) shows that L is the logarithm of superiority or advantage and it is linear not only in terms of X, but also according to the used parameters. Equation (5) is known as logit model. In the above equation, beta (the slope coefficient) measures the change in L for one unit change in X, or on the other hand it measures the rate of change in the logarithm of superiority or advantages (tending to organic farming) in exchange for a unit change in educational level.

Results and discussion

Characteristics of the studied Exploiters

To explore the characteristics of greenhouse cucumber producers, various factors such as greenhouse size, production rate, age, experience, education level, participation in training programs, ownership type, and others were examined. Approximately 68% of farmers operated greenhouses with an area ranging from 1,500 to 6,000 square meters, while only about 2% had greenhouses smaller than 1,500 square meters. Among the producers, 21% were under 30 years old, with an average age of approximately 39 years. The youngest producer was 22 years old, while the oldest was 70 years old. Notably, based on the 2013 General Census of Agriculture, greenhouse operators were generally younger than those in the broader agricultural sector.

Regarding experience, the majority (about 70%) of greenhouse operators had between 5 to 15 years of experience, with an average of 8.5 years. The range of experience varied from a minimum of 2 years to a maximum of 17 years. Approximately 86% of operators owned their greenhouses, while 14% rented them.

In terms of education, 59.7% of operators had an educational level below a high school diploma, 36.8% were university graduates, and 3.5% were illiterate. The survey results also indicated that 20% of greenhouse owners had heard of organic farming, but only about 16% had some degree of familiarity with organic farming practices, which highlights the need for more awareness and education in this area. Table 1 illustrates the extent of familiarity with organic farming activities.

Table 1. Knowledge of organic farming activities

Activity type	Level of acquaintance
Organic Greenhouse Management	1.26
Sales of organic products	1.18
Organic farming rules	1.21
Technical Operations for growing crops organically	1.25

Source: research findings (1 = no knowledge, 5 = very high knowledge)

Based on Table 1, the majority of greenhouse owners had little information about different stages of organic farming. Moreover, in the study they were asked about the sources of their information and their comments on the usefulness of each sources on organic farming. According to Table 2, meetings, seminars, workshops and the present organic greenhouse owners were the most useful sources.

Table 2. The effectiveness of resources

Resources	the effectiveness
Holding meetings, seminars and workshops	3.8
Organic greenhouse owners	3.6
Other people (farmers, their families, friends and relatives)	3.3
Radio, TV	2.6
Universities and research institutions	1.9
Books	1.7
Magazines, newspapers	1.65
Internet	1.5

Source: research findings (1 = not useful, 5 = very useful)

Among cucumber greenhouse owners, 40.97% expressed a desire to transition to organic product production in the future, while 59.03% had no interest in doing so. Of the approximately 41% of producers who were inclined to shift toward organic farming in the future, about 24% had a low level of interest, and 7% had a moderate interest. Similarly, 5% and 4% of them displayed a high and very high level of

interest, respectively. The average interest level was approximately 7%, indicating a relatively low overall interest in transitioning to organic farming among greenhouse owners.

The results suggest that the propensity for adopting organic farming practices among greenhouse owners is generally low. Table 3 provides insights into the reasons why cucumber greenhouse owners choose not to engage in organic farming.

Table 3. Reasons for not adopting organic farming

Reasons	Frequency
Organic farming is a high risk activity	94.1
There is not enough support from the government	89.8
Organic farming is not profitable	88.6
There is no market for selling organic products	86.8
Knowledge and skills is not available on how to manage organic greenhouse	85.4
Access to information about organic farming is difficult	84.7

Source: research findings

The mean and standard deviation and calculated t for greenhouse owners with willingness and no willingness for organic production is provided in Table 4.

Table 4. Mean and standard deviation and calculated t for farmers interested and not interested in organic production

Variable	Interest	Number	Mean	Standard deviation	Calculated t	Mutual recognition point
Age	not interested	85	43.11	9.17	2.32	0.023
	interested	59	38.28	10.15		
Production history	not interested	85	12.86	9.62	1.00	0.316
	interested	59	14.92	8.57		
Education	not interested	85	4.67	4.17	-2.84	0.006
	interested	59	7.52	5.03		
Fertilizer Consumption (Kg/1000 m^2)	not interested	85	320.19	224.12	4.25	0.000
	interested	59	484.21	283.13		
Chemical Consumption (Li/1000 m^2)	not interested	85	7.9	2.89	3.46	0.001
	interested	59	5.5	3.49		
Area under cultivation (1000 m^2)	not interested	85	3254	1.27	0.16	0.872
	interested	59	3657	0.99		
Awareness about organic farming	not interested	85	0.058	0.235	-3.36	0.001
	interested	59	0.342	0.481		
Sanitation	not interested	85	0.231	0.425	-2.40	0.019
	interested	59	0.474	0.506		
Better attitude towards the environment	not interested	85	0.442	0.51	-2.34	0.022
	interested	59	0.684	0.47		
Intercropping	not interested	85	0.423	0.49	-1.24	0.230
	interested	59	0.553	0.54		

Source: research findings

This table is used to investigate the statistical relationship between independent variables and the willingness to cultivate organic products. The following hypotheses related to individual and economic factors were examined, and their significance was

assessed using t-tests for the comparison of means between independent groups.

As indicated in the table above, the calculated t-value for the age variable was 2.32, and the hypothesis test yielded a significance level of 0.023. Consequently, the null hypothesis was rejected. Based on the results, with a 99.5% confidence level, it can be asserted that there is a significant relationship between farmers' age and their willingness to produce organic products in greenhouses, thus confirming the hypothesis. In essence, farmers' age influences their desire for organic production. Notably, younger farmers displayed a greater interest in organic farming, which may be attributed to their higher education levels and risk tolerance.

The calculated t-value for the experience variable was 1.00, and the hypothesis test was not significant at the 0.316 level. Consequently, the null hypothesis was accepted. There is no substantial difference between farmers' experience and their inclination toward organic farming in greenhouses, leading to the rejection of the hypothesis. In other words, farmers' desire for organic production is not significantly affected by their level of experience.

For the educational level variable, the calculated t-value was -2.84, and the hypothesis test was significant at the 0.006 level, prompting the rejection of the null hypothesis. Based on the findings, with a 99.9% confidence level, it can be stated that there is a significant relationship between educational level and farmers' willingness to produce organic products in greenhouses, confirming the related hypothesis. Higher education levels contribute to increased awareness among greenhouse owners regarding the harmful effects of excessive chemical fertilizer and pesticide use, potentially influencing their inclination toward organic farming. Additionally, higher education facilitates the understanding and management of organic greenhouse practices.

The calculated t-value for the use of chemical fertilizers was 4.25, and the hypothesis test was significant, leading to the rejection of the null hypothesis. With 100% confidence, it can be asserted that there is a significant relationship between the amount of chemical fertilizers used and farmers' willingness to produce organic products in greenhouses, confirming the hypothesis.

Similarly, the calculated t-value for the use of chemical pesticides was 3.46, and the hypothesis test was significant at the 0.001 level, resulting in the rejection of the null hypothesis. With a 99.9% confidence level, it can be concluded that there is a significant relationship between the use of chemical pesticides and farmers' willingness to produce organic products in greenhouses, supporting the hypothesis. The results highlight the substantial impact of chemical pesticide use on the willingness of cucumber greenhouse owners to engage in organic production.

In contrast, the calculated t-value for the area under cultivation was 0.16, and the hypothesis test was not significant at the 0.87 level. Consequently, the null hypothesis was accepted, indicating that there is no significant relationship between the area under cultivation and farmers' willingness to pursue organic farming, leading to the rejection of the related hypothesis. The size of the cultivated area does not significantly influence the desire for organic farming.

The calculated t-value for awareness about organic farming was -3.36, and the hypothesis test was significant at the 0.001 level. Hence, the null hypothesis was rejected. With a 99.9% confidence level, it can be affirmed that there is a significant relationship between awareness about organic farming and farmers' willingness to produce organic products, confirming the hypothesis.

For the intercropping variable, the calculated t-value was -2.34, but the hypothesis test was not significant, resulting in the acceptance of the null hypothesis. There is no substantial relationship between intercropping and farmers' inclination toward organic farming, leading to the rejection of the related hypothesis.

In the case of sanitation, the calculated t-value was -2.40, and the hypothesis test was

significant at the 0.019 level, leading to the rejection of the null hypothesis. With a 99.5% confidence level, it can be stated that there is a significant relationship between sanitation practices and farmers' willingness to produce organic products, confirming the related hypothesis. Notably, sanitation is a key element in organic crop production standards, aligning with the principles of organic production.

Finally, the calculated t-value for having a better attitude toward the environment was -2.34, and the hypothesis test was significant at the 0.022 level. Consequently, the null hypothesis was rejected. With a 99.5% confidence level, it can be affirmed that there is a significant relationship between having a positive attitude toward the environment and farmers' willingness to engage in organic farming, confirming the hypothesis. The results demonstrate that a more favorable attitude toward the environment significantly influences cucumber greenhouse owners' inclination toward organic production. A positive attitude encourages producers to exercise greater caution in the use of chemical fertilizers and pesticides, bringing them closer to the principles of organic farming.

Econometric model (Logit model)

The logit econometric model was used to illustrate the impact of independent variables used in the model on the dependent variable (the desire). Logit model estimation results are shown in Table 5.

Table 5: The results obtained by the logit model

Variables	Estimation parameter	The standard deviation	Significance	The final effect
Age	-0.233	0.09	0.009	-0.151
History of culture	0.309	0.102	0.002	0.263
Educational level	0.238	0.114	0.037	0.922
The level of using fertilizers	-0.004	0.002	0.036	0.0029
The level of using pesticides	-0.312	0.117	0.008	0.196
Area under cultivation	0.031	0.337	0.928	0.022
Information about organic farming	0.096	1.244	0.939	0.718
Intercropping	1.09	0.780	0.162	0.843
Sanitation	1.533	0.722	0.034	1.539
Better attitude towards the environment	1.383	0.67	0.039	0.997
Constant number	4.635	3.231	0.151	
Cox & Snell R Square	%44			
Nagelkerke R Square	%59			
The percent of correct prediction of model	%80			

Source: research findings

Based on the results, the Cox & Snell determination coefficient in the model was 0.442, indicating that the explanatory variables in the model accounted for 44% of the variance in the dependent variable. The Nagelkerke determination coefficient was 0.594, suggesting that the independent variables in the model explained 59% of the variance in the dependent variable.

Regarding the final effect estimation, it was found that increasing age by one year resulted in a decrease of approximately 0.151% in farmers' inclination toward organic production. This relationship was statistically significant at the 1% significance level. In simpler terms, younger greenhouse owners showed a higher interest in organic farming compared to their older counterparts.

The table also revealed that with each additional year of cultivation experience, the propensity for organic farming increased. This indicates that greenhouse owners with more experience in organic product production tended to have a stronger inclination toward organic farming.

There was a negative correlation between the use of chemical fertilizers and the willingness to engage in organic farming. The final effect estimation showed that for every unit increase in the use of

chemical fertilizers, there was a 0.0029% decrease in the propensity for organic farming. In other words, greenhouse owners who used fewer chemical fertilizers expressed a greater interest in organic farming. This finding aligns with the results of a study conducted by Sadeghi et al. (2011) in Alborz province.

Similarly, there was a negative correlation between the use of chemical pesticides and the willingness to adopt organic farming. The final effect estimation indicated that for every unit increase in the use of chemical pesticides, there was a 0.196% decrease in the inclination toward organic farming. Farmers who relied less on chemical pesticides and employed more manual weed control methods showed a higher propensity for organic farming.

In terms of the greenhouse area under cultivation, a negative correlation was observed, but it was not statistically significant. A one-unit increase in the cultivation area led to a 0.022% decrease in the inclination toward organic product production.

Positive relationships were identified between having knowledge about organic farming, intercropping, sanitation practices, and a positive attitude toward the environment, and the inclination toward organic farming. However, not all of these relationships were statistically significant.

Specifically, having knowledge about organic farming was associated with a 0.0718% increase in the likelihood of adopting organic crop production, though this relationship was not statistically significant. Intercropping was linked to a significant 0.843% increase in the propensity for organic farming. Sanitation practices were positively related to a 1.539% increase in the inclination toward organic farming, and this relationship was statistically significant at the 5% level. Finally, a positive attitude toward the environment was associated with a significant 0.997% increase in the propensity for organic farming, with statistical significance at the 95% level.

Conclusion

The results suggest that among the 144 interviewed people, 59 people have a positive tendency to become organic farmers and 85 people were reluctant to become organic producers, which reflects that the trend towards organic products is low among cucumber greenhouse owners. Descriptive analysis of the results showed that information about the different stages of production of organic products in the majority of the greenhouse owners was low.

The high risk of organic farming, lack of adequate support from the government, lack of appropriate profit, lack of clear sale markets and also lack of knowledge and skills were the main obstacles in the production of organic products. According to the results, the following suggestions are made:

- We recommend that governmental organizations hold workshops and seminars to provide information on different stages of production of organic products to greenhouse owners.
- Farmers should be supported and encouraged to produce organic products through policies of governmental organizations. Also, through educating farmers, especially producers of greenhouse cucumbers as well as financially supporting of them by the governmental organizations and trade unions in pre-transition and post-transition stages, farmers' concerns can be reduced on the high risk of organic farming and its low profits.
- Through creating the necessary infrastructure to certify organic products and facilitate their marketing and expanding their use, governmental organizations can increase profitability, reduce the risk of organic farming and encourage farmers to produce organic products.

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