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# Estimating the Economic Value of Organic Rice

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Abstract

The demand for organic products has increased in the past decade due to concerns about the environmental and health issues of food products. This study provides marketing data on consumer preferences and willingness to pay (WTP) for organic rice in Babol County, Northern Iran. The main objective of this study was to estimate urban consumers' WTP for organic rice and to determine the main factors that consumers look for when purchasing rice. The contingent valuation method (CVM) and double bounded dichotomous (DBD) questionnaire were used to achieve the study goals. The results of the logit model showed that level of education, cancer history, and insurance history had statistically significant effects on WTP. The expected WTP for 1 kg of organic rice was 152467.33 IRR. Based on the average exchange rate of six months of 2018 (33500 IRR) per family in the study tends to the monthly equivalent of US$ 4.55 of their income to buy organic rice allocated. As a result, the total economic value of organic rice was US$ 2254893.072. These results provide important information about market opportunities and policy implementation regarding the production of organic crops.

*Keywords:*
*Babol, CVM, Logit model, organic rice, WTP*

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## INTRODUCTION

Organic farming is an agricultural production system based on showing respect for natural cycles that sustain the health of soils, ecosystems, and people (Xu et al., 2018). Consumption habits in society are today changing, and the latest tendencies show a greater concern for health and the environment (Martinez et al., 2004; Smith and Marsden, 2004). When consumers are choosing food products, they give a very important role to ethical, environmental, and health factors (Torjusen et al., 2001). From a productive point of view, the development of world organic agriculture has been very important during the last few years. In 2016, the cultivated area of organic crops was 57.8 million hectares in the world, accounting for 1.2 percent of the total useful agricultural land area (IFOAM, 2017).

Iran has diverse climatic conditions and a vast area of land, so it has a rich biodiversity (Bostan et al., 2020; Bostan et al., 2018; Fatahi *et al*., 2016). On the other hand, agriculture plays a major role in the Iranian economy. Growing markets for certified food products indicate that organic farming offers an important opportunity for the rural sector to benefit from international trade (Ghorbani et al., 2007). Finally, Iran can play an important role in the global trade in organic products. According to the 2017 IFOAM statistics, 178 countries had organic farming in 2016. On the other hand, 87 countries had laws on organic products. Also, the number of organic manufacturers in the world totaled over 200,000 producers in 1999, reaching 2.7 million in 2016, which indicates the interest of producers and consumers in the cultivation and consumption of organic products. There is an optimistic market for organic products in the world. It worthed US$ 17.9 billion in 2000. This value reached US$ 89.7 billion in 2016 due to the increase in per capita consumption and the share of organic products in the world. In particular, per capita consumption in developed countries was reported to be US$ 12.1 in 2016. But, given the widespread publicity of organic farming in the past two decades, its growth has not been as large as transgenic products. The acreages of genetically modified (GM) crops and organic crops are presented in Figure 1.

In Iran, the per capita consumption of pesticides for crops has increased by 400 g/person and the rate of fertilizer use has increased from 2.5 to 5.3 million tons over the last 10 years (Razeghijadid, 2019). Research on the adverse effects of chemicals shows that 60 percent of pesticides, 90 percent of fungicides, and 30 percent of insecticides are carcinogenic (Razeghijadid, 2019). The higher price of organic products is related to both the higher costs of their production and elaboration and the higher utility that they have for consumers who perceive them as having a higher quality, being healthier, and being environmentally friendly (Joo Lee and Yun, 2015).

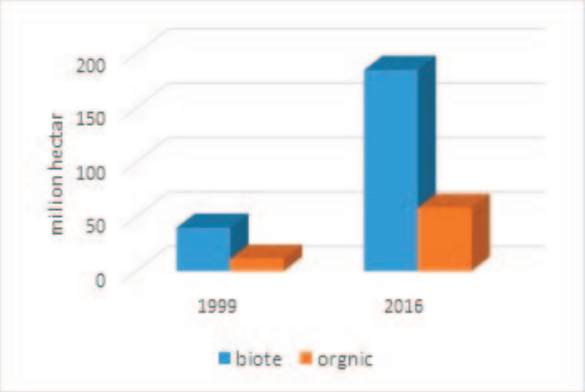


*Figure 1.* The Acreage of GM (Biote) Crops and Organic Crops

Rice is one of the most important crops domesticated by mankind, and about 16 percent of the global arable land is under rice cultivation. Rice is a crop of temperate and dry areas and is planted up to the height of 4750 meters above sea level (IRRI, 2017). Evidence has shown that organic agricultural foods in Iran are non-market goods. These products still have an inadequate diffusion because consumers are not always able to recognize organic products from the conventional ones due to poor certification procedures and insufficient awareness of these food products. Accordingly, the Iranian organic food products market does not follow the usual market rules, and consumers often doubt the authenticity of "organic" products displayed in the market, perceiving them as "non- market" goods; nevertheless, many consumers seek food safety and are willing to pay higher prices for organic products since they increase their utility levels, thereby reducing health risks. However, they are unable to ascertain food safety before purchase. As a result, since "safety" is the most important characteristic of these products, being a non-market good for such foodstuffs is a normal definition in most countries, including Iran. There are some economic methodologies to value non-market goods. One of them is the Contingent Valuation Method (CVM) (Ardakani, 2016), which has been used increasingly for valuing organic products throughout the world (Fattahi Ardakani and Hashemi Shiri, 2019).

The results of a study on comparing preferences for rice in Thailand and Japan show that notwithstanding the higher price of organic rice, Japanese people prefer it (Aoki et al., 2016). The results of a conditional valuation study in Iran showed that 5 percent of people had willing to pay more for organic tomatoes than regular tomatoes. The willingness to pay was also 5 IRR. In addition, the variables of income, amount of offer, environmental tendency, and health index were the most important factors affecting the willingness to pay (Hashemi and Fatahi, 2016). A study communicating organic food quality in China has stated that it is the key to strengthening organic demand in this country. Further, they have declared that organic labeling increases price and quality expectations but not health or taste (Loebnitz and Aschemann-Witzel, 2016). Another study, using the double bound contingent valuation method and logit model, estimates consumers' WTP for green chicken in Rasht city. Among the explanatory variables applied in the logit model, income and education level had positive and significant effects on WTP for green chicken. The results revealed that the average WTP for 1 kg of green chicken equaled 37279 IRR (Kavoosi Kalashami *et al,* 2012). A study shows a positive WTP for an additional 130 Chilean pesos per kilogram of organic apples and a greater preference for apples produced organically than those produced by conventional methods (Cerda *et al*., 2012). A study in Iran estimated the consumers' WTP for organic vegetables and cucumber in Guilan and Mazandaran provinces of Iran. The results revealed that income and knowledge about cancers had positive and significant effects on WTP (Mafi and Saleh, 2009). A study on the effect of organic labeling on consumers' WTP in France showed that half of the consumers were sensitive to organic labeling during food shopping (Tagbata and Sirieix, 2008). A study evaluated consumers' WTP for organic products in Argentina. Their findings showed that consumers would pay more money by about 6-200 percent for buying organic products (Rodríguez et al., 2007). In the research carried out by the «Entorno Foundation» concerning consumers' opinions about price, 47 percent of the Spanish consumers were willing to pay more for organic products (Joensen, 2003). In Spain, a study showed that consumers who were concerned about a healthy diet and environmental deterioration were more willing to purchase organic foods and more willing to pay a higher price (Gilj *et al*., 2000). A study in Germany stated that 52 percent of consumers would pay more for

fruits and vegetables, 34 percent would pay a premium price for animal products, and 39 percent would pay more for grain products (Meier and Woodward, 1999).

Studies show that people pay more for organic products. Also, the variables of environmental tendency, concern for diseases especially cancers, and organic labeled products and price (bid) for organic products have significant effects on willingness to pay. Most studies have used the contingent valuation methodology for the economic evaluation of organic products. As a result, this study applied this method to determine the level of investment and factors affecting the willingness to pay required by citizens.

## METHODOLOGY

*Study area*

In Iran, rice is the most important crop and is the main source of proteins and calories for Iranians. The total cultivated area of rice is more than 600 000 ha and rice is grown in 15 provinces. However, more than 80 percent of the rice area is distributed in the two northern provinces of Mazandaran and Guilan. It is estimated that 218292.9 ha in Mazandaran and 238000 ha in Guilan are under rice cultivation (Agriculture Jihad Organization of Mazandaran and Guilan, 2018; Hadizadeh et al. 2018). The cultivated area of rice is 45444 ha in Babol County. Babol is located in Mazandaran province, Iran. This area encompasses 14301 km$^2$, which is about 6 percent of Mazandaran province located between latitudes 36°05' and 36°35' N. and longitudes 52°30' and 52°45' E. In 2012, the population of Babol city was counted to be 495,472 people. The average per capita consumption of rice in Babol city is 42 kg. With the above data and the price of non-organic rice (different varieties between 40000 and 70000 IRR), a citizen annually pays, on average, 2310000 IRR for their rice consumption.

Contingent valuation is a survey-based economic technique for the valuation of such goods. CVM survey is a technique used to measure aspects like higher health, quality, and taste, or reduced risks in food products (Fattahi Ardakani and Hashemi Shiri 2019; Amirnejad and Tonakbar, 2015). CVM is often referred to as a stated preference model in contrast to a price-based revealed preference model (Fahad and Jing 2018; Bostan et al, 2020). Typically, the survey asks how much money people would be willing to pay (or willing to accept) to use (or be compensated for the loss of) organic food products feature,


*Figure 2.* The Location of the Study site in Iran and Mazandaran Province

such as environmental benefits. Indeed, CVM permits a direct estimation of WTP by means of different elicitation techniques (Boccaletti and Nardella, 2000; Bostan et al, 2020).

Consumers simply indicate their WTP without purchasing the hypothetical product. As was already explained, CVM relies on directly asking individuals about their WTP for a specific commodity. The most important part of CVM application is to choose appropriate survey and elicitation methods to reach the most accurate data. Various survey methods are possible for data collection. In-person interviews are usually held to produce the highest-quality WTP data although telephone and mail surveys are applied in a number of researches (Samdeliri & Shahbazi, 2017).

There are various techniques for eliciting consumers' WTP, such as the dichotomous-choice format. In this approach, the respondent is given a question to appoint if he or she would pay $X for the good, or not.

In the double-bounded dichotomous choice (DBDC) model, respondents are presented with two levels of the bid where the second bid is contingent upon the response to the first bid (Ellis, 2017; Fatahi Ardakani & Fazlolahi, 2015). If the individual responds "yes" to the first bid, the second bid is an amount greater than the first bid (Fatahi et al, 2012). If the individual responds "no" to the first bid, the second bid is somewhat smaller than the first bid (Bateman et al., 2002; Bostan et al, 2018).

In this study, to estimate the consumers' WTP for organic rice using CVM, 117 individuals were randomly selected in Babol city, and data were collected on explanatory variables using a questionnaire filled by them. The utility function of Babol city's consumers was supposed to be as below (Bazghandi et al, 2020):

$$U=(Y,S) \quad (1)$$

in which *U* is the indirect utility function, *Y* is the individual's income, and *S* is the vector of the individual's social-economic characteristics (Molaei et al, 2009; Fatahi & Fathzadeh, 2012). To determine the model for estimating WTP, it is assumed that one accepts the bid based on maximizing his or her utility under the following conditions or rejects it in another way:

$$(1,Y\text{-}A;S)+\varepsilon_1 \geq U(0,Y;S)\varepsilon_0 \quad (2)$$

in which *A* is the bid, and are the residuals with an average of 0 that are distributed and independent of each other. The increase in individual's utility because of organic rice consumption is defined as follows (Fatahi, 2013; Khodaverdizadeh et al, 2009):

$$\Delta U(1,Y\text{-}A;S)\text{-}U(0,Y;S)+(\varepsilon_1\text{-}\varepsilon_0) \quad (3)$$

To estimate the valuation function in CVM, the Logit functional form is used widely (Fatahi et al., 2016; Ardakani, 2016). In the valuation model, the Logit functional form is used to study the different explanatory variables affecting WTP of individuals for consuming organic rice.

In the Logit model, the probability of accepting the bids by individuals is defined as below (Fatahi, 2013):

$$P_i = F_\eta(\Delta U) = \frac{1}{1+\exp(-\Delta U)} = \frac{1}{1+\exp-\{\alpha-\beta A-\gamma Y-\theta S)} \quad (4)$$

in which is the aggregate distribution function with standard logistic in which explanatory variables like income, bid, age, gender, family size, and education level are used to estimate the valuation function. Also, β, γ, and θ are regression coefficients that are expected to be , and , respectively (Hanemann, 1994). After estimating the above logit function, it is possible to calculate the expected WTP using an integral.

Logit regression model coefficients have been determined using the maximum likelihood (ML) estimator (Lehtonen et al., 2003). The integral of from 0 to maximum bid has been calculated based on the following equa-

tion (Bostan, 2017):

$$(WTP) = \int_0^{Max\ bid} F_\eta(\Delta U)dA = \int_0^{Max\ bid} \frac{1}{1+\exp\{-\alpha^* - \beta A\}}dA \quad (5)$$

in which E(WTP) is the expected willingness to pay and α∗ is the adjusted constant constructed as below (Molaei et al, 2009):

$$[\alpha^*=(\alpha-\gamma Y-\theta S)] \quad (6)$$

The suggested prices (bid) (75145, 37571 & 150285 IRR) by 30 basic questionnaires (pretest) were calculated, and then, the required data were collected through questionnaire completion in face-to-face interviews with Babol citizens in summer 2018. The sample was taken by the simple randomization technique.

In CVM, a great deal of data is required because of the high variance of respondents' WTP since the mean standard error is conversely related to the sample size (Mitchell and Carson, 1989). Having the coefficient of variance (in CVM studies, the coefficient of variance varies in the range of 0.75-6, but the acceptable value is 2 (Fatahi, 2013)), the sample size can be determined by Eq. (7) (Mitchell and Carson, 1989).

$$n = \left[\frac{t*\widehat{\delta}}{d*RWTP}\right]^2 = \left[\frac{t*\widehat{V}}{d}\right]^2 = \left[\frac{1.96\times 0.4973}{0.09}\right]^2 = 117 \quad (7)$$

in which *n* is the sample size, *t* is the t-student statistic, *RWTP* is the estimated WTP, and *d* is the percent difference of RWTP from TWTP. The value of *d* is determined by the researcher and shows how much deviation from the actual WTP is acceptable for the researcher. The acceptable *d* value is 0.01-0.3 in CVM studies. According to Equation 7, the sample size was 117. Finally, given the lack of understanding of 12 respondents, the results of 105 questionnaires were included in the final analysis.

## RESULTS AND DISCUSSION

The socio-economic characteristics of the respondents are presented in Tables 1 and 2. As can be seen, the mean age is 34.8 years ranging between 20 and 58. On average, each respondent is educated for 14 years and has a family size of 3.6 people. As shown in Table 2, almost two-fifth of the sample respondents have B.Sc. while the education level of a little more than 10 percent is under-diploma.

*Table 1*

*A Summary of Important Socio-Economic Variables of Respondents*

| Variables | Average | Standard Deviation | Min | Max |
|---|---|---|---|---|
| Age (years) | 34.85 | 9.89 | 20 | 58 |
| Level of ducation (years) | 14.05 | 3.28 | 5 | 18 |
| Family size (ha) | 3.68 | 1.43 | 2 | 8 |
| Monthly income (IRR) | 5245714.28 | 2649130.06 | 2000000 | 14000000 |

*Table 2*

*Frequency Distribution of Educational Level of Respondents*

| Educational level | Master and higher(MS.c) | Bachelor (BS.c) | Associate | Diploma | Under-diploma |
|---|---|---|---|---|---|
| Number | 15 | 42 | 9 | 27 | **12** |
| % | 14.3 | 40 | 8.6 | 25.7 | 11.4 |

*Table 3*
*Respondents' Profile*

| | Characteristic | Percentage | Number |
|---|---|---|---|
| Gender | Male | 54.3 | 57 |
| | Female | 45.7 | 48 |
| Age | 20-25 | 5.7 | 6 |
| | 25-40 | 62.8 | 66 |
| | 40-55 | 28.6 | 30 |
| | 55 | 2.9 | 3 |

*Table 4*
*Status of Answering to the Three Proposed Prices*

| | Condition of acceptance | First bid (75145 IRR) | Lower bid (37571 IRR) | higher bid (150285 IRR) |
|---|---|---|---|---|
| Bid acceptance | Number | 75 | 28 | 24 |
| | Percent | 71.4 | 26.7 | 22.8 |
| Bid rejection | Number | 30 | 2 | 51 |
| | Percent | 28.6 | 1.9 | 48.6 |
| Sum | Number | 105 | 30 | 75 |
| | Percent | 100 | 28.6 | 71.4 |

Table 3 shows the summary of the respondents' profile. The results indicated that the respondents were in the age range of 20-58 years. Most of the respondents were in the age range of 25-40 years old (62.8%). This was followed by those in the age range of 40-55 years (28.6%) and below 25 years (5.7%). The fewest of respondents were above 55 years old (2.9%). By gender, the majority of the visitors (54.3%) were male. More than half (80%) were married.

Table 4 demonstrates the answers given to the proposed prices for healthy products in Babol city. The results as to WTP show that 30 people (28.6%) did not accept the first offer. In fact, they were not willing to pay 75145 IRR to organic rice, while 75 people (71.4%) accepted it. When the lower price was proposed, 2 people (1.9%) rejected the proposal. Those respondents who adopted the first proposal (75145 IRR) were put in a higher offer group (150285 IRR). Also, 24 people (22.8%) accepted the third proposal and 51 people rejected it.

The results of estimating the logit model for organic rice are indicated in Table 5. Logit Model Percentage of Right Prediction equals 68 percent, which insists on the high prediction power of the model .The value of McFadden and Maddala coefficients of determination at the bottom of the table indicates the explanatory power of the model.

Among the factors affecting WTP for organic products, income, history of cancer, insurance history, awareness of the organic products, and proposed price are statistically significant at the 5 percent level. Among these variables, insurance history and proposed price have a negative effect and three other variables have a positive effect on WTP for organic products. The coefficient of the income and proposed price are statistically significant at the 5 percent level. The proposed price has a negative effect on WTP for organic products. This shows that under the scenario of a hypothetical market, the probability of WTP decreases

*Table 5*
*Results of Estimating the logit Model*

| Variables | Estimated coefficient | t- statistic | Elasticity |
|---|---|---|---|
| Constant coefficient | 0.85 | 1 | 0.287 |
| Number of family members | -0.287 | -1.58066 | -0.0277 |
| Education | 0.468** | 2 | 0.125 |
| Income | 0.0000000363** | 2 | 0.0645 |
| Awareness of the organic products | 0.473** | 2.326 | 0.194 |
| History of cancer | 1.027** | 2.18 | 0.148 |
| Proposed Price | -0.0000029** | -2 | -0.03 |
| Insurance history | -0.451** | -2 | -0.151 |

Percentage of Right Prediction = 0.68
Log of likelihood function = -68.13 *p*-value=0.000, ** $p< 0.05$
MC FADEN =0.1607, MADALA =0.1681

by increasing the proposed price.

The calculation of elasticity for the variables of the years of education and income indicated that if the variables are constant, a 5 percent increase in these variables increases the probability of purchasing the organic rice by 12 and 6 percent, respectively. Elasticity values for two variables of proposed price and family size indicated that if all other factors are constant, a 5 percent increase in these two variables reduces the probability of purchasing the organic rice by 3 and 2 percent, respectively.

The expected value that is the average WTP is calculated by the following equation to be a bit more than 150000 IRR per person.

$$WTP = 152467.33 \quad (8)$$

This is the tendency of people to use organic rice, i.e., willingness to invest in the development of this product. The average dollar exchange rate in the six months of 2015 (33500 IRR), at least willing to invest in the development of organic rice in the city of Babol, is equivalent to US$ 4.551.

According to the population of the city of Babol (495,472 people) and the willingness of people to use organic rice, the total economic value of organic rice was USD 2254893.072.

## CONCLUSIONS

The results show that the level of education in the logit model has a significant effect on turnout to invest in organic products in the city of Babol. This suggests that if the level of education increases, the awareness, knowledge, and attention to food safety increase, resulting in increased public participation. There was a significant positive correlation between age and willingness to pay for organic rice, which means that older people tend to pay more for organic products than younger people. There is also a positive and significant relationship between the variable of a history of cancer and WTP for organic rice. A significant positive correlation was also observed between income and WTP for organic rice in Babol and a reverse relationship was detected between family size and WTP. So with lower per capita income, willingness to pay for organic rice decreased. Also, willingness to pay for organic rice decreases with increasing family size. The variable of awareness among citizens showed a significant positive relationship with WTP. So, to improve the level of people's awareness about organic products, it is necessary to use advertising and educational courses for organic products through mass media, schools, and seminars.

The results can provide important informa-

tion about product features to manage agribusiness as a way to identify new sectors of the market. Given the importance and benefits of organic agriculture to produce healthy products, the results of this study provide a general strategy for the development of organic agriculture:

It is recommended to hold workshops and exhibitions related to organic farming and activation, and the development and promotion of agricultural associations with organic products for all segments of society, from public and private institutions to increase consumers' knowledge of the advantages of organic products so that people can be healthy and their tastes are changed towards these products.

Since there are few studies on organic products in Iran, it is recommended to conduct further studies on the economic behavior of people to buy organic products and the related factors.

According to the results of the research, the educational variable has become significant. In other words, with increasing awareness and literacy of people about health and disease issues, people prefer to use organic products. As a result, it is recommended to use private-sector activities including forums (NGO) in the field of information and knowledge to encourage most people.

Due to the positive and significant effect of income on willingness to pay, it can be inferred that any policy to increase household incomes in the studied city will motivate households to purchase organic rice.

The variable of awareness of organic products was found to be the most significant variable. Consequently, with a positive sign, it is suggested to raise public awareness of organic rice and educate and promote the consumption of organic rice through mass media.

Most people are willing to pay more for organic products. Finally, according to the demand of the people in Babol for buying organic rice, it can be concluded that there is a suitable market for selling organic rice in Babol. It is suggested that conditions be provided for the production and supply of organic rice in Babol (one of the Iranian rice production hubs).

Given the positive and significant sign of cancer in the immediate vicinity of people's willingness to pay for organic rice, it is suggested that the government promote awareness of the effects of conventional (inorganic) products on people's health, especially cancer, through mass media.

Since rice is considered a luxury commodity and the majority of those consuming rice are high-income people, the state should support the agricultural sector to increase organic production at lower prices to promote public health.

Successful programs are not necessarily the role of the public in the run up to the full cycle of planning, especially if the program is synonymous with behavior change society. It is proposed government policy for public participation in investments for organic products is.

## ABBREVIATIONS (NOMENCLATURES)

- Contingent Valuation Method (CVM)
- Double Bounded Dichotomous (DBD)
- Double Bounded Dchotomous Choice (DBDC)
- International Rice Research Institute (IRRI)

Willingness To Pay (WTP)

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