Citrus Marketing Channel Strategy and Its Determinants in Mazandaran Province of Iran: An Application of Nested Logit Model

S. M. Mojaverian¹, F. Rasouli¹, and S. A. Hosseini-Yekani¹

ABSTRACT

One of the really important challenges facing agricultural producers is the choice of their product distribution channels. The present study is aimed at investigating the citrus marketing channel strategy and its determinants among citrus orchardists of Mazandaran using a Nested Logit model. Some two hundred and fifty two orchardists from 15 cities of Mazandaran were taken as the study samples. Four distribution channels and three nests were considered in determining the factors influencing the choice of marketing channel. Since the estimated structural parameter did satisfy the condition of lying between 0 and 1, the nested logit model was proved as appropriate for the intended application. The results indicated that the orchard distance from the nearest city, orchardist's experience, sale time, marketing costs, the kind of product and the dominant marketing channel constitute the most important factors of distribution channel selection as regards the citrus producers in Mazandaran. According to the obtained results, by increase in the orchards’ distance from the nearest city, the producers’ tendency to sell their products through channels of shorter distances from buyers also increases. Also, results revealed that the older the orchardist, the higher his/her degree of risk aversion. An estimation of binomial Logit Model for the second and third nests had consistent results regarding the marketing costs. As the marketing costs increases, the orchardist’s tendency to sell his/her products through other channels of a lower marketing cost will increase. Furthermore, results revealed that as the citrus price rises, the producers get further intended to sell their products in the market rather than selecting either the pre-sale method or selling their produce to the local dealers.

Keywords: Citrus, Iran, Marketing channel strategy, Mazandaran, Nested logit model.

INTRODUCTION

Citrus is one of the horticultural products that includes some of the most important tropical as well as subtropical plants. From a botanical point of view, citrus belongs to Rutaceae family and Aurantioideae sub-family. With a transition from traditional to modern agriculture in Iran during the recent decades and the increased share of marketed products as compared with the overall total products, marketing of agricultural products has gained its special importance. Currently, farmers are dissatisfied with how to supply their products to the market and as well with their scant share of the final gain (Kazemnejad, 2005). According to experts, this is due to the existing inefficiencies in the agricultural market structure.(Rezaeizal, 1995). According to FAO statistics, citrus production across the world with an average annual growth of 3%, has reached from 111 million tons in 2005 to 131 million tons in 2011. Iran, producing 3.38% of the world's citrus is ranked seventh worldwide. Iran's citrus production has been about 4 million tons in 2009 and Mazandaran province,

¹ Department of Agricultural Economics, Sari University of Agricultural Sciences and Natural Resources, Sari, Islamic Republic of Iran.
* Corresponding author; e-mail: mmojaervian@yahoo.com
producing 45.1% of this total production is ranked as top throughout the country.

Citrus production is of great significance in Iran, since it benefits from the highest volume of production among the other horticultural products with a share of over 31% (Ardestani, 2010). Therefore, appropriate measures in the marketing of citrus should be taken into account by the experts and producers in order to eliminate the inefficiencies prevalent in the market structure of this valuable product. Some of these inefficiencies are widespread presence of middlemen, small share of producers from the final set price and while a high share of marketing cost (Ardestani, 2010). Channel strategy gets an important position in the marketing process of citrus, because of the increase in the citrus production quantity and the increased distance of producers as well as consumers from the product over time (Rousta, 2004). So an investigation of citrus marketing channel strategy and its determinants can be useful in somehow resolving the existing problems of its marketing.

Mosanejad and Mojaverian (1994) studied citrus marketing system in Babol city of Mazandaran Province, using Logit Model and by investigating 126 orchardists and 7 wholesalers. They found that there existed more than 9 marketing channels of 4 different methods. Based upon the calculated marketing margins of their research, direct sale or selling via brokers were superior as over the other methods.

Ardestani et al. (2008) calculated marketing margin, market agents' shares, marketing net profit and market inefficiency of orange along with the price indices during 2001-2005 in Iran in order to clarify the domestic market of the product. The results of their study revealed the high share and growth in the wholesale margin, high profit share of wholesalers, high share of marketing costs received from the paid price to the producers and as well the obvious improper role of wholesalers.

Tsourgaianis et al. (2008) aimed at identifying the factors affecting the choice of marketing channel by sheep and goat farmers in the Region of East Macedonia and Thrace (EMTh) in Greece relative to the distribution of their livestock and milk products. Four categories of milk marketing and four categories of livestock marketing channels were identified. Many factors were found to be associated with the selection of milk marketing channel, including milk price, loyalty, speed of payment, degree of isolation, farm area, size of flock, volume of production, farmer's age and debt level. Such factors as livestock price, loyalty, capability of buyer to purchase large sums of livestock/meat, speed of payment, personal relationships, size of flock and number of slaughtered lambs were found as associated with selection of a livestock marketing channel.

Martinez (2004) in a survey of horticultural crop growers in the Almeria Province, Spain, showed their preferences for different marketing channels. The influence of such characteristics as grower age, risk aversion, family size as well as holding size on these preferences was determined using Logit Models. The results suggest that the most important marketing channel as regards horticultural products in this state is an auction system.

Park (2009) studied organic producers by identifying specific farm and demographic factors that enhance earnings, given the choice of marketing outlet. The two significant selectivity coefficients confirm that organic earnings when marketing through a single outlet are biased upward since farmers who are better suited to market through multiple outlets have already moved away from this marketing strategy. An accurate evaluation of the projected earnings from any marketing strategy must account for selectivity effects.

The present study aims at identifying the marketing channel strategies among Mazandaran citrus producers using econometric methods and its also aims at investigating the influencing factors of marketing channel selection.
MATERIALS AND METHODS

Inefficiency of linear models in many socio-economical applications has caused researchers to use choice models of a long history in economics and as well in sociology. Choice models are based on consumer theory and the most important characteristic of these models is their behavioral nature.

Discrete choice models show the relationship between a discrete variable \( Y \), which represents the occurrence of an event or a decision among possible choices, and one or more explanatory variables \( X \). Choice process of marketing channel is one application of these models. Discrete choice models, according to the assumptions applied to them, are known as behavioral models.

Choice models are not estimable by simple regression methods because the dependent variable in these models is a random one and such variables are not observable. One of the common estimation techniques of such models is Maximum Likelihood Method which helps to find the closest probability distribution function.

Choice models, according to the individual’s choice set, are divided into discrete vs. continuous choice ones. Discrete choice models are a group of random utility models which have a long application life in economics, marketing and geographies. Most of the discrete choice models are based on the assumption of utility maximization (Bhat, 2004).

In most cases it is assumed that random utility function of activity \( i \) for the individual \( t \) is as follows:

\[
U_{it} = V_{it} + \varepsilon_{it} \tag{1}
\]

Where, \( U_{it} \) is random utility of choice \( i \) for individual \( t \), \( V_{it} \) is the systematic part of utility and \( \varepsilon_{it} \) the random part of it. Basically three common distributions are considered for the random part. Each one of these three distributions results in three major families of choice models namely: Linear Model, Probit Model as well as Logit Model (Mayer et al., 1977).

Nested Logit models, in fact, are special cases of more general models known as Generalized Extreme Value (GEV) (Meyer, 1977). This group of models possess a hierarchical decision making structure. The most famous of such models, the Nested Logit model has been developed by Ben-Akiva and Lerman (1978).

Nested Logit models can be expressed in the form of the product of some polynomial logit models located in a tree according to Figure 1 (Nasiri, 2005). The tree shown in

![Figure 1. Tree chart of nested logit model.](image-url)
Figure 1 has three levels of $I$, $J$ and $K$ and the options are shown at each level. As shown in the Figure, the number of options in every branch and at every level of the branches can be different. But specifically in some branches like 1, 11 and 22 there may be only one member and in this case, structural parameter related to that level of branch and the choosing probability of that option at that level of the branch equals 1.

The values of the structural parameters $\theta_k$ and $\theta_{jk}$ indicate substitution or relationship between cross elasticity in every branch (Zhang, 2004). The more the number of options, the more nested structures could be proposed. But all the structures may not be correct. This point should be considered in developing the nested logit models along with the introduced conditions of developing multinomial logit model. For example, let's assume that there are three options of $a$, $b$ and $n$ with a structure similar to that of Figure 2.

In this structure a measure of utility is taken into account for options $a$ and $b$ as like as combination models. Then a measure of combined utility is defined for nest $m$ including the following two options:

$$I_m = \ln \sum_{i=1}^{n} e^{V_i}$$

Where, $V_i$ is the total utility of every option inside the nest. Therefore, the total utility of option $m$ is rewritten as:

$$V_m = \theta_{m} + \beta X_m$$

Where, $X_m$ is the descriptive variable of option $m$ and while vectors $\theta$ and $\beta$ the model parameters.

The nested model is estimated within two phases. In the first phase, parameters of the options existing in nest $m$, i.e. $a$ and $b$, are estimated as like a binomial logit model. Then the value of $I_m$ is calculated and retained for all the components used in estimating the recent model. In the second phase, the model parameters in the top level are estimated like a binomial logit with two options $m$ and $n$ (Asadi, 2003). It is proved that: $0 < \theta \leq 1$

If $\theta < 0$, an increase in the utility of one option of the nest at the second level, will result in decreasing the probability of selecting the options of the nest. Also, if $\theta = 0$, either an increase or a decrease in the utility of one nest's option won't change the probability of choosing the options. Again, if $\theta > 1$, an increase in the utility of one option of the nest (e.g. option $b$) will increase the probability of selecting $b$ as well as the utility of any other option in the nest. Finally when $\theta = 1$, the results of nested model are algebraically identical to the results of a similar simple multinomial logit model. Following the developing and an estimation of the nested models, every structure which couldn't meet the condition $0 < \theta \leq 1$ will be eliminated. If $\theta$ is close to 1, from a mathematical point of view, the nested structure will be close to the multinomial logit structure (Asadi, 2003).

Figure 3 illustrates the nest structure in the present study. According to this figure, the four types of marketing channels include: forwarding (preselling), selling to a local dealer (in the garden), selling through fruit and vegetable market (to wholesaler), and direct sales (at the retail level). Branches from top to bottom indicate a more depth of sale in the market. At the top-level, orchardists have to choose between two options i.e. sell their products prior to fruit ripening (forwarding) or leave it to after ripening. Selection between these two choices is dependent on the farmers’ risk aversion coefficient and their financial situation. If orchardists decide to sell their
fruits after being ripened, then they have to choose between two options: either sale in garden (selling to local dealers) or choose the market sale. Finally, if orchardists decide to sell their products to the market, in the next stage they must choose from between any of the two options i.e. selling to either wholesalers or to retailers.

The data needed for this study have been collected through questionnaires filled by 252 of the 40,938 orchardists sampled in Mazandaran Province.

It should be mentioned that three dummy variables, representing three types of citrus, are considered in this study i.e. orange, mandarin vs. some other types of citrus.

Table 1 introduces the variables and parameters used throughout the rest of the paper.

## RESULTS AND DISCUSSION

Whereas the dependent variable in this study, marketing channel strategy, was chosen from among the four commonly used marketing channels, it was not only non-quantitative but also not of two-state. Therefore common methods of regression were not feasible, so the maximum likelihood approach was employed to estimate the model. The econometric package
LIMDEP was applied to estimate the model. The new version of this software which is of the capacity of directly estimating the nested logit models was not available at the time of estimation. So the current model of nested logit was estimated nest to nest. It should be mentioned that modeling starts from the lower nest, e.g. choice between direct sale and selling in fruit and vegetable market, to upper nests.

In order to estimate the binomial logit model of the first nest, choice between two options, i.e. direct sales vs. selling in the fruit and vegetable market, was modeled. To this end, data associated with 114 orchardists who had selected market sale, have been applied in the modeling. In this case, dependent variable was equal to 1 for direct sale choice and 0 for selling in the fruit and vegetable market. Following a determination of dependent vs. independent variables, binomial logit model was evaluated using Maximum Likelihood method. At this stage, either a variable or a set of variables, which according to the research hypotheses influence the dependent variable, have to be included in the model. Then either the acceptance or rejection of the new model is investigated comparing double difference of log-probability of the new vs. basic models, which have chi-square distribution, with critical values of this statistic, as well as evaluating the importance of variables using t-test. Log-Probability value, with the assumption of equal selection probability of each option, is as follows:

$$L(0) = -\sum_i n_i \ln P_i$$  

(4)

Where, $n_i$ indicates the number of option i observations and $P_i$ representing the selection probability of option i. In the first step of modeling process, market share and zero models are compared with each other. In market share model, all the coefficients of independent variables, except the model fixed term are equal to 0 and selection probability of each option is exactly equal to the relative frequency of observing that option. According to the obtained results, the log-probability of market share model was calculated as 77.2552 using LIMDEP. In this step, zero model was served as the basic model since the chi-square statistic value was less than the critical one with a 95% confidence interval and a degree of freedom of 1. Similarly, this procedure was performed for the other variables expected to influence the marketing channel strategy of orchardists. The results related to this procedure are presented in Appendix 1. The final model of the mentioned nest was as follows:

$$U_1 = -0.306Dis -1.095Expr +1.332Time$$  

$$+0.019 \text{price} - 3.637\text{Type1} + 4.165\text{Type3}$$

(0.14) \hspace{1cm} (0.38) \hspace{1cm} (1.13) \hspace{1cm} (0.69) \hspace{1cm} (1.47) \hspace{1cm} (1.39)

The numbers in parentheses show the standard errors.

The results show with an increase in the distance from orchard to the closest city, the producer's tendency to sell his/her products in the fruit and vegetable market increases, while the utility of direct sale being decreased. This is because of the considerable increase in the marketing cost through an increase in the distance, whereas according to questionnaire data, the sale price difference in these two marketing channels is negligible. Also, by increase in the experience of orchardist, the utility of direct sale is decreased and the orchardist tends to sell his/her products in the fruit and vegetable market. Again, results show that producers, whose sales occur in autumn, further tend to directly sell their products. Moreover, an increase in the sale price increases the profitability of direct sale, instead of sale in the fruit and vegetable market. It can be said that the higher sale price encourages the producers to directly sell the product. Furthermore, according to the estimated coefficient of variable Type 1, orchardists whose produce is comprised of various types of oranges (Thompson Navel, Siavaraze, Moro) less tend to directly sale their product. Also based on the estimated coefficient of variable Type 3, producers who produce different a type of citrus from
orange and mandarin, i.e. lemons, sour oranges and grapefruit, more tend to directly sell the products, rather than sale to wholesalers.

Estimation of the Binomial Logit Model of second nest deals with choice modeling between market sale and sale in place (garden). For this purpose, the statistics data from 189 producers who sell their product in the garden vs. in the market were utilized. In this case, dependent variable is taken 0 for those who sell their product to the local dealers vs. 1 for those who choose market sale (either direct sale or selling to fruit and vegetable market).

The extra step existing in this phase is calculation of bottom nest structural parameter and its entry in the current nest. In order to calculate this parameter, first, using relative utility function obtained in the previous phase, relative utility of direct sale to the selling in fruit and vegetable market, was calculated for all the 189 producers in this phase. According to Equation (2), \( I_m \) is calculated as:

\[
I_m = \ln(e^{\mu_m} + 1)
\]

Then, this calculated variable was placed into the model of this nest, as for the other variables. It is worth mentioning that, as it was discussed before, if the assumed structure is accurate for the choice, the coefficient of this variable must lie between 0 and 1. The results of estimation of this stage are shown in the Appendix 2. The final model for this nest is as follows:

\[
U_2 = 1.605 + 0.208I_m - 0.189Dis + 0.51price - 0.115Mrc - 0.062Expr
\]

(0.77) (0.09) (0.33) (0.17) (0.33) (0.22)

According to the attained results, an increase in the distance decreases the profitability of selling in the market. It can be said that suburban orchardists benefit from more update information and therefore incur less marketing costs. On the other hand, the farther orchardists, because of suffering from the more transportation and the other such marketing operations costs as warehousing, have more tendencies to sell their products when still in the garden. Also, the more experienced orchardists have less tendencies of selling their products in the market. From the level of prices point of view, with an increase in the citrus prices, the profitability of selling in the market increases and tendency of producers to sell the products to local dealers decreases. Finally, by an increase in the marketing costs, the profitability of selling the products in the market decreases and the producers have more tendencies garden to sell their products.

The estimation of binomial Logit Model of the third nest was related to the choice of selling the product either before or after fruit ripening. A total sampled data of 252 orchardists were involved to model this nest. Rank 1 is assigned to the orchardists who have sold their fruits after being ripened, and 0 to those who have forwarded their products. In this nest like in the previous ones, using the profitability functions obtained in the previous phase, the structural parameter value was determined for all the producers. Estimated results of the third nest are presented in Appendix 3. The final model for this nest is as follows:

\[
U_3 = 6.672 + 0.185I_m - 0.108Dis - 2.866Time - 0.145Mrc - 2.281Dummy - 0.092Expr - 2.676Type2
\]

(0.03) (0.72) (0.03) (0.79) (0.97) (0.05) (1.99) (0.07)

The results show that with an increase in the distance from the orchard to the closest city, producers’ tendency to pre-sale increases and the profit of selling fruits after being ripened decreases. Also the experienced orchardists benefit from a higher profit of forwarding and therefore, they are less inclined to sell their product after being ripened. The estimated coefficient of variable Time shows that orchardists whose sale occurs in the autumn are less inclined to sell their fruits when ripened. These orchardists get a higher benefit from presale. Also, with an increase in the marketing costs, the profitableness in forwarding increases and producers’ tendency to sell their fruits after ripening.
### Appendix 1. Binomial Logit Model estimation process of the first nest.

<table>
<thead>
<tr>
<th>Number of model</th>
<th>Description of Operation</th>
<th>Number of model coefficients</th>
<th>(-L(F))</th>
<th>(-L(R))</th>
<th>df</th>
<th>(-2\cdot[L(R)+L(F)])</th>
<th>(X^2), 95%</th>
<th>Model verification</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>The basic model</td>
<td>1</td>
<td>77.2528</td>
<td>77.2553</td>
<td>1</td>
<td>0.05</td>
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<td>2</td>
<td>Variable of Area entering the model*</td>
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<td>77.2553</td>
<td>1</td>
<td>2.57</td>
<td>3.84</td>
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<td>3</td>
<td>Variable of Dis. entering the model*</td>
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<td>75.4915</td>
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<td>1</td>
<td>3.53</td>
<td>3.84</td>
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<td>4</td>
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<td>75.4915</td>
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<td>0.8</td>
<td>3.84</td>
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</tr>
<tr>
<td>5</td>
<td>Variable of Expr. entering the model*</td>
<td>1</td>
<td>62.7064</td>
<td>75.4915</td>
<td>1</td>
<td>25.57</td>
<td>3.84</td>
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</tr>
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<td>6</td>
<td>Variable of Mrc. entering the model*</td>
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<td>62.6467</td>
<td>62.7064</td>
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<td>0.12</td>
<td>5.95</td>
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<tr>
<td>7</td>
<td>Variable of Price entering the model*</td>
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<td>62.7064</td>
<td>2</td>
<td>59.83</td>
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<td>8</td>
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<td>3</td>
<td>3.67</td>
<td>7.81</td>
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</tr>
<tr>
<td>9</td>
<td>Variable of Time entering the model*</td>
<td>3</td>
<td>30.0529</td>
<td>32.7878</td>
<td>3</td>
<td>5.57</td>
<td>7.81</td>
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<td>10</td>
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<td>30.0529</td>
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<td>21.11</td>
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<td>6</td>
<td>14.74</td>
<td>12.59</td>
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</table>

Source: The results. *These variables are significant at the 95% confidence interval. **These variables are significant at the 90% confidence interval.

### Appendix 2. Binomial Logit Model estimation process of the second nest.

<table>
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<tr>
<th>Number of model</th>
<th>Description of Operation</th>
<th>Number of model coefficients</th>
<th>(-L(F))</th>
<th>(-L(R))</th>
<th>df</th>
<th>(-2\cdot[L(R)+L(F)])</th>
<th>(X^2), 95%</th>
<th>Model verification</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
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<td>1</td>
<td>126.952</td>
<td>126.952</td>
<td>1</td>
<td>0.002</td>
<td>3.84</td>
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<td>Variable of L_e entering the model*</td>
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<td>3.84</td>
<td>3.84</td>
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<td>1</td>
<td>64.70</td>
<td>3.84</td>
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</tr>
<tr>
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<td>13.82</td>
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</tr>
<tr>
<td>7</td>
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<td>1.38</td>
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<td>0.099</td>
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<td>73.8380</td>
<td>6</td>
<td>0.106</td>
<td>7.81</td>
<td></td>
</tr>
</tbody>
</table>

Source: The results. *These variables are significant at the 95% confidence interval. **These variables are significant at the 90% confidence interval.
A comparison of the estimated results of the three models regarding the marketing channel selection indicates that the second and third nests had consistent results regarding the marketing costs. As the marketing costs increase, the orchardist’s natural tendency to sell his/her products through channels with a lower marketing cost will increase. Furthermore, as the citrus price rises, the producers further intend to sell their produce in place (the garden). Also, depending upon the type of the fruits, their producers’ tendencies to choose the markets in the market rather than selecting the products in the market further intensify. For instance, orchardists whose produce consists of either orange or mandarin are more inclined to sell their fruits in place (the garden), while, orchardists who produce satsuma and kinnow are more inclined to sell their fruits through channels of shorter distances from the buyers.

CONCLUSIONS

A comparison of the estimated results of the second and third nests reveals that the model verification of the binomial Logit Model for the second and third nests had consistent results regarding the marketing costs. As the marketing costs go on the increase, the orchardist’s natural tendency to sell his/her products through channels with a lower marketing cost will increase. Furthermore, as the citrus price rises, the producers further intend to sell their produce in place (the garden). Also, depending upon the type of the fruits, their producers’ tendencies to choose the markets in the market rather than selecting the products in the market further intensify. For instance, orchardists whose produce consists of either orange or mandarin are more inclined to sell their fruits in place (the garden), while, orchardists who produce satsuma and kinnow are more inclined to sell their fruits through channels of shorter distances from the buyers.
producers of the other types of citrus (except orange and mandarin), i.e. lemon, sour orange, grapefruits etc. are inclined to sell their products in the market.

REFERENCES

استراتژی کانال پazarیابی مربوط به آن در اتاق مازندران ایران: کاربردی از مدل لاجیت آشیانهای
س. م. مجاوریان، ف. رسولي، و س. غ. حسینی یکانی

چکیده

یکی از مهم‌ترین چالش‌های بیش‌روی تویلیدکننده‌گان کشاورزی، انتخاب کانال‌های توزیع محصولات است. هدف از این مطالعه بررسی استراتژی کانال پazarیابی محصولات و عوامل مؤثر بر آن در بین غذاران مربوط به آن در اتاق مازندران است. در این راستا، 252 غذاران از 15 شهرستان اتاق مازندران نمونه گردیدند. چهار کانال توزیع و سه آشیانه به منظور تعیین عوامل مؤثر بر انتخاب کانال پazarیابی در نظر گرفته شد. از آنجا که پارامتر ساختاری بین صفر و یک قرار داشته است، شرایط لازم برای انتخاب کانال است. نتایج نشان داد که فاصله با گزینه‌های غیرغیرت، تجهیزات غذاران، زمان فروش، هزینه‌های پazarیابی، نوع محصول و کانال پazarیابی غالب‌‌های مهربان عوامل مؤثر بر انتخاب نحوه توزیع در بین تویلیدکننده‌گان محصولات استان مازندران می‌باشد. بر اساس این نتایج، با افزایش فاصله با گزینه غیرت، تمایل تویلیدکننده‌گان برای فروش محصولات قندی در طیف کانال‌های کوتاه‌تر نسبت به خریداران افزایش می‌یابد. همچنین، نتایج نشان داد که غذاران قدمی‌تر در جریان ریسک‌های بیشتر ندارند. برآورد مدل لاجیت دو گانه در آشیانه‌های دوم و سوم با هزینه‌های پazarیابی سازگار است. همچنین که هزینه‌های پazarیابی بیشتر می‌شود تمایل غذاران برای فروش محصولات زیادی از طرفی کانال‌های کم سطح‌های بر افزایش می‌یابد. علاوه بر این، نتایج آماری ساخت با افزایش قیمت محصولات، تویلیدکننده‌گان تمایل بیشتری به فروش محصولات نشانه نسبت به شیوه‌های پیش‌روش می‌دارند که دلایل محدودی از خود نشان می‌دهند.