Agricultural Land Consolidation in Iran: Advantages and Limitations (The Case of Villages in Dehgolan Township, Iran)

H. Ghadermazi¹*, A. Ahmadi Dehrashid², and M. Bijani³

ABSTRACT

The purpose of this descriptive-analytical research was to analyze the advantages and limitations of agricultural land consolidation in the villages of Dehgolan Township, Iran. The statistical population of this study included 190 farmers in the villages of Dehrashid (where the adaptive consolidation plan was implemented between beneficiaries) and Telvar (in which the plan has not yet been implemented among farmers). The samples were selected from 140 people by using the Krejcie and Morgan sample size table and stratified random sampling method. The data gathering instrument was a researcher-made questionnaire, which was presented to the faculty members of the Department of Rural Geography at Kharazmi University to confirm the face and content validity. Further, the reliability of the tested items was confirmed by using the Cronbach’s alpha (α= 0.81). To analyze the data obtained from the farmers' opinions, multi-criteria decision making FTOPSIS (Fuzzy TOPSIS) analysis methods and linear regression in SPSS 24 were used. The results of regression analysis indicated that the main obstacles of implementing consolidation in the studied area were "economic" (β= 0.416) and "technical" (β= 0.304). Also, there was a significant difference between the two periods before and after consolidation of agricultural lands in terms of crop production and reduction of operating costs. In general, the effects of consolidation indicated a higher level of crops production per unit area, yield per unit area, income from agriculture and its sustainability, job diversification, and a decrease in immigration in the studied villages.

Keywords: Agriculture, Fragmented land, Fuzzy TOPSIS, Researcher-made questionnaire.

INTRODUCTION

Lack of optimal utilization of the production factors, especially land and water, is regarded as one of the most important challenges faced by rural communities, which is related to the problem of small farm size and dispersion of lands belonging to each of beneficiaries. Fragmentation of agricultural land is considered as one of the most important structural challenges in agricultural development, especially in traditional exploitation, which is related to the type of land management structure at the national level. This issue is faced by two deep-rooted problems of the small-scale equipment of exploitation and the dispersion and small-size of land for cultivation, which are largely rooted in Iran’s feudal system in the era of land reform and before (Abdullahzadeh and Kalantari, 2006; Ahmadi and Amini, 2007; Einali et al., 2013).

Land dispersion has led to a slowdown in agriculture transfer from traditional to advanced system. The high costs of production, poor income, non-optimum utilization of machinery and new technical and scientific achievements in production...
activities, as well as rural poverty as an indicator of underdevelopment, are related to land dispersion. In order to achieve self-sufficiency and food security and agricultural development, it is necessary to implement agricultural land consolidation programs by using governmental support, participation of farmers, and the private sector (Rostami et al., 2008).

The policy of land consolidation is a kind of renewal of optimal allocation in production factors based on soil and water resources through re-grouping or aggregating plots along with the process of land ownership transfer, in order to improve the land ownership structure and strives to provide the ground for the efficiency of new structures that make possible the use of modern technologies (De los Rios and Diaz, 2011). Therefore, increasing the size of plots and reducing their number is the most justifiable reason for the usefulness of land consolidation programs (Vitikainen, 2004). In order to improve the agricultural productivity, numerous efforts have been made. These include adopting appropriate policies for land management through the improvement of water and drainage management (Thomas, 2006), management of natural production resources, especially water resources (Rembold, 2003), soil and water conservation and industries development (Falkgrad and Sky, 2002), improvement of lands and rural buildings (Pašakarnis and Maliene, 2010, Xiang and He, 2012), creating the necessary infrastructure for agricultural and rural development and environmental protection (Lisec and Pintar, 2005), and providing suitable grounds for mechanization, improving the quality of land, using modern irrigation techniques, and commercial production (Huang et al., 2010).

Land consolidation provides the ground for achieving goals of rural and national development. Although distribution of agricultural land in traditional societies with traditional structures can be effective, it delays the achievement of development goals and other developmental processes in both developing and developed societies. Land dispersion not only adds to the plights of people, but also reduces their cooperation, as well as their motivation for further efforts (Roknoddin Eftekhari, 1988).

Regarding the problems and issues of dispersion of agricultural lands, to address the problems and complications of this issue, agricultural planners and policymakers recommend the logical and practical solution of the land consolidation. This approach is a policy associated with changing the land size and increasing agricultural production, rationalizing exploitation, using machinery and new crop technology and, ultimately, achieving agricultural development. In other words, this process and organization of the land are essential for the sustainable development of agriculture (Ibid).

Agricultural activities and severe land fragmentation, as one of the most important challenges of rural economies, have led to a reduction in production and, consequently, lower income of farmers, and the instability in economic growth and social development in developing countries and can reduce food security, employment, income, and rise in immigration and poverty levels in rural areas (Shirzad, 1998). On the other hand, agricultural growth (as the main source of income and rural employment) has a close relationship with the enhancement of the productivity of production factors, such that the production inputs is implemented through infrastructure development, appropriate technology, new farming methods, and farm management improvement. Therefore, land consolidation is a tool for better management of land use and the improvement of the productivity of production factors in agricultural production units and is considered as a "secret weapon" for generating economic growth and shared wealth. Thus, removing small and scattered farms as one of the important obstacles to increase production and improve the productivity of agricultural production factors and increasing the scale of exploitation units can facilitate the process of rural development and, as a result, the national development (Ghaffari et al., 2016; Abbasian et al., 2017).
In Iran, there are three conceptual approaches to land consolidation, of which the first and second approaches do not differ greatly in terms of implementation; however, the third one has different approaches including all farmers of one or several villages. The three approaches are as follows:

1. The general consolidation of the plots (landowners switching or transferring lands to one or more points)
2. Consolidation of all cultivated lands (Consolidations of lands are that under cultivation of a specific crop and belongs to several farmers)
3. Land consolidation (reallocation of all agricultural lands and the formation of larger farms) (Einali et al., 2013).

There are not many differences between the three types of land consolidation. However, their executive approach is different in Iran. This difference stems from the variability in the pattern of crop cultivation [according to the geographical pattern of rain reduction (in Iran, with movement of north to the south due to locate on the warm and dry belt of the earth decreases the amount of rainfall decreases)]. For example, in the western parts of Iran, especially in Kurdistan, some of the plain areas have high fertile land, but most of the western borders of the province are mostly mountainous and there is no opportunity for agricultural activity and more gardening is done in this area. In the northern regions, as there are many fertile lands and a rainy area, the second method is often implemented. The third method is also not implemented in the current situation due to the division of land and the diversity of minorities as well as the existence of the law of inheritance. However, during implementation of the third phase of land reform (1960-1970s), land consolidation was used.

Although many efforts have been made in this regard in Iran, a technological gap is still tangible in global analogy and competition. The dispersion and small size of agricultural lands are regarded as a deep-rooted challenge. Working on a land that is divided into large and small pieces has many problems for the farmer. The most important problems mentioned by the farmers are water conveyance losses (Yazdanpanah et al., 2014; Bijani et al., 2017; Mirzaei et al., 2017, Valizadeh et al., 2018) and irrigation problems, non-use of agricultural machinery because of the land dispersion, the high percentage of fragmented lands, low yield of agricultural products, the problem of traffic, absence of roadways between farms, low area under cultivation, lack of access to inputs (pesticides and fertilizer), conflict and struggle over water and land, waste of time, and the need for more due to the increase in the number of plots (Yasuri et al., 2012). These issues increase costs and, consequently, reduce profits, despite the great difficulty (Derakhshanfar, 2011). It should be noted that many actions [such as agricultural activities (planting, harvesting, harvesting) as collectively, forming community groups] have been taken in the last few years in Iran; however, most farm lands are still fragmented despite the problems due to fragmentation. Although this issue has a long history in Iran, the desired goals have not been reached due to the lack of social, economic, and technical constraints. The dispersion of land plots is one of the elements of the traditional agricultural structure of the country, which has gradually lost its positive role to the extent that it has become a major hindrance to the advancement and promotion of agriculture and, consequently, a serious problem for the rural society and agricultural development in the present circumstances (Ibid).

In this regard, the present study aimed to investigate the limitations and advantages of land consolidation in some villages in Dehgolan Township. Obviously, the results of this study can be used to understand the problems and challenges of rural economy used by managers, planners and policy makers of rural development in Iran.

MATERIALS AND METHODS

Theoretical Background

There have been various studies and analyses on the advantages and limitations of land consolidation in villages. Some studies express that there was a significant
difference in the number of land plots of each exploiter, the area under the cultivation before and after the implementation of the plan, as well as the yield of wheat and barley, the area covered by the pressurized irrigation systems, the cost of using machinery for plowing, plotting, fringe, nesting and frescos (Farzoni: in this way the field surface becomes shallow and stacked after planting and softening to plant some crops such as potatoes), the cost of land preparation, planting costs, the rate of using machinery for fertilizing, seeding, harvesting and transporting the product, the use of pesticides and workers, as well as the rate of using water. These created significant changes in the productivity of the production factors (Ghaffari et al., 2016). Another study showed that land consolidation improved the technology, farm management, cropping pattern in terms of size and number and water transfer methods, increased the scope of exploitation and production efficiency, reduced costs, saved water consumption and time, and achieved farmers’ satisfaction in the villages where the consolidation plan was implemented (Aslan et al., 2007; Zou et al., 2008; Lisec et al., 2012; Yasuri et al., 2012).

In addition, Tahamipour and Shahmoradi (2007) indicated that the annual average growth rate of productivity of the production factors was 0.8.3 in the agricultural sector during the years from 1967 to 2003, by measuring the general productivity growth of the production factors in the agricultural sector and its contribution to the value added. Investigations on the impact of land consolidation on agricultural products show that land consolidation has a significant impact on the reduction of plots number, increase in area under cultivation, decrease in water use, increase in using agricultural machinery, increase in the yield of agricultural products and, ultimately, increase in farmers’ income in the region. Thus, there is a direct relationship between land consolidation and its mechanization with agricultural production (Alizadeh and Kaykha, 2010) and land consolidation reduced the production costs, especially the transportation and the machinery costs, and increased and diversified production (Roknoddin Eftekhari, 1998). Gonzalez Garcia (2007) in Spain showed that land consolidation programs are an important step in improving the labor efficiency and the optimal land productivity. In addition, farmers’ awareness of the economic and social outcomes of land consolidation, the transfer of useful information from promoters to farmers, and government support programs are effective factors in accepting consolidation (Gonzales Garcia, 2007).

Review of previous studies has led to the identification of a set of variables in the form of obstacles and consolidation effects, which are shown in Figure 1.

### Methodology

The method of this research is a descriptive-analytic approach. A survey technique was used to collect descriptive data from reference library sources. The statistical population of this study was 90 farmers from Dehrashid village, where all the villagers had consolidated their agricultural lands, and 100 farmers from the village of Telvar who had not implemented the agricultural land consolidation. These villages are located in the suburb of Dehgolan Township in Kurdistan Province (Figure 2). In this regard, the examined samples included 140 people and were selected using the Krejcie and Morgan’s table (Krejcie and Morgan, 1970) and stratified random sampling method with proportional assignment. The data-gathering tool was a researcher-made questionnaire that was presented to the faculty members of the Rural Geography Department of Kharazmi University to confirm visual and content validity. Further, the reliability of the tested items in the advantages and limitations of consolidation was confirmed by using Cronbach’s alpha (Cronbach, 1951) (α= 0.81). To analyze the data obtained from the farmers’ opinions, multi-criteria decision making (Fuzzy-TOPSIS) analysis methods and linear regression in SPSS software was used. The compilation of Fuzzy-TOPSIS
method is the most recent and accurate analytical method in research on the nature of the assessment of multiple analyses in various societies. Especially in cases where the variance between the data in the samples is very low and the relationships between variables are vague and uncertain, this method is used to measure the accuracy of the analysis and measurement of the relationships and their effect levels is between zero and one. Therefore, the results of this method are highly accurate. This compilation technique can provide quantitatively and mathematically many of the concepts and variables that are inaccurate and ambiguous, providing a ground for reasoning, deduction, control, and decision making in conditions of uncertainty. In the present study, considering that multi variables with different nature are investigated in two different societies, application of this method has been useful due to its high accuracy.

The variables examined in this study have been identified based on previous studies and field surveys (Tables 1 and 2). Subsequently, for each variable, items and questions were developed in the form of a five-point Likert scale and provided to the sample population, such that its results could be used to achieve the research goal.

The questionnaires designed by FTOPSIS were used to identify the most important component and prioritize the variables to
Table 1. The obstacles to agricultural land consolidation.

<table>
<thead>
<tr>
<th>Components</th>
<th>Variables</th>
<th>Indicator</th>
</tr>
</thead>
<tbody>
<tr>
<td>Individual and social obstacles</td>
<td>Lack of trust of farmers to each other</td>
<td>O1</td>
</tr>
<tr>
<td></td>
<td>Lack of interest in group and collective work</td>
<td>O2</td>
</tr>
<tr>
<td></td>
<td>Dependence of farmers on their land</td>
<td>O3</td>
</tr>
<tr>
<td></td>
<td>Low farmer literacy</td>
<td>O4</td>
</tr>
<tr>
<td></td>
<td>The existence of laws such as inheritance and endowment (Waqf)(^1)</td>
<td>O5</td>
</tr>
<tr>
<td></td>
<td>Aging of farmers</td>
<td>O6</td>
</tr>
<tr>
<td></td>
<td>Lack of trust of farmers in the government and its programs</td>
<td>O7</td>
</tr>
<tr>
<td></td>
<td>The existence of traditional beliefs in the village</td>
<td>O8</td>
</tr>
<tr>
<td>Economic obstacles</td>
<td>Land price difference</td>
<td>O9</td>
</tr>
<tr>
<td></td>
<td>Fear of losing individual land ownership (^b)</td>
<td>O10</td>
</tr>
<tr>
<td></td>
<td>Fear of risk due to poverty and bad economic conditions</td>
<td>O11</td>
</tr>
<tr>
<td>Technical obstacles</td>
<td>The difference in land quality and access to water and road resources</td>
<td>O12</td>
</tr>
<tr>
<td></td>
<td>The high dispersion of land</td>
<td>O13</td>
</tr>
<tr>
<td></td>
<td>Traditional exploitation</td>
<td>O14</td>
</tr>
<tr>
<td></td>
<td>Lack of access to water resources (Wells and rivers, etc.)</td>
<td>O15</td>
</tr>
<tr>
<td></td>
<td>A large number of people working in agriculture</td>
<td>O16</td>
</tr>
<tr>
<td></td>
<td>The multiplicity of agricultural land plots for each household</td>
<td>O17</td>
</tr>
<tr>
<td></td>
<td>Lack of awareness of farmers about the technical benefits of consolidation</td>
<td>O18</td>
</tr>
<tr>
<td>Organizational obstacles</td>
<td>Lack of written and specific rules for land valuation</td>
<td>O19</td>
</tr>
<tr>
<td></td>
<td>Lack of a specific organization to implement the plan and pay compensation for land swap</td>
<td>O20</td>
</tr>
<tr>
<td></td>
<td>Absence of training-promoting classes in the field of consolidation</td>
<td>O21</td>
</tr>
</tbody>
</table>

\(^a\) O in column of indicator is abbreviation of the word Obstacle. \(^b\) The fear of losing individual ownership is a factor resulting from the economic thinking of farmers, which means the loss of land and its consequences as poverty. This idea provides the basis for creating social barriers, including farmers’ lack of trust in each other and lack of interest in teamwork. Hence, the fear of individual ownership (as an economic barrier) provides the basis for the emergence of social barriers.

achieve the research objectives. This method was a generalization of the TOPSIS method in the management science, in which the predictions of experts were initially expressed in terms of definite numbers. This theory can express many of the inadequate concepts and phrases with mathematical language and provide a ground for reasoning, inference, control, and decision-making in uncertainty conditions. In this theory, a fuzzy number is a special fuzzy set as \( \hat{A} = x \in R/\mu_{\hat{A}}(x) \) in which \( x \) accepts the real values of the set member of \( R \) and its membership function is \( \mu_{\hat{A}}(x) \). The most commonly used fuzzy numbers are triangular and trapezoidal fuzzy numbers. Triangular fuzzy numbers are more commonly used due to their simpler computations. Hence, we used fuzzy triangular numbers in this study. A triangular fuzzy number (\( A \)) with the step-linear membership function of \( \mu_A \) is defined as (1):

\[
\mu_A(x) = \begin{cases} 
1, & a_1 \leq x < a_m \\
\frac{(a_r-x)}{(a_r-a_m)}, & a_m \leq x \leq a_r 
\end{cases}
\]

This can be represented as triangular fuzzy numbers \((a_1, a_m, a_r)\). Figure 3 illustrates this membership function.

If \( A = (a_1, a_m, a_r) \) and \( B = (b_1, b_m, b_r) \) are two triangular fuzzy numbers, the function of the distance \( d(A, B) \) is defined as (2) (Chang, 2002):

\[
d(A, B) = \sqrt{\frac{1}{3}[(a_1-b_1)^2 + (a_m-b_m)^2 + (a_r-b_r)^2]}
\]

After receiving expert opinions in the first stage, the fuzzy numbers (\( \hat{A}_{ij} \)) are then...
<table>
<thead>
<tr>
<th>Components</th>
<th>Variables</th>
<th>Indicator</th>
</tr>
</thead>
<tbody>
<tr>
<td>Changing in production rate</td>
<td>Crop yield per unit area in agricultural lands</td>
<td>E1&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td></td>
<td>The production rate in garden products</td>
<td>E2</td>
</tr>
<tr>
<td></td>
<td>Cultivating market products with guaranteed purchase</td>
<td>E3</td>
</tr>
<tr>
<td></td>
<td>Reducing the diversity of cultivated products</td>
<td>E4</td>
</tr>
<tr>
<td></td>
<td>Increasing production due to the possibility of using agricultural machinery</td>
<td>E5</td>
</tr>
<tr>
<td></td>
<td>The possibility of cultivating uneven lands in farm</td>
<td>E6</td>
</tr>
<tr>
<td></td>
<td>Increasing the land under cultivation because of the use of rain irrigation</td>
<td>E7</td>
</tr>
<tr>
<td></td>
<td>Increasing yield per unit area</td>
<td>E8</td>
</tr>
<tr>
<td>Investing in agricultural activities</td>
<td>Establishing facilities on the farm (Warehouse, labor resting place ...)</td>
<td>E9</td>
</tr>
<tr>
<td></td>
<td>Ability to provide timely delivery of facilities and machinery</td>
<td>E10</td>
</tr>
<tr>
<td></td>
<td>Access and use of agricultural credits and insurance of crops and livestock</td>
<td>E11</td>
</tr>
<tr>
<td></td>
<td>Investing in soil leveling</td>
<td>E12</td>
</tr>
<tr>
<td></td>
<td>Investing in water conveyance</td>
<td>E13</td>
</tr>
<tr>
<td></td>
<td>Investing in improving the cultivation process</td>
<td>E14</td>
</tr>
<tr>
<td></td>
<td>Buying agricultural machinery</td>
<td>E15</td>
</tr>
<tr>
<td></td>
<td>Increasing investment in improving land quality (Using micronutrient fertilizers and ...)</td>
<td>E16</td>
</tr>
<tr>
<td>Increasing incomes and employment in the agricultural sector</td>
<td>Job diversification</td>
<td>E17</td>
</tr>
<tr>
<td></td>
<td>Increasing agricultural incomes and sustainability</td>
<td>E18</td>
</tr>
<tr>
<td></td>
<td>Reducing immigration among active people and among families</td>
<td>E19</td>
</tr>
<tr>
<td></td>
<td>The variety of income sources</td>
<td>E20</td>
</tr>
<tr>
<td></td>
<td>Using family workforce</td>
<td>E21</td>
</tr>
<tr>
<td>Agricultural activities costs</td>
<td>Saving time at different stages and reducing the resulting risk</td>
<td>E22</td>
</tr>
<tr>
<td></td>
<td>Saving in the consumption of agricultural inputs</td>
<td>E23</td>
</tr>
<tr>
<td></td>
<td>Saving by decreasing movement of machinery</td>
<td>E24</td>
</tr>
<tr>
<td></td>
<td>The simultaneous performing of agricultural activities and livestock maintenance at the farm</td>
<td>E25</td>
</tr>
<tr>
<td></td>
<td>Increasing the level of family members' cooperation in agricultural activities</td>
<td>E26</td>
</tr>
<tr>
<td></td>
<td>Saving in water consumption</td>
<td>E27</td>
</tr>
<tr>
<td></td>
<td>Accessing and transferring inputs and products to the farm and vice versa</td>
<td>E28</td>
</tr>
<tr>
<td></td>
<td>Common ownership of machinery</td>
<td>E29</td>
</tr>
</tbody>
</table>

<sup>a</sup> E in column of indicator is abbreviation of the word Effect.
calculated in the next step in this model. Given the choice of triangular fuzzy numbers in the research model, these numbers are defined in the form of quadruple relations:

\( a_{ij} = (\alpha_{ij}, \beta_{ij}, \gamma_{ij}) \)

\( \alpha_{ij} = \min(\beta_{ijk}), k = 1, \ldots, n \)

\( \delta_{ij} = (\prod_{k=1}^{n} \beta_{ijk})^{1/3} \)

\( \gamma_{ij} = \max(\beta_{ijk}), k = 1, \ldots, n \)

Where, \( \beta_{ij} \) represents the relative importance of the parameter \( i \) on the parameter \( j \) from the \( k \)th expert's point of view, \( \gamma_{ij} \) indicates the upper limit of the experts opinions and \( \alpha_{ij} \) is the lower limit of the experts' opinions for the research variables. In these relations, \( \delta_{ij} \) is the geometric mean of experts’ opinions. Obviously, the fuzzy components should be defined as follows: \( \gamma_{ij} \leq \delta_{ij} \leq \alpha_{ij} \). Table 3 presents the values of components or fuzzy numbers for evaluating the experts on the research indicators.

In the following, after quantifying indicators based on Table 1, the matrix of the required indices is formed as follows:

\[
G = [G_{1}, G_{2}, \ldots, G_{n}] \\
A \begin{bmatrix} A_{1} & C_{1} & C_{2} & \cdots & C_{n} \end{bmatrix} \\
A_{2} \begin{bmatrix} G_{11} & G_{12} & G_{13} & \cdots & G_{1n} \end{bmatrix} \\
A_{n} \begin{bmatrix} G_{n1} & G_{n2} & G_{n3} & \cdots & G_{nn} \end{bmatrix}
\]

Here, \( A_{1}, A_{2}, \ldots, A_{n} \) are possible options that experts should evaluate. \( C_{1}, C_{2}, \ldots, C_{n} \)

are Criteria that are considered with respect to the options. \( G_{ij} \) represents the rate of \( A_{i} \) option versus the Criterion \( C_{j} \), and \( W_{i} \) is the Weight of \( C_{j} \). In the process of evaluating these weights, the importance degree of the criteria presented by experts (in this research, the councils) is represented by linguistic terms (Wang, 2008).

We assume that \( b_{ij}(e) \) indicates the value of the representing index \( j \) in the period of \( e \), where \( i=1, 2, \ldots, m \), \( j=1, 2, \ldots, n \) and \( e=1, 2, \ldots, t \). Regarding the concept of triangular fuzzy numbers, we define \( G_{ij} \) as:

\[
G_{ij} = (g_{ij}^{1}, g_{ij}^{m}, g_{ij}^{s})
\]

Where,

\[
g_{ij}^{1} = \min\{b_{ij}(e) \mid e = 1, 2, \ldots, t\}
\]

\[
g_{ij}^{m} = \frac{1}{t} \sum_{e=1}^{t} b_{ij}(e)
\]

\[
g_{ij}^{s} = \max\{b_{ij}(e) \mid e = 1, 2, \ldots, t\}
\]

Therefore, \([G_{ij}], [G_{i2}, \ldots, G_{in}]\) indicates the performance ranks of \( A_{i} \) in \( n \) criteria.

In the following, using MAX and MIN operators, the positive ideal (A') and negative ideal (A) solutions are identified for the options set.

\[
A' = [G_{1}', G_{2}', \ldots, G_{n}']
\]

\[
A = [G_{1}^{'}, G_{2}^{'}, \ldots, G_{n}^{'}]
\]

In above relations, \( G_{i}^{-} \) and \( G_{i}^{+} \), which are triangular fuzzy numbers as the relation (9), are composed of the smallest and largest quantities of \( g_{ij}^{1}, g_{ij}^{m}, g_{ij}^{s} \), and \( g_{ij}^{1} \) for the \( n \)th option, respectively, \( d_{ij}^{-} \) and \( d_{ij}^{+} \) represent the distance of \( G_{ij} \) from \( G_{i}^{-} \) and \( G_{i}^{+} \), respectively, and are calculated using the following formulas:

\[
d_{ij}^{-} = d(G_{i}, G_{j}) = \frac{1}{3}\sqrt{[(g_{ij}^{1} - g_{ij}^{-})^{2} + (g_{ij}^{m} - g_{ij}^{-})^{2} + (g_{ij}^{s} - g_{ij}^{-})^{2}]
\]

\[
(i=1,2,\ldots,m), (j=1,2,\ldots,n)
\]

\[
d_{ij}^{+} = d(G_{i}, G_{j}) = \frac{1}{3}\sqrt{[(g_{ij}^{1} - g_{ij}^{+})^{2} + (g_{ij}^{m} - g_{ij}^{+})^{2} + (g_{ij}^{s} - g_{ij}^{+})^{2}]
\]

\[
(i=1,2,\ldots,m), (j=1,2,\ldots,n)
\]

Fuzzy Numbers are used to determine the coefficient of the importance of different decision criteria. In this case,
RESULTS AND DISCUSSION

The analysis of the limitations of agricultural land consolidation in the studied areas indicated that (Table 4) the main obstacles to land consolidation in the studied villages were the individual and social obstacles (the existence of laws such as inheritance and endowment, as well as the low literacy of farmers and the aging of most of them), economic obstacles (fear of loss of individual ownership), and technical obstacles (high number of employed people). One of the most important obstacles to land consolidation is the study villages.

Further, the analysis of the effects of land consolidation in the studied villages revealed that land consolidation caused changes in production rate and investment in agricultural activities and increased income and, consequently, reduced the agricultural activities costs. Also, results of research showed in survey studied variables based on its components. Based on the results, land consolidation increased the amount of crops production per unit area, reduced the diversity of cultivated products and increasing production performance per unit area is eliminated for duplication above. In
the component of accomplished investments, land consolidation caused investment in soil leveling and investment in improving the cultivation process and improve ability to timely supply inputs. On the other hand, consolidation increased the income resulting from agriculture and its sustainability, enhanced job diversification and decreased migration among active people and between families in the component of increased incomes and employment. In addition, the process of consolidation led to saving in water consumption and time at different stages, and reduced the risk of it and simultaneous performance of the agricultural activities and keeping livestock on the farm in the component of agricultural activities costs (Table 5).

The effect of effective obstacles on agricultural land consolidation in the studied villages was investigated by using the linear regression method. In this method, two parameters of the standardized effect factor Beta ($\beta$) and the Sig. value are used for better interpretation. In this regard, any variable whose Sig. value is closer to zero and its Beta coefficient is closer to 1 indicates the level of significance of its effect. The results indicated that the maximum impact was related to the economic ($\beta = 0.419$) and technical obstacles ($\beta = 0.304$), respectively.

This suggests that the difference between land prices and the unfavorable economic conditions of farmers and the fear of losing the individual ownership of agricultural land, along with the extensive dispersion in lands, traditional exploitation, multiple plots...
of agricultural lands in each household, lack of access to water resources (wells, rivers etc.), as well as the traditional exploitation system of agricultural land have prevented consolidation of agricultural land (Table 6 and Figure 4).

Figure 4 shows the relationship between independent variables (horizontal axis) and dependent variables (vertical axis). Given that the direction of the linear axis is from low values to incremental values, the analysis of this graph shows that there is a direct relationship between the variables and the higher the density of the points around the linear axis. This indicates that the relationship between the variables is significant, as seen in Figure 4.

Further, the average change in the components of agricultural land consolidation was investigated in the studied villages, in order to increase the efficiency of production factors and improve productivity in the period before the implementation of the land reform plan and after implementation of consolidation as an agreement between the beneficiaries, based on the results of the study. The results revealed the difference in all measured components, in such a way that the greatest difference was seen in the component of the change in production and the change in the cost of agricultural activities. This result suggested that land consolidation improved the productivity and reduced production costs in the studied villages (Table 7).

CONCLUSIONS

The present study aimed to analyze the

**Table 6.** The effects of effective obstacles components on agricultural land consolidation.

<table>
<thead>
<tr>
<th>Model</th>
<th>Non-standard coefficient B</th>
<th>Std Error</th>
<th>Standardized effective coefficient Beta</th>
<th>t</th>
<th>Sig</th>
</tr>
</thead>
<tbody>
<tr>
<td>(Constant)</td>
<td>5.428</td>
<td>3.708</td>
<td>-</td>
<td>1.464</td>
<td>0.150</td>
</tr>
<tr>
<td>Social and individual barriers</td>
<td>-0.066</td>
<td>0.088</td>
<td>-0.110</td>
<td>-0.745</td>
<td>0.460</td>
</tr>
<tr>
<td>Technical barriers</td>
<td>0.335</td>
<td>0.132</td>
<td>0.304</td>
<td>2.547</td>
<td>0.014</td>
</tr>
<tr>
<td>Economic barriers</td>
<td>0.379</td>
<td>0.159</td>
<td>0.419</td>
<td>2.383</td>
<td>0.021</td>
</tr>
<tr>
<td>Organizational barriers</td>
<td>0.210</td>
<td>0.150</td>
<td>0.215</td>
<td>1.399</td>
<td>0.168</td>
</tr>
</tbody>
</table>

**Figure 4.** The spatial orientation of the impact of obstacles on agricultural land consolidation.
advantages and limitations of land consolidation in the villages of Dehgolan Township. Given the importance and position of the agricultural sector in development at various levels, especially rural development, creation of employment areas, income, and population welfare, this sector faces numerous structural challenges. The ownership structure of agricultural lands, such as the fragmentation of land belonging to each farmer and, consequently, the increase of the agricultural activities costs, the loss of production inputs, and the reduction of production efficiency are among the main challenges associated with the productivity of the production factors. Therefore, integration policies have been used as a successful tool in mobilizing rural development. Investigation of the economic effects of land consolidation programs and identification of the weaknesses and strengths of these programs and their rooting can be effective in achieving the goals of agricultural and rural development programs, which is the increase of the rural production and income and the optimal exploitation of production factors. Over the past two decades, agricultural land consolidation has been implemented in the studied area in a few villages that have access to water resources (wells and rivers) as cooperative and adaptive. In some other villages of the studied area, this plan has not yet been comprehensively implemented due to its challenges and obstacles, despite the importance of the issue.

In this regard, the limitations and advantages of land consolidation in the studied villages indicated that the economic and technical issues were the main obstacles to consolidation. This suggests that the difference between land prices and the unfavorable economic conditions of farmers and the fear of losing the individual ownership of agricultural land, along with the extensive dispersion, traditional exploitation, multiple plots of agricultural lands in each household, and lack of access to water resources (wells, rivers etc.) have prevented the consolidation of agricultural land. These results are in accordance with or in accordance with the findings of Mahdavi et al. (2017). These issues have caused other problems in the studied villages, which are:
- Reduction in the area under cultivation of agricultural crops
- Reduction in the yields of agricultural and horticultural crops
- Wasting water resources
- Increasing costs of planting, maintaining, and harvesting
- Reduction in sustainable income
- Lack of investment

Furthermore, the results in the study of obstacles showed that the existence of laws such as inheritance and endowment, as well as the low literacy of farmers and the aging of most of them, fear of loss of individual ownership, high number of employed people in agriculture, lack of access to water resources (wells, rivers, etc.), the difference in land quality and access to water resources and roads, and inexistence of written and precise rules for land valuation are among the most important obstacles in each of the

Table 7. Effects of agricultural land consolidation in the period before and after its implementation

<table>
<thead>
<tr>
<th>Components</th>
<th>Average</th>
<th>Change in production rate</th>
<th>Investing in agricultural activities</th>
<th>Change in income and employment</th>
<th>Agricultural activities costs</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Before</td>
<td>After</td>
<td>Before</td>
<td>Before</td>
</tr>
<tr>
<td>Average</td>
<td></td>
<td>0.251</td>
<td>0.413</td>
<td>0.255</td>
<td>0.026</td>
</tr>
<tr>
<td>After</td>
<td></td>
<td></td>
<td>0.413</td>
<td>0.293</td>
<td>0.059</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
research components. The findings of this section are consistent with the findings of Mahdavi et al. (2017).

Regarding the effectiveness of the land consolidation plan in the studied villages on issues such as increase in crop production rate per unit area, reducing the diversity of cultivated products and increasing the yield per unit area, increasing investment in soil leveling and improving the stages of cultivation and the ability to ensure the timely provision of institutions and machinery, increasing the income from agriculture and its sustainability, job diversification and the reduction of immigration among active people and families, the results of this section are consistent with the findings of Wu et al. (2005), Yasuri et al. (2012), Fall Soleyman et al. (2011), Zarifian et al. (2011), Einali et al. (2013), and Ghaffari et al. (2016).

In order to explain the positive effects of land consolidation plan, it is necessary to mention some points: Wherever (for example the village of Dehrashid) the consolidation plan took place, the productivity and the level of cultivation of some products, including alfalfa, increased. This has led to the development of livestock husbandry and even the development of livestock processing industries and related service industries and some other businesses in the countryside. Therefore, agricultural land consolidation can boost employment, diversify jobs and income sources in rural areas. Affected by these consequences, over the past two decades, the return of young migrants from the city to the countryside has occurred and the survival rate of the population in the village has improved. In the village of Dehrashid, especially in the seasons of planting and harvesting, unemployed young people are attracted to agricultural activities, especially in the fall season. To harvest agricultural products, the labor force population (including unemployed youth, urban households), from nearby cities (Dehgolan, Ghorveh and Sanandaj) come to work in this village. However, in the village of Telvar, which is located about three kilometers from Dehrashid and does not include land consolidation, during the last decade, immigration rate has been on the rise and population has declined, and there has been a downturn in the rural economy.

Since agricultural sector is regarded as one of the three main sectors of the economy of each country and is responsible for supplying food in each country, both at the household level and at the industry level (due to the inter-sectional link.), it should receive due attention and the emphasis on the rapid development of agricultural sector should be considered as one of the main priorities of policymakers, planners, and decision makers.

ACKNOWLEDGEMENTS

The authors hereby express their special gratitude to all the rural people who completed the study questionnaires with great patience as well as the surveyors and interviewers who did their best in terms of data collection.

REFERENCES


در آن این طرح تاکنون میان کشاورزان اجرای آن‌ها است، بود در این راستا، به عنوان نمونه، ۱۴۰ نفر با بهره‌گیری از جدول نمونه گیری گرجسی و مردان و میان نمونه گیری تصادفی طبقه‌ای بان هنگام انتخاب شدند. اثر جمع آوری داده‌های پرسشنامه محقق‌ساخته که جهت تأیید روایی صوری و محتملی، در اختیار یکی از اعضای هیأت علمی گروه جغرافیای روستایی دانشگاه خوارزمی قرار داده شد. همچنین، یکی گویی‌های مورد استفاده با استفاده از آلفای کروناخ، مورد تأیید قرار گرفت (۸۱/۰/۰ = α). جهت تجزیه و تحلیل داده‌های بدست آمده از نظرت کشاورزان از روش‌های تحلیل تصمیم‌گیری چند معاصر (فازی تایپسیس) و رگرسیون خطی در نرم‌افزار ویس انجام شد. نتایج تحلیل رگرسیون نشان داد که مهم‌ترین عوامل اجرای پیکارچه‌سازی زمین‌های کشاورزی در ناحیه مورد بررسی، مواد "اقتصادی" (۴۱۶/۰/۰)، "اقتصادی-فیزیکی" (۴۱۶/۰/۰) هستند. همچنین نتایج معنی‌داری میان دو دوره قبل و بعد از اجرای پیکارچه‌سازی در میزان تولید و کاهش هزینه‌های بهره‌برداری، مشاهده شد. در کل، اثرات پیکارچه‌سازی، بیانگر افزایش میزان تولید در واحده سطح در محصولات زراعی، عملکرد در واحده سطح، درآمد حاصل از کشاورزی و پایدار بودن آن، نوع گویی و نیز کاهش مهاجرت در روستاهای مورد مطالعه بود.