Original Article

A comprehensive model for the implementation of agricultural land levelling and consolidation plan in the Abu Fazel region of Ahvaz

Modelo abrangente para a implementação do plano de nivelamento e consolidação de terras agrícolas na região de Abu Fazel, de Ahvaz

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Abstract

It has been shown that land fragmentation can negatively impact the efficiency of farming. Therefore, experts recommend land consolidation process, as a logical and workable solution to solve the problems and complications caused by land fragmentation. Land levelling and consolidation is a process of land reform that changes the construction of agricultural lands which leads to rural development through reforming farm management. However, a single plan cannot be applied to different regions, even though they might be in the same country. Hence, it is vital to investigate multiple factors in a certain region to devise the perfect consolidation plan.

The present study, which is a survey-exploratory research, is conducted to provide a comprehensive model to implement the plan for levelling and consolidation of agricultural lands in the Abu Fazel region of Ahvaz, Iran. This research is an applied field research which uses both library and field methods to collect the required data. The study population is in Abu Fazel in the northeast of Ahvaz in Zargan region. The results of the study show that cultural, social, economic, policy-making, educational, agricultural and managerial factors have an effect on the participation of farmers in the levelling and consolidation of agricultural lands in the study area ($p \geq 0.01$). Also, there is a strong positive relationship between these factors and the farmers' participation in levelling and consolidation of agricultural lands ($p \geq 0.01$). Among these factors, it is observed that policy is main factor. Policymakers can play an effective role in land consolidation and macro development on the one hand and agricultural and rural development. On the other, by accurately assessing the interactive effect of land consolidation and related factors, along with the effects of this process on the evolution of agronomic systems.

Keywords: agriculture, land levelling, land consolidation, land fragmentation, Ahwaz.

Resumo

Tem sido demonstrado que a fragmentação da terra pode impactar negativamente a eficiência da agricultura. Portanto, os especialistas recomendam o processo de consolidação de terras como uma solução lógica e viável para resolver os problemas e as complicações causadas pela fragmentação de terras. O nivelamento e a consolidação da terra são processos de reforma agrária que alteram a construção de terras agrícolas, o que leva ao desenvolvimento rural por meio da reforma da gestão agrícola. No entanto, um único plano não pode ser aplicado a diferentes regiões, mesmo que estejam no mesmo país. Portanto, é vital investigar vários fatores em determinada região para elaborar o plano de consolidação perfeito.

O presente estudo, que é uma pesquisa exploratória de levantamento, é realizado para fornecer um modelo abrangente para implementar o plano de nivelamento e consolidação de terras agrícolas na região de Abu Fazel, de Ahvaz, no Irã. Trata-se de uma pesquisa de campo aplicada que usa métodos de biblioteca e de campo para coletar os dados necessários. A população do estudo está em Abu Fazel, no nordeste de Ahvaz, na região de Zargan. Os resultados do estudo mostram que fatores culturais, sociais, econômicos, políticos, educacionais, agrícolas e gerenciais influenciam a participação dos agricultores no nivelamento e na consolidação das terras agrícolas na área de estudo ($p \geq 0,01$). Além disso, há forte relação positiva entre esses fatores e a participação dos agricultores no nivelamento e na consolidação das terras agrícolas ($p \geq 0,01$). Entre esses fatores, observa-se que a política é o principal deles. Os formuladores de políticas, por um lado, podem desempenhar um papel efetivo na consolidação da terra e no macrodesenvolvimento e desenvolvimento agrícola e rural e, por outro, avaliar com precisão o efeito interativo da consolidação de terras e fatores relacionados, juntamente com os efeitos desse processo na evolução dos sistemas agronômicos.

Palavras-chave: agricultura, terraplanagem, consolidação de terras, fragmentação de terras, Ahwaz.

1. Introduction and Background

To ensure food security of people and to maintain the health of the community, it is required to meet the necessary conditions to preserve and protect existing lands for their continuous and effective use (Prosekov and Ivanova, 2018). Hence, one of the important missions of governments and people of any society is sustainable land management and planning to organize, protect and optimally use agricultural lands as basic sources of food supply and ensure the continuity of human life. Therefore, in recent decades, the issue of land management and implementation of laws and regulations related to public and private ownership and land use in Iran has faced complex and numerous challenges. Solving these challenges requires cooperation and coordination between people and government. Additionally, increasing the interaction and synergy of all executive, legislative and regulatory bodies, utilizing the knowledge and experience of domestic and international experts in this field and creating a research-based planning system are of utmost importance.

1.1. Land fragmentation

Research studies related to land consolidation have shown that one of the challenges facing sustainable rural development programs in the transition from tradition to modernity is the fragmentation of farmers' agricultural lands (Ntihinyurwa and Vries, 2021). The fragmentation of agricultural lands can be categorized into two types. First, lands with artificial or natural boundaries distributed between different owners. This type of fragmentation is an obstacle to the rational and optimal use of land and other production factors and reduces the efficiency of the entire activity in a geographical area. The second type is the fragmentation of the lands of each owner in distant and often small parts, which also adds to the first type and as mentioned by studies such as Khan et al. (2022) leads to the aggravation of the whole situation. Such an arrangement of agricultural lands which is not a new phenomenon and not specific to Iran, has been formed under special conditions and has had positive functions. However, with the formation of a new system of production and social relations, these positive functions have not only lost their advantages but have gradually become a deterrent to agricultural and rural development (Ali et al., 2019; Ghadermazi et al., 2020; Ramalingam et al., 2022; Farani et al., 2022; Hosseini, 2022a; Panbehch and Bozorgkhou, 2017).

Currently, about two-thirds of Iran's arable land is often owned by individuals and scattered in small fragments and non-geometric shapes. This issue causes disruption in land use and optimal use of factors of production. The harmful impacts of land fragmentation on the process of agricultural transfer from traditional to modern status is gradually becoming evident, especially with the expansion of the relation between villages and cities and the formation of local, regional and international markets. Fragmentation can lead to technical problems such as inefficient use of water, low productivity, high production costs, waste of resources, consolidation and expansion of inappropriate agricultural patterns, inefficiency of farm management, ineffective use of machinery and new technical tools and scientific achievements in production activities, disputes between farmers and weakening of social solidarity in rural society which ultimately leads to poverty and rural migration. Each one of these issues is an indicator of underdevelopment (Hoang, 2021; Nam et al., 2021).

1.2. Land consolidation

In order to achieve self-sufficiency and food security and agricultural development in regions that contain fragmented agricultural lands, it is necessary to implement the agricultural land consolidation plan with the help of the government and the participation of farmers and the private sector (Ahmad et al., 2021; Jahandini et al., 2020; Liu et al., 2016; Rejaei et al., 2010). Therefore, today, land consolidation is a key policy for the optimal use of tools and production facilities and it is also considered a necessary step towards the establishment of a developed agriculture (Berlinck et al., 2022). Also, land consolidation is considered as a process of land reform in agricultural development (Huang et al., 2011; Hosseini, 2022b; Wu et al., 2005). Every developing country should take appropriate measures to prevent the fragmentation and shrinkage of land and adapt the experiences of developed countries to its principles and policies. Land consolidation should be defined within the framework of general rural development and agricultural policies and is an essential tool for achieving sustainable rural development. Due to special attention to land consolidation and its process, developed countries have been able to create a dramatic change in their agricultural sector and have the largest share of agricultural production (Perrin et al., 2020).

Land consolidation plan along with equipping and renovation of the required tools are among the basic requirements for achieving rural development programs. This plan would make reconstruction of irrigation, drainage and communication networks, reconstruction and improvement of rural settlements and industrial development possible. This will increase production and productivity, redistribute agricultural land, and finally make integrated rural development possible (Demetriou et al., 2012; Man et al., 2019; Pašakarnis and Maliene, 2010). Therefore, it can play a fundamental and infrastructural role in the development of rural areas (Pašakarnis and Maliene, 2010). This plan is implemented to increase crop yields, mechanize cultivation, make secondary cultivation possible, improve farm management, improve the economic and social status of the agricultural community, and finally increase productivity. The world Food and Agriculture Organization (FAO) lists land consolidation as one of its most important actions in comprehensive rural development programs (Demetriou et al., 2012; Taghibeikzadehbadr et al., 2020; Tajdari et al., 2022).

1.3. Research goal

Due to the problems facing the agricultural sector of Iran, such as small and scattered arable lands and lack of economic wealth of farmers to use production tools optimally, there are limitations in achieving sustainable development in rural areas of the country. To increase

production and productivity and restructuring production and redistribution of land, it is necessary to create a capable environment with the active participation and responsibility of all stakeholders. Implementing methods of land consolidation should be based on saving costs and time and using simple tools available, along with advanced and modern methods. Also, land consolidation should be based on understanding the cultural, social, historical, economic, political and geographical differences of different rural communities and paying attention to their indigenous knowledge and technology (Kupidura et al., 2014; Hosseini and Khamesee, 2021). The common principle that needs to be considered in all approaches is that land consolidation should be participatory, democratic, free and rooted in society and focused on rural livelihood, rural development and sustainable economic development of the whole society and its modernization (Shamsipur et al., 2012; Mehbodniya et al., 2022; Farani et al., 2022).

Khuzestan province in Iran is known as one of the important regions in the production of agricultural products in Iran. However, high water levels in agricultural lands and their salinity have made the land uncultivable or reduced the level of crop production in the region. Also, land fragmentation, unlevelled land and unmechanized production has also caused reduced production. Due to the fragmentation of agricultural lands and their small size, Abu Fazel-e Zargan region in Ahvaz is facing problems in efficient use of water, land, manpower, mechanization and other factors affecting agricultural production in this region. This region is within the scope of the plan of Agriculture Organization of Khuzestan of drainage, levelling and consolidation of the lands in Khuzestan. This plan aims at improving the fertility of the lands and replanting of crops and increase production per unit area. Also, it contributes to the employment and livelihood of the old farmers. Since most of the people in this region are of Arab ethnicity, it is necessary to study the factors that influence the participation of the people of the region according to their cultural characteristics. Therefore, due to the importance of the issue, the purpose of this study is to investigate the factors affecting the participation of farmers in the implementation of the land consolidation plan. The main question of this research is that what model is suitable for farmers' participation in the implementation of agricultural land consolidation plan.

The rest of this paper is organized as follows. Next section discusses the research method in detail along with the conceptual model of the research, study population, research variables and analysing method. Section 3 reports and analyses the data obtained on the land fragmentation in Abu Fazel. Section 4 discusses the land consolidation plan for Abu Fazel region based on the analyses in section 3. Finally, the paper is concluded in section 5.

2. Research Method

The research method in this paper is an objective and real study of the model of participation of farmers in Abu Fazel region of Ahvaz in levelling and consolidation of agricultural lands and discusses the necessary strategies to achieve the desired results. This research is generally a survey-exploratory correlational study which uses regression. Also, this is an applied field research. Since the variables cannot be controlled in this study, the research is a causal-relational quasi-experiment. Also, field data is used in this research. From a methodological point of view, this research uses a quantitative approach. The sample size was estimated to be 380 people from Cochran's formula (1 relationship), but due to the confusion in the statistics related to the exact number of beneficiaries and to prevent errors and increase confidence, after consulting with experts in statistical sciences, 5% was added to the obtained sample, and the number of samples increased to 404 users (Equation 1).

$$n = \frac{\frac{z^2 pq}{d^2}}{1 + \frac{1}{N}(\frac{Z^2 pq}{d^2} - 1)} \tag{1}$$

Where in: = n, sample size, z= the standard variable value of the unit corresponding to the confidence coefficient, p=0.95 the probability of the presence of the adjective (if unknown, p =0.5) q = the probability of the absence of the attribute d= the permissible error value(0.05-0.1) N= The number of members of the whole society.

In order to ensure the validity and reliability of the information gathering tool and the variables measured in it, the first questionnaire was tested by 30 users outside the target villages. To ensure the validity of the variables tested in the questionnaire, the KMO coefficient was used, and Cronbach's alpha was also used to measure the reliability of the research data collection tool. The obtained coefficients shown in Table 1 confirm the high reliability and reliability of the questionnaire.

According to the number of variables and their measurement level, descriptive statistics methods such as frequency percentage, mean, standard deviation and inferential statistics, such as consensus tables and correlation coefficient were used to analyze the data obtained from the research.

Table 1. Calculating the reliability and validity of the main concepts used in the research.

Case study	Variable	Cronbach's alpha	KMO	Barttelet's	Sig
beneficiaries	Economy	0.837	0.748	75.699	0.000
	Social	0.851	0.727	25.981	0.004
	Culture	0.798	0.643	893.053	0.000

KMO: Kaiser-Meyer-Olkin; Sig: Significance.

2.1. The conceptual model of the research

The conceptual model of the research is depicted in Figure 1. In this model, all the factors that impact the farmers' tendency to cooperate with the authorities in the implementation of a land consolidation plan are considered. These factors are: cultural, social, economic, policy-making, educational, agronomic and managerial factors. Also, the available technologies and their features would ease the framers into participation in the consolidation plan.

2.2. Study population and sample

The study population is located in Abu Fazel in the northeast of Ahvaz in Zargan region. The statistical data about this region is reported in Table 1. According to this table, Abu Fazel region has 5 villages where 415 farmers work in 4300 hectares of arable land which consists of 763 distinct agricultural lands. The sample size was calculated using the Cochran formula and the data were collected using the relative stratified random sampling method. According to the population ratio in the village, individuals were randomly selected from each of the villages of the region (5 villages), and a questionnaire was completed by the sample population (see Table 2).

2.3. Research variables

In this research, two methods, namely library and field methods, were used to collect the required data. Some parts of this data were extracted from the documents and questionnaire of 2017.

The dependent variable in this study is the levelling and consolidation of agricultural lands. The independent variable are the factors affecting the participation of farmers in levelling and consolidation of agricultural lands, which are measured by indicators such as cultural, social, economic, policy-making, educational, agricultural and managerial factors, each of which in turn consists of special items.

Kolmogorov-Smirnov test was used to evaluate the normality of the research variables. The test results are reported in Table 3. Since the significance level of all variables are greater than the error value of 0.05, all research variables are normal. Hence, parametric tests were used.

Table 2. Statistical data on Abu Fazel region.

Village name	Zargan Abu Fazel; Sedin village; Beyt-e Maluh Beit Mohareb village; Qaleh Marzban village
Number of villages	5 villages
Number of farmers	415
Number of agricultural lands	763

Table 3. The results of the Kolmogorov-Smirnov test.

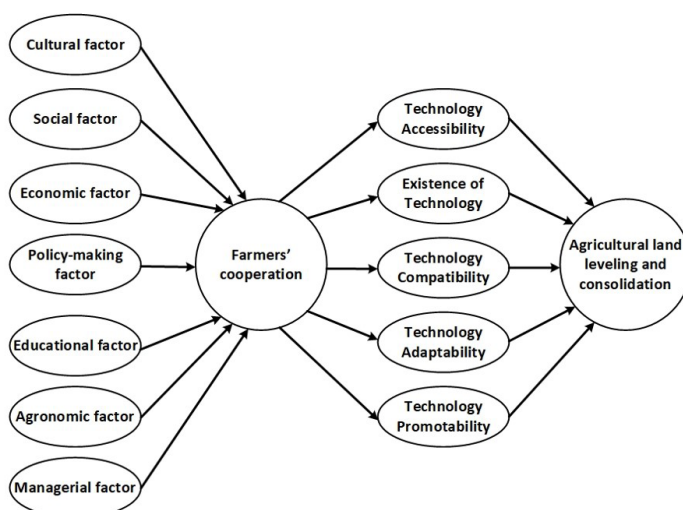| Research variables	Z-score	Significance level	Result
Educational factor	1.027	0.242	normal
Economic factor	1.327	0.695	normal
Managerial factor	2.031	0.071	normal
Social factor	2.475	0.080	normal
Policy-making factor	1.353	0.51	normal
Cultural factor	1.458	0.28	normal
Agronomic factor	1.543	0.17	normal

Figure 1. Conceptual model of the research.

2.4. Analysing method

In this research, descriptive and inferential statistical methods were used to analyse the information. First, in the descriptive statistics method, a table containing the frequency and percentage of respondents' opinions was prepared for each questionnaire. Then descriptive statistics such as mean, median, mode and standard deviation of each question were calculated. Then the bar graph related to the percentage of frequency of options for each question was plotted.

To refute or prove any research hypothesis, inferential statistics hypothesis testing such as T-test and structural equation modelling (SEM) was used and Kolmogorov-Smirnov test was used to test normality. Data analysis was performed by SPSS statistical software and diagrams were drawn by EXCEL software.

3. Results

3.1. Descriptive results

According to the information in Table 4, it is clear that most respondents have a cultivated area of 15 to

Table 4. Information on area under cultivation (hectares) of the respondents' lands.

Land under cultivation (hectares)	Frequency	Percentage of frequency
mai/14	47	31.3
15-24	83	55.3
25-34	20	13.3
Total	150	100

Table 5. Information on the number of irrigated land plots owned by the respondents.

Number of irrigated plots	Frequency	Percentage
01/mai	111	74.0
06/out	38	25.3
nov/15	1	0.7
Total	150	100

24 hectares, which is 55.33% of the total respondents. Also, the average area under cultivation is 17.7 hectares with the mode value being 15 hectares. Additionally, 13.33% of the respondents have 25 to 34 hectares of area under cultivation which has the lowest frequency.

According to the information in Table 5, most respondents own between 1 to 5 irrigated lands, which accounts for 74% of the total respondents. The average number of irrigated lands is 4.33 with mode value of 5. Also, 0.7% of respondents own 11 to 15 lands that have the lowest frequency.

3.2. Testing the hypotheses

The hypothesis in this study is defined as: Cultural, social, economic, policy-making, educational, agricultural and managerial factors play a role in the level of farmers' participation in the levelling and consolidation of agricultural lands in the region under study. The t-test result of the hypothesis is reported in Table 6.

According to the respondents, it seems that cultural, Social, economic, policy-making, educational, agricultural and managerial factors have an effect on the level of farmers' participation in the levelling and consolidation of agricultural lands with 95% confidence in the region under study.

3.3. Structural equation model

The results from Table 7 shows that there is a strong positive relationship between each pair of the educational, economic, managerial, social, policy-making, cultural and agronomic factors in determining the pattern of farmers participation in Abu Fazel region of Ahvaz in the levelling and consolidation of agricultural lands. In other words, all factors have a positive and high correlation with each other, which is statistically significant at 1% level of significance.

After ensuring of the existence of correlations between research variables, to investigate the causal relationship in the research hypotheses, SEM was used in AMOS software. Figure 2, which uses a standard form in SEM applications, was drawn to examine the theoretical model of the research that states the relation of the hypotheses. Model structure is depicted in Figure 2 using the common shapes in SEMs shows the observed variables with rectangular nodes and the latent variables with a circle
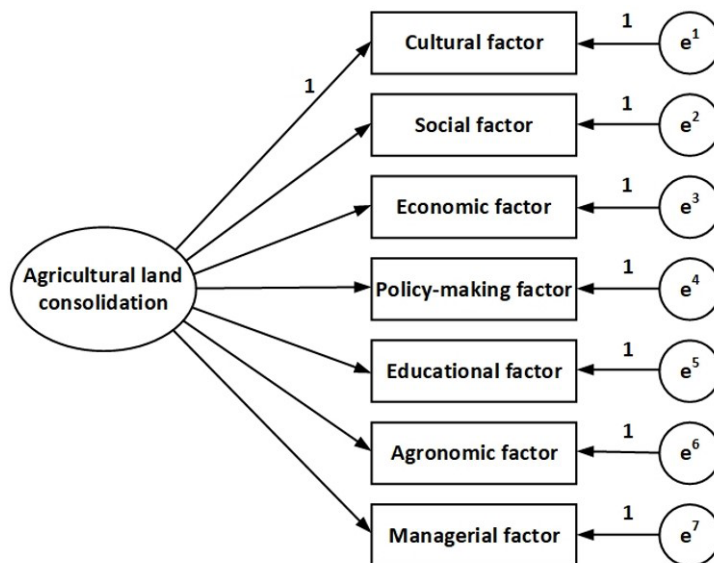
Table 6. t-Test results of the study hypothesis.

Study variables	t-value	degrees of freedom	Significance level	Mean difference	95% confidence interval for mean difference	
					High	Low
Educational factor	11.299	149	0.000	0.43320	0.5090	0.3574
Economic factor	9.338	149	0.000	0.39340	0.4766	0.3102
Managerial factor	7.822	149	0.000	0.34707	0.4347	0.2594
Social factor	7.378	149	0.000	0.33040	0.4189	0.2419
Policy-making factor	10.04	149	0.000	0.40520	0.4850	0.3254
Cultural factor	9.838	149	0.000	0.40153	0.4822	0.3209
Agronomic factor	8.509	149	0.000	0.36920	0.4549	0.2835

Figure 2. Standard diagram in structural equation programs.

Table 7. Correlation between variables.

Research variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Educational factor (1)	1						
Economic factor (2)	0.979**	1					
Managerial factor (3)	0.959**	0.943**	1				
Social factor (4)	0.949**	0.919**	0.951**	1			
Policy-making factor (5)	0.991**	0.974**	0.967**	0.950**	1		
Cultural factor (6)	0.993**	0.972**	0.966**	0.951**	0.991**	1	
Agronomic factor (7)	0.965**	0.948**	0.955**	0.938**	0.976**	0.975**	1

**Statistically significant at 1% level of significance.

or ellipse. The results of the analyses of relations using SEM are presented in Figure 3 separately for standardized coefficients (path coefficients) and significance level of coefficients of relations.

In the first step, confirmatory factor analysis was used to evaluate the validity of the theoretical model and check if a relationship between observed variables and their underlying latent constructs exists. In the confirmatory approach, the researcher assumes a specific theoretical model, collects the data, and then fits the data with the test model. There are various indicators, called model fitness indicators, to evaluate the fitness of the model and are constantly evolving and improving.

The reported results in Table 8 show that the degree of freedom is 14 and the value of Chi-square is relatively large (103.800). Based on the significance levels of the relationships between the variables, to check the validity of the default model, various indicators such as the Chi-square value divided by the degree of freedom (relative Chi-square, CMIN / DF), Goodness of Fit Index (GFI), Adjusted Goodness of Fit Index (AGFI) and Comparative Fit Index (CFI) and Root Mean Square Estimation Error

Table 8. Chi-square results of the test model.

Chi-square	103.800
Degrees of freedom	14
Probability level	0.000

of Approximation (RMSEA) were used. The results of the model validation and fit indices are presented in Table 9. The acceptable value GFI, AGFI and CFI is in the range of 0 (not fitted) to 1 (perfect fit).

The results of the analysis and the values of the goodness of fit indices do not indicate a good fit for the model. This means that the data of the studied sample do not confirm our theoretical model. The relative Chi-square, GFI, CFI, AGFI and RMSEA statistics compare the similarity of variance-covariance matrix of the hypothetical model with the sample matrix. Therefore, modifications should be made in the model. These modifications are applied based on AMOS software suggestions in the modification indices section.
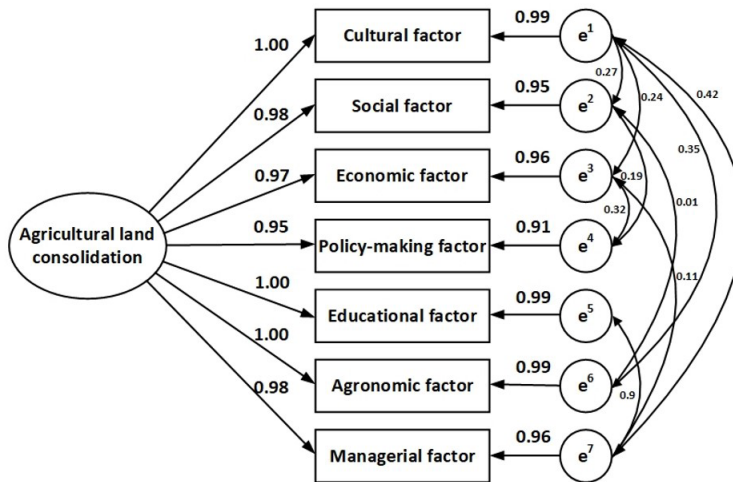
Figure 3. The final diagram with factor loadings and indicators weights in structural equation application.

Table 9. Model validation and goodness of fit indices.

Index	Acceptable value	Result		Interpretation	
		Model	**Modified Model**	**Model**	**Modified Model**
p-value Chi-square	greater than 5%	0.183	0.000	Unacceptable	Acceptable
CMIN/DF	1 to 5	1.510	7.414	Unacceptable	Relatively Acceptable
GFI	0 to 1	0.986	0.841	Relatively Acceptable	Acceptable
AGFI	0 to 1	0.921	0.683	Unacceptable	Acceptable
CFI	0 to 1	0.999	0.971	Unacceptable	Acceptable

CMIN/DF: chi-square fit statistics/degree of freedom.

The results of the analysis and the values of the goodness of fit indices after modifying the model show that the model fits relatively well. This means that the results of the sample data of the study confirms the validity of the modified model. In other words, the assumption that the variables are related is accepted. In this model, the amount of correlation between dimensions is also statistically significant at 1% level of significance. After ensuring the accuracy of the measurement model, the next step in the analysis is to obtain the standardized coefficients (path coefficients) and the significance level of the effect of each of the regression coefficients in the model.

In Table 10, critical ratio value is the value obtained from dividing the unstandardized estimated value of a parameter by the standard error for that parameter. This value shows the error probability if the null hypothesis, which sets the value of this parameter to zero, is rejected. Critical ratio and its level of significance show the level at which the factor loadings are statistically significant. The results show that most of the indicators are related to each other at 0.01 level of significance. These results are also confirmed by the correlation results. This means that unstandardized regression weight estimates obtained by maximum likelihood method show a direct relationship between the variables. According to the factor loadings, each variable's share in the measurement of the relevant

structure can be obtained. In other words, an index that has a larger factor loading has a greater share in measuring the relevant structure and an index that has a lower factor loading has a smaller share.

The results show that most of the indicators are related at 0.01 level of significance and these results are confirmed by the correlation results. This means that standardized regression weight estimates that are estimated by maximum likelihood method between variables, are estimated at a 99% confidence interval.

4. Discussion

Land consolidation is a process of land reform that, by changing the construction of agricultural land through farm management reform, while motivating the rural economy, leads to mobilization of resources in rural areas and rural development. In this process, the scattered lands are reallocated to farmers in order to consolidate and redistribute them without any change in ownership. The newly allocated land to each farmer is in most cases equal to the sum of their originally scattered lands. In other words, the policy of land consolidation is a kind of optimal redistribution of factors of production based on water and soil through regrouping of land plots or their

Table 10. The relationship between variables and standard estimates of regression weight and maximum likelihood for the theoretical model of the research.

Index Title	Shape	Index Title	Relationship Between Variables and Maximum Likelihood Standard Estimates				Standardized Regression Weight Between Variables	
			Estimate	Standard Error	Critical Ratio	Significance Level	Rank	Estimate
Land consolidation	--->	Educational Factor	1				2	0.995
Land consolidation	--->	Economic factor	1.078	0.019	56.341	***	5	0.976
Land consolidation	--->	Managerial factor	1.128	0.027	42.172	***	6	0.970
Land consolidation	--->	Social factor	1.121	0.03	37.381	***	7	0.955
Land consolidation	--->	Policy-making factor	1.054	0.012	91.204	***	1	0.996
Land consolidation	--->	Cultural factor	1.065	0.01	108.331	***	3	0.995
Land consolidation	--->	Agronomic factor	1.113	0.025	445.208	***	4	0.978

***$P \leq 0.001$.

integration along with the process of land transfer in order to improve the structure of land ownership. This process tries to provide opportunities for the efficient use of new structures and modern technologies. Therefore, increasing the size of land plots and reducing their number is the most justified reason for the usefulness of land consolidation programs. Hence, adopting appropriate policies to organize lands would lead to improved agricultural productivity. These policies include improving water management and drainage, management of basic resources for natural production, soil and water protection and industrial development, improvement of farms and rural buildings, creation of necessary infrastructure for agricultural and rural development and environmental protection, and preparation for revolutionizing through mechanization, improvement of land quality, the use of modern methods of irrigation and commercial production, etc.

The issue of fragmentation of agricultural lands has been one of the main features of the traditional agronomic system in Iran since ancient times. After the land reform of agricultural stock companies, agro-industrial cooperatives set up by the government to consolidate land did not succeed much. Therefore, the issue of land fragmentation remains one of the obstacles on the way of Iran's agricultural development. Given the importance of this issue, this study focused on land consolidation in one of Iran's regions that has heavily fragmented agricultural lands and the results of this study are as follows.

According to the results, it was found that most respondents own a cultivated area of 15 to 24 hectares, which accounted for 55.33% of the total respondents. Also, 13.33% of the respondents have 25 to 34 hectares of cultivated area, which has the lowest frequency. Most of the respondents own between 1 to 5 plots of irrigated lands, which is 74% of the total respondents, and also 0.67% of the respondents own 11 to 15 plots of irrigated land, which have the lowest frequency.

Findings of previous studies (Pašakarnis and Maliene, 2010; Prosekov and Ivanova, 2018; Yaslioglu et al., 2009) have shown that as the farmers get older, they tend to agree less with the implementation of the land consolidation plan. Due to the negative relationship between the age of farmers and innovation-based ideas, especially among farmers who become increasingly psychologically dependent on their assets over time, this result is not unexpected (Fang et al., 2016; Wang et al., 2014). However, in this study, the relationship between age and the tendency to participate in land consolidation was not investigated. In this case, regarding the relationship between age and land consolidation, setting up training programs to raise awareness of this group of beneficiaries, especially for influential people and local leaders, would beneficial. People with influence in such regions would be able to inform the target population of the project (i.e., farmers) about the necessity of land consolidation and make it easier for them to accept the plan.

According to the respondents, cultural, social, economic, policy-making, educational, agricultural and managerial factors have an effect on the level of farmers' tendency to participate in levelling and consolidation of agricultural lands in the area under study. These results are consistent with the results of similar studies such as (Iranpour et al., 2022; Roozitalab, 2021; Liu et al., 2019).

Agronomic factors are of the most important factors in land consolidation. Given that farmers often own small and fragmented lands and investment on small land plots is not economically viable, considering the obstacles to land consolidation in some areas, if land consolidation plan

is implemented, it would solve many of the problems of smallholders. It is suggested that in order to facilitate the implementation of this plan, the annual cultivation pattern should be announced by the Agricultural Organization with the cooperation and consultation of the farmers of the region before the crop year.

The results showed that economic factor is one of the variables affecting farmers' agreement with the implementation of land consolidation plan. Considering that one of the constructive indicators of the economic welfare of farmers was their employment, it is observed that a small number of farmers are engaged only in agricultural activities and the rest have a second job in addition to farming. Therefore, the second group has limited time to deal with agricultural work, especially if they own multiple land plots instead of one. Since land consolidation can help them manage their time better, they are usually more agreeable to land consolidation plans. Therefore, due to the limitations of the agricultural sector, perhaps providing the opportunity for the farmers who do not have a second non-agricultural occupation, can eliminate the hidden unemployment in rural areas, help them understand the real value of time in managing their lands and increase their tendency to agree to land consolidation plans. On the other hand, land price and quality are important issues related to the economic factor and it is suggested that a staff consisting of organizational and legal entities and local individuals be formed to provide the necessary training on how to evaluate and compare land plots to farmers. The results show that implementation of consolidation plans leads to a change in the agricultural structure of lands and increases the area under cultivation and makes utilizing of new irrigation methods possible which in turn have positive effects in economic fields (increasing production efficiency, reducing costs, saving water, etc.). The research results from studies such as Zhengfeng and Baiming (2003) also confirm these results as well.

The results showed that one of the most important factors in agricultural land consolidation is social and cultural factors. In order to remove cultural and social barriers in the way of consolidation plans, farmers need training and a change in their attitude towards this subject and the need for its implementation. It is therefore suggested that governments encourage farmers to consolidate their lands through mass media such as radio, television, the internet and social networks. Also, due to the cultural differences of different regions and the need to adapt the method of implementation of land consolidation plan to the conditions of the area, studying the traditional and spontaneous methods and strategies of consolidation that are common in villages and among local users, can play an important role in helping the farmers to accept land consolidation.

The results also show that there is a structural relationship between educational, economic, managerial, social, policy-making, cultural, agronomic factors in tendency of farmers in Abu Fazel region of Ahvaz to participate in levelling and consolidation of agricultural lands. The results of this study were consistent with the results of studies such as Khorsandi et al. (2022), Azarian et al. (2020), Rejaei et al. (2010). Other positive results of consolidation projects include increasing the production and yield of crops in the villages under study. The results of studies such as Roozitalab and Majidi (2017), Aravindhan et al. (2021), Barzamini and Ghassemian (2019), Kupidura et al. (2014), Daneii et al. (2022), Sarvaramini et al. (2021) also confirm the research results of our study. Also, with the implementation of the land consolidation plan, positive changes can be experienced in the use of machinery in different stages of production of agricultural products, especially in the harvest stage of products such as wheat, barley and potatoes.

One of the important factors that was recognized as the first indicator in land consolidation was the policy-making factor. Lack of supportive laws by the government and policymakers is one of the obstacles in the way of land consolidation implementation. Therefore, it is suggested to pave the way to implement this plan by passing and formulating a coherent law that includes the objectives of the land consolidation plan. Also, it is necessary to prevent further fragmentation of agricultural lands by amending and enacting laws, especially inheritance law. Additionally, laws should be passed regarding the optimal size of agricultural lands in different areas or the minimum size of lands that are not separable. This can prevent further division of plots and provide the opportunity for land consolidation in the long run.

Policymakers and agricultural specialists should carefully assess and examine the effect of land consolidation process and related factors in agricultural development, and the effects of this process on the evolution of agronomic systems. Additionally, they should assess the relationship between land consolidation and macro development on the one hand and agricultural and rural development on the other. Also, research on the negative effects of land fragmentation on agricultural and rural development and comparison of these effects on different agricultural units in different regions of the country is necessary. The use of mass media such as radio and television and the use of audio-visual educational technology along with visits to consolidated farms are necessary in order to promote the achievements and benefits of consolidation. These activities would raise farmers' awareness and should be considered by the relevant organizations, policy makers and planners.

Educational and promotional programs are an important factor in easing farmers into the process of land consolidation. Therefore, increasing educational programs and disseminating useful information through agricultural promoters can motivate farmers whose lands have not yet been consolidated, to accept this process. Considering the effectiveness and significance of funds and credits provided by the organizations in charge of consolidation in the acceptance of this process by farmers, increasing financial support and funds by providing long-term facilities with low interest rates by government and affiliated organizations can be an important step in motivating farmers into accepting the process of consolidation of paddy fields and other agricultural lands.

In summary, the most important benefits of land consolidation can be described as:

1- Reduced production costs and increased efficiency of production factors (Wu et al., 2005),

2- Increased irrigation efficiency and increased arable lands under cultivation (Aravindhan et al., 2021; Bozorgkhou and Hakimipour, 2014),

3- Reducing the need for labour,

4- Optimal land use and reducing soil erosion (Yu et al., 2010),

5- Protecting the environment (Sonnenberg, 2002), and,

6- Facilitating the implementation of political, macro and infrastructural decisions and ease of providing extension services (Van der Molen et al., 2005).

5. Conclusion

In this paper, we investigated the issue of land fragmentation in Abu Fazel-e Zargan region of Ahvaz in Khuzestan province of Iran. A conceptual model for the research was proposed which took factors such as cultural, social, economic, policy-making, educational, agronomic and managerial factors and their impact on farmers' tendency to participate in a land consolidation plan into account. The research in this paper was based on the results of a questionnaire which was responded to by the farmers in Abu Fazel and statistical data available on the Abu Fazel region and the villages in its vicinity. To determine the normality of the gathered data, the Kolmogorov-Smirnov test was carried out. Furthermore, to ensure the existence of correlation between the study variables and the response variable, SEM and Chi-squared test was used. Also, the model validity was evaluated using multiple goodness of fit indices. In general, the results of this study indicate the positive effects of land levelling and consolidation on reducing production costs and increasing productivity, increasing irrigation efficiency and increasing area under cultivation, reducing the need for labour, reducing soil erosion and optimal land use, protection of the environment and the ease of implementing political, macro and infrastructural decisions and the ease of providing extension services. The results also showed that cultural, social, economic, policy-making, educational, agricultural and managerial factors play a very effective role in the level of farmers' tendency to participate in levelling and consolidation of agricultural lands in the area under study. Among these factors, the policy factor was more important than other factors due to its high correlation with other variables and the response variable.

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