Factor Analysis of Paddy Fields Consolidation Barriers in Iran (Case of Western part of Guilan Province)

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Abstract

The aim of this study was to identify the deterrent factors in implementation of Land Consolidation (LC) projects in paddy fields of west part of Guilan Province, Iran. The correlational design was used for the research. The statistical population included all 119 agricultural experts working at the Agricultural Organization (Jihad-e-Keshavarzi) offices in the studied region. Data were collected through a survey using a semi-structured questionnaire with a five-point Likert-type scale, which was validated by a panel of experts and found to have sufficient content and face validity. The reliability alpha coefficient (0.84) indicates internal consistency of the scale. Results showed that "delays in the allocation of agricultural lands", "incomplete side projects such as sand planning and irrigation water tubing", "lack of trust regarding fair distribution of new paddy fields", and "untimely implementation of the LC projects" were the most effective deterrents in the LC projects. Using the factor analysis technique, the deterrent factors were classified into five groups: utilization system, technical-executive, social, conflict-related, and educational. Overall, these factors described 61.90% of the total variance.

Keywords: rice, deterrent, fragmentation, land consolidation, productivity.

INTRODUCTION

Rice feeds more than two billion of world population [6]. The Food and Agriculture Organization (FAO) has estimated 2014 global milled rice production at about 503 million tons, up about 1.2% from an estimated 497 million tons produced in 2013 [10]. Over 90 percent of the world's rice is produced and consumed in the Asia-Pacific Region. China, India, Indonesia, Bangladesh and Vietnam were the main producers of rice in the world in 2010 [11]. Islamic Republic of Iran ranked 21th among the world's top producing countries with production of paddy rice of 3.013 MT and cultivated area of 564,000 ha in 2010 [11].

The Guilan and Mazandaran Provinces are the main rice producers in Iran and have produced more than 80% of the rice in the country since 2002 [2 , 5]. More than 80 percent of rice harvested areas were found in the two provinces [14]. Paddy cultivated area in Guilan is 39% of the total area in the country and more than 35% of Iran's rice is produced in this province. More than 300,000 farmers work on a total paddy cultivated area of 238,000 ha every year. Rice accounts for more than 98% of the irrigated crops in Guilan [2]. It is the most important farming activity in this province and serves as the cornerstone of the province's economy.

In recent years, Iran Agricultural Jihad Ministry has made efforts to achieve self-sufficiency in cereal production, including rice, to meet local consumption needs. Measures to develop agriculture to achieve self-sufficiency were largely focused on the supply-side. These include improved extension education services to encourage the application of scientific methods and to improve farm management practices. Developments include greater use of mechanization, irrigation

investments, use of high-yielding seeds and improved application of fertilizer. The objectives were to promote land productivity and to reduce post-harvest losses. Efforts also include more structural reforms such as paddy fields consolidation projects.

Fragmentation of land is widespread in many developing countries in Asia, and it is believed that it be behind the low levels of agricultural productivity. It was reported that in South Asia such as in Nepal and Bangladesh, the average farm size was 0.14 and 0.06 ha respectively in 2000, whereas in the countries of East Asia such as Japan and Korea, the size of farmlands were increasing leading to more efficient use of labor and other resources [16]. The most important deterrents to sustainable development in rural areas include small farmland areas, irregular and non-geometric shape of farms, long distances between plots, lack of suitable roads to access the farmlands, as well as issues regarding ownership rights [7]. Small and scattered agricultural plots lead to increased labor time and cultivation costs, low access to irrigation water resources, difficulty of cultivating small and irregular shaped fields, uncontrolled use of chemical fertilizers and pesticides leading to hazardous consequences like water pollution, destruction of wild animals and plants, and soil degradation [20].

Agricultural Land Consolidation (LC) is the process of merging framers' land scattered in different locations in the same farming area to help them make optimum utilization of the resources [14].Allowing farmers to have larger farms with fewer parcels that are better shaped enables them to become more cost effective. It can facilitate the adoption of new agricultural technologies and improvement in the access of machinery leading to a more land and labor efficiency through farm mechanization [14].

Implementation of LC projects had also a positive effect on preventing decreased rural population in the Galicia Region in Spain [17]. Thus, LC is a powerful tool for sustainable development, but its implementation is not an easy task financially [8]. Agricultural land consolidation schemes in Turkey started in 1961. Yet, in spite of its 50 year history, it had not attained the expected success [18, 19].

A national strategy in Iran for land consolidation of paddy fields is very demanding. It requires thorough investigation of the problems and issues encountered during implementation. Among the issues to be addressed carefully; analysis of the situation, evaluation of projected costs and benefits, methodology for land reallocation, taking into account the constraints of the project and the landowners' requirements, legal procedures for identification of boundaries and the legal status of parcels, handling of objections related to boundaries, ownership, land quality and valuations, schedule for the project, elaboration of the detailed land consolidation plan, construction of public works (agricultural improvements, leveling, drainage, new roads etc.) final updating of the cadastral map and issuing and registration of new titles [12]. Cultural and social problems in Iran were cited as the main deterrents in the way of general acceptance of paddy field consolidation in Mazandaran Province in Iran. These problems were attributed to low literacy level, lack of the required know-how and some the traditional beliefs. Reduction of production costs and increased income for farmers wasthe most important goals for the LC projects [1]. Similar findings were reported in Geleyroud Village, Joibar, Iran by Ashekar_Ahangar-Kolahi et al. [3] using the Analytical Hierarchy Process (AHP) model. They further recommended training farmers in terms of improving farm structure and encouraging young agricultural experts to play a more active role in this regard. Ebrahimi et al. [9] used the SWOT analysis to evaluate the strengths, weaknesses, opportunities, and threats involved in the paddy field consolidation projects in Guilan Province, Iran. The main threat was reported to be "re-division of paddy fields between heirs and thus creating additional boundaries", and the main opportunity was determined to be "creating the possibility of using agricultural machinery in paddy fields".

Thus, with the high costs of implementation of such schemes, and to achieve an increase in productivity, it is highly imperative to identify such deterrents in order to contribute to overcoming the problems associated with the LC project and to help the Agricultural Jihad Ministry to have more consistent planning and to operationalize the project. This would eventually help farmers to become more productive by benefitting from more effective implementation of LC project of paddy fields. Against this background, this study aimed to investigate the deterrents of paddy fields LC projects in western part of Guilan Province, Iran.

MATERIALS AND METHODS

This study was conducted in the western rice-rich areas Guilan Province in the northern part of Iran. The statistical population consisted of the West part of Guilan' agricultural experts including managers, technical deputies, water and soil experts, plant production units, personnel in charge of various centers, and agricultural supervisors. A total of 119 eligible experts were eventually interviewed. A review of relevant literature in the area of LC, secondary data (reports and previous studies), interviews with professors, managers, and experts in the field of LC of paddy fields were used for preparing the questionnaire.

Data were collected through a survey using a semi-structured questionnaire. The questionnaire consisted of two sections: socio-demographic/ professional characteristics such as age, sex, marital status, education level, major, organizational position, years of general experience, years of experience in the agricultural sector, and years of experience in LC activities. The second part is a 19 –items scale to rate the potential deterrents (obstacles) to the implementation of the consolidation projects. The items were scored on a five-point Likert-type scale rated from very much (5) to nothing (1). The data collection instrument was validated by a panel of experts and found to have sufficient content and face validity. The reliability alpha coefficient (0.84) indicates internal consistency of the scale.

Descriptive and analytical statistics were used to analyze the data using SPSS software. Descriptive statistics include frequency distributions and measures of central tendency and dispersion to profile the respondents and to rank and prioritize the scale items. The correlation method was used for the research. As correlation among variables (correlation matrix) might be attributed to sharing common factors, factor analysis (FA) was used to reduce the number of variables and to identify the underlying factors. Every factor is a construct, made up of a set of variables which characterize the factor. A small number of interpretable factors might provide explanations and new insights into a complex phenomenon such as deterrents to the implementation of the LC projects.

RESULTS

Demographic Characteristics of the Statistical Population

Socio-demographic and professional characteristics were investigated. The age of the respondents ranged from 20 to 55 years. The mean age was 40 years (SD=6). There were 96 (80.7%) men and 23 (19.3%) women in the statistical population, 8 (6.7%) of whom were single and 111(93.3%) married. Most participants (67.6%) held a B.S. degree. Due to the diversity of majors in the agricultural field, many different majors were identified among the participants, so that the most frequency was obtained for Agricultural Engineering (77.3%).Most of the participants had working experience between 5-15 years (58%), and 64.7% of them had 5-15 years of experience in LC projects.

Results Obtained for Deterrent Factors

Using the mean values and standard deviations of the items scores, variables of "delays in the allocation of new paddy fields", "incomplete side projects including sand planning and irrigation water tubing", "lack of trust regarding fair distribution of new paddy fields" and "untimely implementation of the LC projects" comprised the most important deterrents of the LC projects (Table 1). Moreover, the least important deterrents were identified as follows: "soil subsidence resulting from passage of time and disturbance of leveled land", "diversity in the peasant community in terms of production methods and lack of a proper substitute method", "reduction of cultivated area for local cultivars and increased risk of a decrease in cultivar diversity", and "increased unemployment due to mechanizing the paddy fields".

Table 1. Ranking of Deterrents in Implementation of Paddy Fields Consolidation Plan

Rank	Variables	Mean	SD
1	Delays in the allocation agricultural lands	3.86	0.961
2	Incomplete side projects	3.79	0.961
3	Lack of trust regarding fair distribution of new paddy fields	3.71	0.940
4	Untimely implementing of the LC projects	3.58	0.827
5	Lack of legislation for the Consolidation Projects	3.56	0.869
6	No educational and promotion/extension support	3.52	0.869
7	Decreased yield in the first year due to soil disturbance	3.48	0.919
8	Faulty excavation operations	3.38	0.896
9	Lack of trust in the projects contractors	3.36	0.954
10	Resistance by some farmers	3.26	0.964
11	Allocation of a certain percentage of the land to construction of access roads	3.21	0.949
12	Soil compaction due to use of heavy equipment	3.21	0.973
13	Tillage and seedling tools digging deep in the ground due to improper leveling of land	3.10	1.05
14	High share of volunteer work	3.10	1.01
15	Change of land use due to easy access to roads	2.94	1.02
16	Soil subsidence resulting from passage of time and disturbance of leveled land	2.86	0.947
17	Diversity in the peasant community in terms of production methods and lack of a proper substitute method	2.80	0.945
18	Reduction of cultivated area of local cultivars and increased risk of a decrease in cultivars diversity	2.75	0.991
19	Increased unemployment due to mechanizing the paddy fields	2.65	0.972

Scale: very much =5 to nothing =1

Factor Analysis of the Deterrents

Factor analysis (FA) is used to analyze groups of correlated variables representing one or more common factors (constructs); i.e. in this study, indicators of deterrents to LC projects. The objective is to reduce the number of variables, to identify the underlying factors and to identify the contribution of each factor in paddy-field consolidation. An exploratory factor analysis was conducted for the data presented in Table 2 by means of the Principal Component Analysis method for factor extraction with VARIMAX rotations the method used for data analysis.

The four commonly used decision rules were applied to identify the factors: (1) minimum Eigenvalue of 1; (2) minimum factor loading of 0.4 for each indicator item; (3) simplicity of factor structure; and (4) exclusion of single item factors. Bartlett's test and KMO measure showed that the research variables were appropriate for factor analysis (KMO= 0.825, Bartlett =772.884, p<0.01).

Table 2. Factor loadings of deterrents in paddy field consolidation plan

Variables	Utilization System	Technical-executive	Social	Conflict-related	Educational
Increased unemployment due to mechanizing the paddy fields	0.787				
Diversity in the peasant community in terms of production methods and lack of a proper substitute method	0.731				
Reduction of cultivated area of local cultivars and increased risk of a decrease in cultivars diversity	0.700				
Change of land use due to easy access to roads	0.698				
Soil subsidence resulting from passage of time and disturbance of leveled land	0.667				
Allocation of a certain percentage of the land to construction of access roads	0.578				
Faulty excavation operations		0.739			
Soil compaction due to use of heavy equipment		0.653			
Lack of trust in the projects contractors		0.610			
Incomplete side projects		0.584			
Tillage and seedling tools digging deep in the ground due to improper leveling of land		0.593			
Decreased yield in the first year due to soil disturbance		0.509			
Delays in the allocation of agricultural lands			0.834		
Lack of trust regarding fair distribution of new paddy fields			0.737		
Untimely implementing of the LC projects			0.669		
High share of volunteer cost			0.519		
Resistance by some farmers				0.845	
Lack of legislation for the Consolidation Projects				0.531	
No educational and promotion/extension support					0.836
Eigenvalue	**6.701**	**1.742**	**1.510**	**1.301**	**1.144**
Percent specific variance	**31.955**	**9.167**	**8.947**	**6.848**	**6.023**
Percentage of cumulative variance	**31.955**	**41.121**	**49.068**	**55.916**	**61.939**

Results of the factor analysis revealed that; based on opinions of respondents, five factors affect as deterrents of paddy-field consolidation (Figure 1). These factors account for 61.90% of variance. Factor scores after rotation are given in Table 2, choosing variables with factor loading of more than 0.4 [15].

The first factor in Table 2 which was named "Utilization system factor", described 31.955 of the total variance with an eigenvalue of 6.701. The second factor was termed "Technical-executive factor". This factor described 9.167% of the total variance with an eigenvalue of 1.742. The third factor was termed "Social factor". This factor described 8.947% of the total variance with an eigenvalue of 1.510. The fourth factor was termed "Conflict-related". This factor described 6.848% of the total variance with an eigenvalue of 1.301. The fifth factor was termed "Educational factor". This factor described 6.023% of the total variance with an eigenvalue of 1.144.

As shown in Table 2, the above factors collectively determine 61.939% of the total variance. Therefore, the remaining 38.061% of the variance can be attributed to other factors which could not be investigated in this study.

DISCUSSION AND CONCLUSIONS

The results of the factor analysis showed that the increased unemployment variable (classified as a Utilization system factor) with a factor loading of 0.787 was the most important deterrent in implementation of the paddy field consolidation projects in Western Guilan Province. Ebrahimi et al. [9] also identified unemployment and reduced seasonal jobs as an important economic threat to such projects. Development of mechanized cultivation and, as a result, reducing production costs has always been a main aim in LC projects. Obviously, as compared with traditional ways, mechanized cultivation requires fewer workers, thus leading to higher unemployment in rural areas [4]. It is therefore necessary for the government to arrange for macro planning schemes in production and service sectors (particularly in the agricultural sector) in parallel to paddy field consolidation plans, so that the required infrastructure can be provided for employing those who lose their jobs as a result of LC.

Also, disturbance of the peasant community with a factor loading of 0.731 was determined as the second deterrent in the paddy field consolidation plan. Family comprises an essential part of peasant community, and rural people love to work alongside their family members on the land they have inherited from their ancestors. Therefore, in the allotment of the consolidated paddy fields, it is essential to arrange for farmers from the same family or clan to work on neighboring lands. Such arrangements are not easy due to the difference in the quality of the renovated land. In any case, the long distances between consolidated paddy fields and farmers' homes is a disadvantage leading to disturbances in the peasant community.

Faulty excavation operations and soil compaction resulting from heavy machinery used for leveling are among the most important technical-executive factors with factor loadings of 0.739 and 0.653, respectively. Incorrect calculations as well as improper implementation methods in some areas have produced problems for paddy field workers. Destruction of the soil hardpan is of extreme importance in rice cultivation. Lack of know-how in implementation of the plan led to difficulties regarding human and machinery traffic in certain areas of *Guilan* Province. Therefore, correct technical procedures in implementing the consolidation plan is another duty that the supervisory authorities of the LC projects must pay particular attention to.
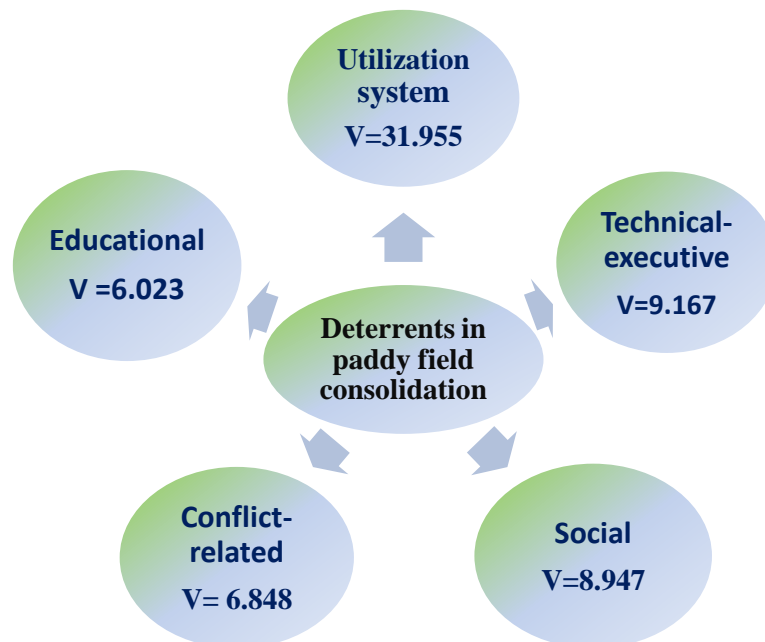

Figure 1. Factor analysis model of deterrents in paddy-field consolidation with specific variance for each set of factors

Delays in the allocation of modified paddy fields as well as lack of trust regarding fair distribution of lands were determined as the most important social factors with factor loadings of 0.834 and 0.737, respectively. Ebrahimi *et al*. [9] also referred to non-delivery in due time and the consequent dissatisfaction of farmers as a social threat to the implementation of paddy field consolidation plans. The difference in earth operations at high, medium, and low altitudes, as well as problems associated with impounding and lack of a suitable drainage in lower lands, are among the factors that slow down implementation of the LC projects and lead to threats such as delay in delivery of paddy fields. Therefore, it is necessary for the administrative organizations to use their leverage for selecting proper contractors for the projects and supervising the proposals offered by these contractors. Thus, timely delivery of lands to the participating farmers can be guaranteed. Moreover, legal and expert mechanisms must be in place for supervising fair distribution of land among farmers.

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