Short Communication

Network connection between the components of agricultural mechanization affecting agricultural productivity in agricultural settlements using DEMATEL approach

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ABSTRACT:
The current research seeks to study the economic conditions needed for agricultural productivity and sustainable development. The main objective underlying establishment of agricultural settlements is to improve the quality and quantity of production and increased revenue from agricultural products through the recognition and optimal use of Zanjan province's potential and with a glance at the supply for domestic consumption and product export. Agricultural settlement is a place with definite constraints and unit management that is constructed for the establishment and integrated management of agricultural, livestock, and fisheries complexes and service and logistic units of supply and complementation of production chain, in compliance with technical regulations and standards and according to the type and composition of the activities and size of settlements, all or some of the related units. The results showed that Job Creation (JC), Immigration Control (IC) and Development of industrial Agriculture (DIA) have the greatest influence on the network connection.

Abbreviations

(DIA) = Development of industrial Agriculture**; (EAI) =** The establishment of appropriate infrastructure**; (SI) =** Create standard infrastructure based on modern technology**; (OP) =** Optimize production conditions**; (PE) =** Increase the product efficiency**; (CTI) =** Complementary transformation industries**; (SE) =** Organize supply and export promotion**; (POH) =** Healthy and organic products**; (JC) =** Job creation**; (IC) =** Immigration Control**; (SW) =** Soil and water conservation**; (EPC) =** Environmental pollutions control

INTRODUCTION

Agricultural production is a function of multiple factors. Resources needed for farming are the main factors affecting the production and development of agricultural products. Some of these resources include water, soil, labour, consumer inputs such as pesticides, fertilizers, seed, fuel, farm machinery, buildings and facilities, etc. (Azkia*,* 2011). Implementing in short-term and temporary strategies, lack of attention to agricultural resource constraints and the impact of internal and external factors are some of the reasons that cause production fluctuations. Besides the fact that agricultural productivity has been fluctuated in recent years, and various products have been periodically replaced each other, misuse of resources have created heavy financial, environmental and life damages for the country, and this process still continues, and it may cause irreparable losses to the country due to the non-implementation of effective short-term, medium-term and long-term planning (Mohammadi, 2012).

The intercropping of trees and crops are still common in Iran and also at many parts of the world. Forest-agricultural systems, especially in tropical areas, have received renewed attention. Agroforestry systems has more ability than other agricultural systems in terms of ecological and agricultural view point (Kouchakai and Mahalati,

2012). In such systems, the movement of wind and water is reduced, and soil erosion is minimized. By planting trees, they modify microclimate conditions, reduce temperature absorb air, and re-distribute it into the soil. Farming systems take advantage of a kind of animal husbandry. In dry areas, animal husbandry is performed in the form of pastoral systems. During the past 40-50 years, in the vast fields, where too much inputs are consumed, animal husbandry has been isolated from agriculture. Chinese have developed a type of agricultural system with livestock where plant and livestock in these systems are linked with microphage chain. In these systems, rice is the main agricultural crop. When the seed is harvested, straw and chaff along with livestock fertilizer is converted into compost through a biogas digestion device, and the methane obtained from this process is used for cooking and lighting. Mud and silt obtained from congestion device is used for mushroom production. After mushroom was harvested, the remains of organic matter as fertilizer is returned to the rice fields. In terms of energy and nutrients rotation, the system is extremely efficient

Agricultural settlements

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establishment of agricultural settlements is to improve the quality and quantity of production and increased revenue from agricultural products through the recognition and optimal use of Zanjan province's potential with a glance at the supply for domestic consumption and product export. To achieve the objectives of the current research, inappropriate factor deletion method was used to determine the right products for cultivation and production, and then appropriate factors with preset parameters and criteria along with the compatibility of different agricultural, fisheries, greenhouse, and animal husbandry cultivation were selected (Langroodi *et al.,* 2012). This method prevents the production of additional information, and the results tend to executive procedures. Agricultural settlement is a place with definite constraints and unit management that is constructed for the establishment and integrated management of agricultural, livestock, and fisheries complexes cum service and logistic units of supply and complementation of production chain, in compliance with technical regulations and standards according to the type and composition of the activities along with the size of settlements for all or some of the related units.

The most important objectives of agricultural settlements include, finding an effective location for the establishment of agricultural settlements, the construction of appropriate infrastructure based on technical calculations, creating standard structures with high levels of appropriate technology, and knowledge-based industrial agricultural expansion, diversification and expansion of complementary and economic activities, the establishment of complementary transformation industry and other relevant units to supply and complement production chain, organization and establishment of proper operation system, implementation of unified management, reduction production costs, especially energy and fuel costs, increase efficiency and efficient use of water resources, soil, energy and inputs, sustainable production of high quality and healthy agricultural products to promote social health, productive, active, and sustainable employment, supply organization, export promotion, market and marketing of manufacturing products. According to the above-mentioned factors that are the result of the analyses and investigations made in the previous years, the idea of establishing agricultural settlements as a basic necessity is unavoidable throughout the country and Khuzestan province. This necessity can be justified in two parts: (Langroodi *et al.,* 2012).

However, the per capita investment in agriculture is much lower than other economic

Table 1. DIMATEL result of the research survey conducted at Zanjan region

S. No	Components	Total row	Components	Total column	Components	Total row & column	Components	Subtraction of row & column
1	JC	-0.7799	DIA	-0.1346	DIA	-1.1659	IC	0.5408
2	IC	-0.8016	SI	-1.0835	JC	-1.9987	JC	0.4389
3	DIA	-1.0313	SE	-1.1264	IC	-2.1441	EPC	0.3186
4	EPC	-1.1414	EAI	-1.1264	SWC	-2.3746	CTI	0.1776
5	PE	-1.1477	SWC	-1.1625	SE	-2.4014	OP	0.1588
6	CTI	-1.1700	JC	-1.1288	PE	-2.4109	HOP	0.1466
7	HOP	-1.2064	PE	-1.2632	CTI	-2.5176	PE	0.1155
8	SWC	-1.2121	IC	-1.3424	HOP	-2.5593	SWC	-0.0496
9	SE	-1.2750	CTI	-1.3476	EPC	-2.6014	SE	-0.1486
10	OP	-1.3144	HOP	-1.3529	SI	-2.6074	EAI	-0.3615
11	EAI	-1.5239	EPC	-1.4600	EAI	-2.6863	SI	-0.4404
12	SI	-1.5239	OP	-1.4732	OP	-2.7876	DIA	-0.8967

sectors. In addition, the authors' findings confirmed a negative relationship between per capita investment in agriculture and capital productivity in this part at the significance level of one percent (Smaeti and Faramrzpour, 2004).

In fact, high inflation can increase manufacturing activity risk, and provides much benefits for intermediation and business activities (Lilyan and Richard, 2010). Thus, the capital is channeled towards the markets of coins, gold, land and office building that are more secured. High costs of initial and infrastructure activities in the area of agriculture such as land reclamation and land leveling and insecurity of land ownership are also other barriers to agricultural investment (Kiani, 2008). Another effective factor affecting the inefficient allocation of capital to the agricultural sector included granting credits to farmers without supervision and without feasibility

that eventually can lead to non-productive and non-consumer applications. It is found that 13% of peasants' living cost belonged to the agricultural affairs and the rest was dedicated to consumer affairs (Azkia, 2011).

Agricultural Mechanization

Agricultural mechanization is a collection of applied arts and sciences that is comprised in the study, understanding and application of different types of machines and driving force tools at various stages of production and processing of agricultural products. Initially, hard agricultural work alongside population growth and the need to more production caused mechanization to be considered as a desirable need, and any idea that could facilitate work and lower the cost was selected to be operationalized and developed promptly (Amjadi and Chizari, 2006).

MATERIALS AND METHODS

In general, research methods can be divided based on two criteria: research objective and data collection. Accordingly, the current research is applied in terms of objective, and it is a descriptive survey in terms of data collection. The main goal underlying applied research is the development of practical knowledge in a particular field. In other words, applied research is directed to practical application of knowledge (Sarmad *et al.,* 2012). Descriptive research includes a set of methods that aim to describe the situation or phenomenon under study. Descriptive research seeks to better understand the circumstances or assist decision making process. Survey research is a branch of descriptive research. In this type of research, some samples of the population under study are selected, and the need to study the sample is due to the fact that the study of the whole population is difficult, and the sample can represent an accurate picture of the studied statistical population, which one of its most important benefits is to generalize the results. In addition, this research was performed in the time period of November 2014 to May 2016 (Sarmad *et al.* 2012).

There are generally two sets of factors in the definition and delimitation of population. The first set emanates from the circumstances underlying the problem, because responding to any specific question necessitates a good relevant population.

The second set arises from scientific constraints, because the scope of scientific research is influenced by the facilities that are provided for researchers (Sarmad *et al.,* 2011)**.** Given that this research is performed based on Delphi method, the statistical population is composed of agricultural experts. Based on Delphi method, the sample size was 30 people, and random sampling is used to perform sampling.

The necessary tool for data collection is in a documentary and field-based form, in such a way that in the parts relevant to the first and second chapters and a part of the third chapter, documentary research method (books, reliable and related journals, periodicals, theses, research projects and other documents found in both Persian and English) was used. For data collection and achieving the required information, written questionnaires were used. Due to their wide applications, highly reliable standardized questionnaires have been modified, and they are mainly used by researchers. In this research, open and DEMATEL questionnaires were used (Tahcry *et al.,* 2014).

DEMATEL technique is an abbreviated term for Decision Making Trial and Evaluation. The technique was developed in 1971 by Fonetla

and Gabus. DEMATEL technique is derived from a variety of decision-making methods based on pairwise comparisons takes advantage of expert judgment in extracting the factors relevant to a system and systematic structuring by applying the principles underlying graph theory, and then presents a hierarchical structure of the factors in the system along with mutual interaction, in such a way that it can determine the impact of the relevant relations through a numerical rating. DEMATEL technique is used to identify and assess reciprocity between the criteria and to present the mapping of network relations (Jafarnejad *et al.,* 2012). Because directed graphs can show relationships of a system in a better way, DEMATEL technique is based on the charts that can divide the factors involved into two groups of cause and effect, and also to convert the relationship between them into an understandable structural model. DEMATEL technique was created generally for surveying very complex global issues.

DEMATEL is also used to structure a sequence of constructive knowledge, so that it seeks to examine the severity of communication in the form of scores, to investigate feedbacks, their significance, and to accept non-transferable relations (Taheri *et al.* 2014).

Consideration of mutual connection

The advantage of this method over network analysis technique is its clarity in reflecting mutual communication between a wide range of components, so that professionals are able to express their views on the effects (direction and severity of impacts) between the factors. It should be noted that the matrix resulted from DIMATEL technique (interconnection matrix) constitutes a part of super matrixes, i.e. DIMATEL technique does not operate independently but as a subsystem of a larger system such as ANP (Tahcry *et al.,* 2014).

Structuring complex factors

This forms the cause and effect groups. This is one of the most frequently used functions and one of the most important reasons why it is widely applied in problem solving process, such that with the division of a wide range of complex factors into cause-effect groups, decision-maker is placed at a better condition to understand the relations. This leads to a greater understanding of the factors and their role in mutual influence process. The following is the stages to perform DIMATEL technique (Taheri *et al.* 2014).

Establish direct connection matrix (M)

When the opinions held by some people are considered, simple opinion mean is used, and M is formed.

Normalize direct connection matrix

$N = K*M$

In this formula, 'K' is calculated as follows. First, all rows and columns are calculated. The inverse constitutes the largest number and k columns (Jafarnejad *et al.,* 2012).

Full connection matrix calculation

DEMATEL formula

$T = N \times (1-N)^{-1}$

Total elements of each row (D) for each action is indicative of the effectiveness of the factor on other system factors (influence of variables)

Total column elements (R) for each factor indicate the other factors' influence on the relevant factor (the extent of being influenced by variables)

Thus, horizontal vector (D + R) is the impact of the relevant factor in the system. In other words, whatever the amount of D + R is greater, the factor has more interaction with other factors in the system.

Perpendicular vector (D-R) shows the influence of each factor. Generally, if D - R is positive, the variable is considered a causal variable A, and if it is negative, it is disabled.

Finally a Cartesian coordinate system is drawn. In this system, longitudinal axis is based on D + R values, and transverse axis is based on D - R. Position of each factor relative to the points at the coordinates (D + R, D - R) is specified in the system (Jafarnejad *et al.,* 2012).

The analysis of data to verify the theory in any type of research is of importance, and nowadays, in most research that is built upon the information collected from the research subject, data analysis is considered one of the most important research parts. The research population is comprised of 30 agricultural experts in Zanjan province. In the current chapter, first, using open-ended questionnaire and library-based research, the most important components of financial performance are identified, and then using DEMATEL, the relations between them are analyzed. In the current research, the open-ended questionnaire is used to identify the components relevant to financial performance in Zanjan province. To perform this procedure, 30 agricultural experts were asked to respond to the questionnaire. Domestic and overseas theses and articles were used to identify the most important elements in the area of agricultural mechanization influential on agricultural production in agricultural settlements (Taheri *et al.,* 2014). After identifying the component, we design DEMATEL model for the research.

Implementation of DEMATEL

Since DEMATEL method does not have a specialized software, calculations must be made either manually or with the help of other software such as Excel. DEMATEL method is used to obtain the relations between the factors of one

decision making model, and the completion of the options of column headline is presented at the same row. The various stages to implement DEMATEL method are presented as follows (Shai'ati *et al,* 2012).

RESULTS AND DISCUSSION

After completing the questionnaire by the statistical population, the average of each of the paired comparisons are calculated and entered in a single table. At this stage, the sum of each of matrix rows and columns are obtained, and the results would be in accordance with the Table 1. After summing rows and columns, the largest amount of rows and columns are obtained. As can be seen from the Table 1, the largest amount equal to the number of rows and columns is 40. By summing each of the columns and rows, the individual numbers within the matrix is divided into the largest sum of rows and columns or it is multiplied into its inverse. At the next stage, the normalized matrix is subtracted by unit matrix. By subtracting the matrix from the normal matrix, a matrix can be obtained that can inverse it, and then the result is multiplied by normal matrix. At this stage, the results from the previous section is processed. Based on the processing method, the results obtained from rows and columns for each factor are added and subtracted, and then they are

ordered based on the value obtained. The results of this processing are presented in the Table 1 (Taheri *et al.,* 2014).

Based on the results obtained from the Table 1 and the total row, it can be concluded that job creation, immigration control and the spread of industrial agriculture have the greatest influence on other factors. It was also concluded that the spread of industrial agriculture, construction of standard constructs based on modern technology and organization of supply and export promotion are heavily influenced by other factors. It could be concluded that the spread of industrial agriculture, job creation, and population control have the greatest influence in the system. In the part of the subtraction of total columns and rows, it could be concluded that population control, job creation, and environmental pollution control can have the greatest influence in the system (Jaefar *et al.* 2011).

The current research showed that Iran's agriculture and natural resources take privilege of distinguishing characteristics compared to other economic sectors. The characteristics include "the role of agriculture in national security", "distinctive feature of the agricultural sector in job creation both directly and indirectly", "potential of this sector in the implementation of a development built upon poverty alleviation and justice", "early

returns of investment and higher productivity in the sector", "the ability to establish a link between agriculture and natural resources and service and industry sector", "provide multiple economic, social and environmental functions, "immigration control", "global comparative advantage" and "ideological importance of agriculture". Due to the abundance of labour supply in Iran, the country's development strategies should search for practical and applied approaches rather than capital-based approaches. Despite these advantages and requirements, evidence suggested that the capability underlying agriculture and natural resources is not properly utilized and its potential has not been fulfilled. While the allocation of public funds and capital stock in Iran has been afflicted with bias and discrimination against agricultural sector, evaluation of success and importance of different economic sectors based on national accounts would be misleading. This judgment and evaluation should be interpreted within its own context (low investment and discrimination against agriculture). In addition, 75% of total natural resource functions are not valued and recognized in national accounts, and a large part of agricultural activities, particularly in horticulture and animal husbandry sub-sectors is done by rural women, which is not valued at all. On the other hand, nowadays, the statistics relevant

to the value added of agricultural sector and its function in the prosperity of the national economy is under a condition that a fertile ground to establish link with other sectors (industry and services) has not been well provided, and this has led to undercount and underestimation of agriculture and natural resources. In general, it should be stated that Iran's industrial development through import substitution strategy is like a direction adopted by Latin American countries, and Iranian officials responsible for national development have practically shown so much discrimination against agriculture rather than sufficient and proper investment in this critical field. Policy makers often have failed to create synergy between agriculture and industry. Reducing the share of agricultural sector from the economy is not a sign of sustainable economic development, and under the situation that relevant authorities outcry the motto "priority of industry" and continuous changes are occurring in agricultural land, the questions is that: how much we can be hopeful of domestic production and self-reliance on food security and sustainable development.

CONCLUSION

Standard Infrastructure based on Modern Technology (SI) and Organized Supply and Export

Promotion (SE) are the factors that are heavily influenced by other factors, and the factors namely Development of industrial Agriculture (DIA), Job Creation (JC) and Immigration Control (IC) systems have the highest influence in the system. In addition, IC, JC and environmental pollution control have the greatest impact in the system.

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