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Factor analysis of barriers and problems affecting the development of nanotechnology in agriculture

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ABSTRACT

The aim of this paper is to utilizing factor analysis to classify "The importance of the (relevance) development of nanotechnology in the framework of National Innovation System and barrier and problems that affect the diffusion of nanotechnology in agriculture" And the amount of variance explained by each of the variables is grouped into factors. Description of the research is based on the data which was collected through questionnaires that was obtained according to the opinions of experts, and its reliability was confirmed by calculating Cronbach's Alpha by SPSS software (α = 0.94). The study population consisted of 120 researchers working in 15 National Institutes and Agricultural Research Centers (affiliated to the Ministry of Agriculture) in the country. According to Krjsy – Morgan Table, about 92 of them were selected for the study and after distribution and collection of the questionnaires, the results of the 81 questionnaires were found suitable and analyzed. In order to Factor analysis of barriers and problems affecting the development of nanotechnology in agricultural, the exploratory factor analysis with the approach of data summarizing was used. Using factor analysis, four factors with eigenvalues greater than 1 were extracted. Variables and barriers affecting the development of nanotechnology in agriculture according to factor loadings after orthogonal rotation using the varimax factors were classified. These factors explained 74.399% of the total variance, and only less than 25.601% of variance was due to factors that were not identified through factor analysis. As a result, according to extracted results, the "financial - support" factor with the variance of 24.175 had the highest importance in the explanatory variables. After that, the "Communication - Management", the "cognitive - learning" and "operating infrastructure" factors were following it respectively.

Keywords: Factor analysis, agriculture, affecting problems and barriers, nanotechnology

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INTRODUCTION

The word technology comes from the Greek roots of (techne) and (logic). The first has the meaning of art and skill, and second has the meaning of knowledge [1]. The world population is currently 6.4 billion people and it is predicted that by 2050 it will be more than 8.9 billion. It is expected that 5 billion of it will live in cities by 2030, the growing population and the demand for food will rise quickly. The global grocery organization finds it inevitable to increase the agricultural production in order to feed the9 billion population.

The agricultural area is one of the most important areas that use the achievements of nanotechnology, and will get a lot of benefits from it. The first report of the use of nanotechnology in agriculture was published in 2003 by the U.S. Department of Agriculture. Nanotechnology is now one of the priorities of the country, which has been emphasized in general policy and Fifth program of Five Year Plan of the country. In this context, the Ministry of Agriculture along with some of the country's ministries and agencies has the infrastructure and activities in the field of nanotechnology [2].

Despite 8 years of activity in this field and some effective programs and useful steps to get a good result, a remarkable position which could be applicable to most parts of the agriculture systems of the country and the access to important achievements of this technology which can be used in agriculture science is still not possible. Thus, despite the successful achievement of certain business activities in international level, it seems that agricultural sector in comparison to the other sectors involved in the field of nanotechnology in the country, has not a good position and various problems is encountered in the field.

With regards to the role of agriculture in the national economy and facing barriers to increase productivity from one hand, and nanotechnology's potential and ability to reduce or eliminate many of these problems on the one hand, development of this technology in the agricultural sector in the National Innovation System seems to be essential [3].

MATERIALS AND METHODS

Method of this research is descriptive.

Population, sample and sampling method

A survey of 120 researchers working in 15 National Institutes and Agricultural Research Centers (affiliated to the Ministry of Agriculture) in the country. According to Krjsy – Morgan Table, about 92 of them were selected for the study and after distribution and collection of the questionnaires, the results of the 81 questionnaires were found suitable and analyzed. To choose the samples, taking into account almost the same distribution of research centers and institutes in the study, random sampling was used. It should be noted that these people were from researchers in recent years in various forms (practically and theoretically) in the applications of nanotechnology in agriculture-related fields and areas and had sufficient knowledge of the subject.

Research Tools

Measurement tool is a device to receive data from the study population.

Questionnaire survey is one of the most popular tools of collecting data in the study and it is a direct method of collecting data. You can ask questions to learn about the knowledge, interests, attitudes and beliefs of an individual, and get information about his previous experiences and about what he currently does [4].

Statistical Methods

Inferential statistics (inferential)

The part of statistics which relies on analyzes, interprets and extends the results of the preliminary calculation and analysis, is called inferential statistics. Using inferential statistics, the characteristics of population profile of the sample can be inferred. In the present study, factor analysis method was used. In this study, we used factor analysis to classify "The importance of the (relevance) development of nanotechnology in the framework of National Innovation System and barrier and problems that affect the diffusion of nanotechnology in agriculture" And the amount of variance explained by each of the variables is grouped into factors. In order to do factor analysis in this study the following general steps have been taken:

1 - Determining the suitability of data for factor analysis using the KMO and Bartlett tests:

If the value of KMO (Kaiser-Meger-Olkin) be less than 0.5, the data won't be appropriate for analysis. And if its value be between 0.5 to 0.7 the correlation between the data will be appropriate for factor analysis and if it be greater than 0.7 it will be completely suitable for this aim.

2 - Determining the number of factors:

One important thing in factor analysis is to determine the number of extracted factors.

Although a precise basis about determining the number of extracted factors is not given, but there are some criteria for determining the number of extracted factors as:

Eigen-value criterion, the previous criterion, the criterion of variance percentage, the test cuts criterion [5]. Considering the fact that factor analysis is of exploratory type, so the Eigen-value criterion is used to extract factors, and the aim is to extract factors with Eigen values greater than one.

3 – Rotating the factors:

The goal of rotation in factor analysis is rotating the factor axes around the center of coordinates. When interpreting the factors is not possible is a simple way, rotating the factor axes is used. Therefore, in order to simplify the factor structure and interpretation we use this method. There are several methods to this aim and here Varimax rotation method was used study and the factors with values greater than 1 were extracted as meaningful ones.

4 - Factor Calculation:

Factor analysis summarizes main variables in a limited number of factors. When these new limited factors are used in next analysis (such as regression analysis or diagnosis); some values should be used to derive new variables. These values are, in fact, a combination of all of the variables that have a major role in building the new factor. This combination of variables is called a factor scores (values). Since this study aimed to use a new but limited set of factors of a combination of variables instead of main variables, in subsequent analyzes (regression analysis), so the factor values are calculated to achieve this goal.

RESULTS AND DISCUSSION

In order to Factor analysis the barriers and agricultural problems affecting the development of nanotechnology in this field the exploratory factor analysis approach was used to summarize the data.

To determine the suitability of the collected data the analysis of the coefficient of KMO (Kaiser Coefficient) and Bartlett test was used.

In this work KMO coefficient was found equal to 0.873, indicating the suitability of data for factor analysis. On the other hand, to ensure the suitability of data for factor analysis the Bartlett test was used. The value of this statistic is equal to 926.140, which was significant at the 1% level, so the data were suitable for factor analysis (Table 1).

Table 1- The KMO and Bartlett's test of significance

The analyzed set	KMO	Bartlett	Significance (Sig.)
Barriers affecting the growth of nanotechnology in agriculture	0.873	926.14	0.000

Table 2- extracted factors with eigenvalue, percent of variance and cumulative percent of variance they

Factor	Eigen value	percent of the variance	Cumulative frequency percent of variance
1	4.110	24.175	24.175
2	3.051	17.948	42.123
3	2.864	16.847	58.970
4	2.623	15.429	74.399

Table 3 – variables of each of the factors and factor loading value obtained of rotated matrix

Factor Name	Variables	Factor Loading
Financial - support	Inadequate budget allocation among units and sections in the field of agricultural technology	0.854
	Incomplete intellectual system and laws and poor insurance of its implementation in the area of nanotechnology	0.808
	Lack of proper coordination between the headquarters of the Ministry of Agriculture and Nanotechnology Committee	0.803
	Lack of adequate funding and allocations to agriculture (insufficient funds) in the field of nanotechnology	0.679
	Lack of standardization in the field of nanotechnology in agriculture products	0.679
Communication - Management	Lack of appropriate information to inform an audience about nanotechnology in agriculture at different levels	0.799
	Lack of strong information –communication network among active individuals in the field of nanotechnology agriculture	0.792
	Lack of a proper goal in nanotechnology-related research	0.747
	Weaknesses in theoretical leadership and leading program conducting strategic related to nanotechnology in agriculture	0.527
	Lack of effective communication and interaction among research centers and centers of production and trade in agricultural technology	0.523
Cognitive-Teaching	Lack of adequate knowledge among managers, experts, decision makers, and other agricultural workers on nanotechnology and sometimes lack of believe of managers in this field and in the need to pay particular attention to the nanotechnology	0.828
	Lack of stability of management and continuous attention to applications of nanotechnology in agriculture	0.803
	Shortage of trained manpower in the field of agricultural technology	0.769
Infrastructure	Lack of support from venture funds to finance the development of nanotechnology in agriculture	0.796
	Lack of commercial and marketing centers of agricultural products in Nanotechnology	0.758
	Lack of equipment and hardware facilities of nanotechnology in agriculture	0.567
	Lack of or Shortage of supporting structures such as incubators, industrial clusters, technology parks in Agricultural Nanotechnology	0.503

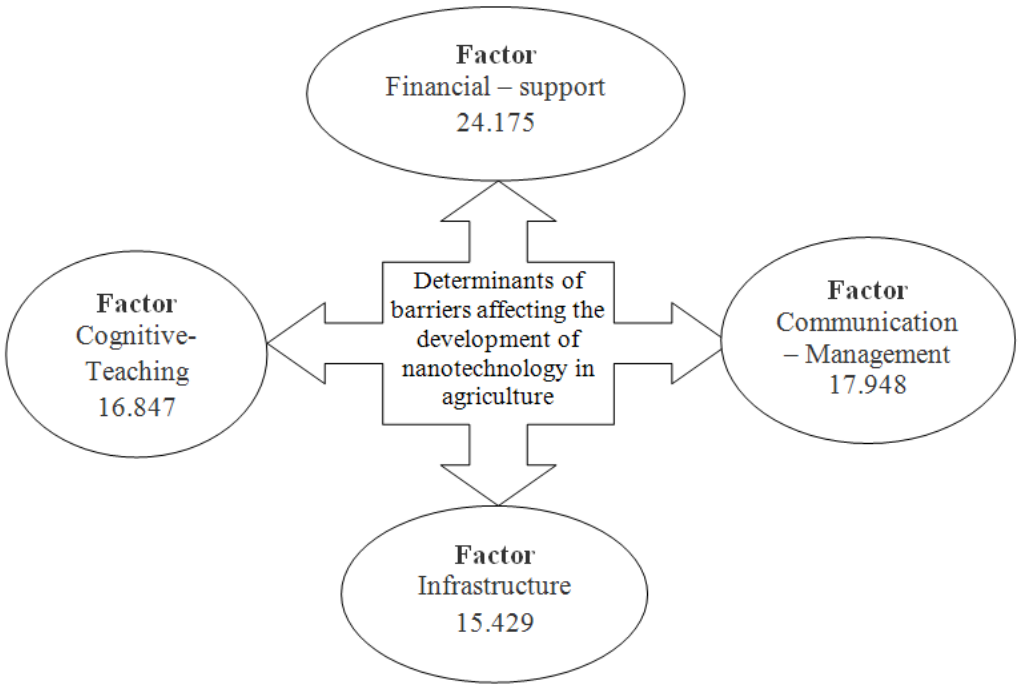

Figure 1- Determining factors expressing the obstacle and problems which influence the development of nanotechnology in agriculture and the percent of variance

Using factor analysis, four factors with eigenvalues greater than 1 were extracted. Impediments variables that influence the development of nanotechnology in agriculture according to factor loadings after orthogonal rotation using the Varimax factors were classified. These factors explained 74.399% of the total variance, and only less than 25.601% of variance was due to factors that were not identified through factor analysis. Table (2) shows the number of each extracted factor with Eigen values, percentage of variance and cumulative variance of each of the factors. Position of relevant variables determines the factors influencing barriers preventing the growth of nanotechnology in agriculture. The factors derived by assuming the variables which have loadings being greater than 0.5 after Varimax rotation method and renaming and are presented in Table (3). As a result, according to extracted results, the "financial - support" factor with the variance of 24.175 had the highest importance in the explanatory variables. After that, the "Communication - Management", the "cognitive - learning" and "operating infrastructure" factors were following it respectively. The results were included in the order (Figure 1).

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