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Effective factors and barriers on the implementation of precision farming from agriculture experts' viewpoint

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ABSTRACT

Precision farming is aglimpse to the future of agriculture in that management of agricultural production inputs such as fertilizer, lime, herbicide; seed and so on is implemented based on local features of farm. The more precision application of inputthrough exact farming leads to reduce costs, increase farm income and reduce adverse environmental impacts. Iran, as a developing country should be able to use precision farming technologies in agricultural development programs in the future. In this regard, a study was conducted in Ardabil province to study the effective factors and barriers on the implementation of precision agriculture from the perspective of agricultural experts of this province in 2011. This research is quantitative considering paradigm and it's applied considering research purpose. And also comparative-causative researchmethod is used in this research and since there was identification and field searching, the research was survey research. Participants of this study were experts of agriculture center of agricultural researches and center of agricultural training in Ardabil province (N=365) who had BA or MA degree in one of the branches of agricultural engineering and were employed in one of the mentioned organizations. Research results showed that Cronbach's alpha was calculated for Likes spectra questions that result was .96. With regard to the obtained results it was evident that the effectiveness amount of challenges and barriers to implement precision farming in Ardabil with the mean of 3.94 and standard deviation of .92 is "excessive".In this section the greatest impact is related to "investment costs"with the mean value of 3.92 and standard deviation of 1.05and the least impact is related to the "process's being time-consuming," with the mean value of 3.49 and standard deviation of 1.07 respectively. And also correlation amount of KMO equals to .70 that is indicator of fitness of existent correlations between data to factorial analysis. Using factorial analysis technique, four factors with specific values were found greater than 1. And variables as challenges and difficulties that are affecting the implementation of precision agriculture are classified based on the factorial loads and after orthogonal factorial rotation by varimax method in these factors and these factors have explained 62.75percent of the total variance and only less than 37.23 percent of rest variance were related to the factors that are not identified through factorial analysis. Number of extracted factors is given along with specific values of each one, variance value of factors and cumulative variance percent of factors. Given the specific values of extracted factors, the "insight related" factor with variance values of 88.16 played a major role in defining the variables. Then, the "agricultural" factor, "educational and promotional" factor and "financial and equipment related" factorswere respectively in the next ranks.

Key words: precision farming, barriers and difficulties, factorial analysis

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INTRODUCTION

From the beginning of this decade, precision farming technology has attracted a lot of attention in the developed world. Precision farmingis taken into consideration as a revolutionary approach to the improvement of crop management and sustainable agricultural development. Precision farming is a promising technology in the next century [1]. The main goal of precision farming is providing local data to reduce uncertainty - far from the pomp and

ceremony and should be seen a necessary element to the rapid changes in the developing world, even in different from of what has offered in Europe or North America [2].

Iran also as a developing country has many capabilities to explore from precision farming. With respect to the existence of agricultural developed fields, lack of irrigation water difficulties, semi-arid most of the areas of the country and with regard to the informational technology and also existent machines that can change to the semi-intelligent by the settlement of systems, precision farming can be used through considering an arrangement [3].

MATERIALS AND METHODS

Sampling Method

Classified random sampling method with proportional assignment was used as sampling method among agricultural experts in Ardabil Province.Thus, in this research the centers that most experts were employed there were identified in three classes (Agriculture Research Center, and Agricultural Training Centre). Then relative to the number of individuals in each class, sample was detected through random sampling method within classes.

Research Instruments

The needed instrument for data collection was questionnaire. The questionnaires were instruments by which respondents respond to the questions and show their reaction to the subjects and questions clearly. In this study questionnaire will be designed based on questions, goals and research variables. In designing the mentioned questionnaire researchers' studies, professors' and experts' viewpoints are used.

Used Statistical Methods

Selection of appropriate method in data analysis is the most important step in the analysis of the collected data.In order to analyze the data, descriptive and inferential statistics was used. Descriptive statistics describe existent condition. Therefore, items as frequency, minimal, maximal, measurement of attention to center (mean, chart, and medium) and distribution indices (variation and standard deviation) were used to describe research variables.

Inferential Statistics

This section of statistics which relays on the analysis, description and generalization of the obtained results of arrangement and elementary statistical calculation, is referred to as inferential statistics.Using methods of inferential statistics it's possible to induce features of research participants. In the current study, factorial analysis methods are used. Through factorial data analysis in this study generally the following stages have considered:

1-Identification and realization of appropriateness of data to factorial analysis through KMO and Bartlett tests
If KMO value is less than .5, the data will not be appropriate to factorial analysis and if its value is between .5 and .7 the existent correlation between data will appropriate to the factorial analysis and if it is more than .7 variables will be more appropriate.

2-Determination of Factor Number
One of the important cases in the factorial analysis is determination of the number of factors that can be extracted. Although there have not been exact qualitative base to the decision making about the number of extracted factors, but there is principle that are used to in the determination of the number of extracted factors, these criteria are as follow: specific amount criteria, previous criteria, variance criteria [4].
In this research based on the fact that factorial analysis is heuristic the first criteria, i.e. specific value, has been used and the aim is extraction of factors that their specific value is more than 1.

3-Factors' rotation
The aim of rotation in the factorial analysis is rotating factor axes around center of coordinates. The rotation is done when factors interpretation is not simply possible. Thus, factorial rotation is used in order to simplify structure of factors and their interpretation.There are various methods to the factors rotation that Varimax method has been used in this paper and variables that their factorial load is more than 1 extracted as significant 3 factorial loads.

4-Calculation of factorial values
Factorial analysis summarizes main variables in limited numbers of factors. When these limited factors are used in the next analysis (such as regression analysis), some of the values should be used to the induction of new variables.

These values are in fact combination of all main variables that have central role in the creation of new factor. This combination of variables is referred to as factorial grades (values). Since the aim of the current research is achieving to the new but limited set of combined variables in order to use in stead of main variables in the next analysis (regression analysis), thus factorial values are calculated in order to achieve to this purpose.
The following statistical methods have been calculated and analyzed using SPSS version 16.

RESULTS AND DISCUSSION

Reliability means fixed quality that is shown through data collection material or methods during time [5]. Reliability is generally a quantitative and technical issue and mostly pays attention to the question about the way of measuring special attitude or phenomenon correctly and accurately [4]. Pilot test is used to obtain test reliability. To do those 30 questionnaires were distributed among people other than research subjects. Then Cronbach's alpha of the questions of Likret spectra was calculated using SPSS 16 that the obtained value was .96 (table 1). Since Cronbach's alpha value above .70 is indicator of acceptable reliability of measuring instrument, the obtained value indicates high reliability of this research questionnaire.

Table 1. Reliability of different parts of questionnaire using SPSS software of Cronbach'Alpha Raw section Cronbach'sAlpha

1	familiarity amount of experts with precision farming	.894
2	experts' viewpoints in the field of concepts and technologies of precision farming	.753
3	educational and developmental factor in the application of precision farming	.929
4	investigative factors on the application of precision farming	.931
5	economical factors on the application of precision farming	.833
6	infrastructural factors on the application of precision farming	.942
7	governmental and political factors on the application of precision farming	.914
8	capabilities and advantages of precision farming	.931
9	challenges and barriers of precision farming	.751

With respect to the obtain results it was realized that the effectiveness of potential challenges and barriers of precision farming implementation in Ardabil province is "high" with the mean value of 3.94 and standard deviation of .92. the most effectiveness amount was due to the "investment costs" with mean value of 3.92 and standard deviation of 1.05 , the least effectiveness was related to the "process's being time-consuming" with the mean value of 3.49 and standard deviation of 1.07 (table 2).

Table 2. prioritizing of challenges and barriers to the implementation of precision farming (169 = n)

Priority	Challenges and obstacles	*Mean	Standard deviation
1	Lack of required equipment and infrastructure to implementation of precision farming	3.92	1.05
2	The lack of government financial support of precision farmers	3.49	1.07
3	farmers being illiterate or low-literate	4.07	0.95
4	Information poverty on precision farming technologies among farmers and experts	3.82	1.03
5	Lack of access to facilities and satellite data	4.05	1.02
6	Smallness and distribution of land surface	3.96	1.02
7	Subsistence related farming systems	3.94	1.03
8	Diffusion problems of precision farming technologies	3.69	1.08
9	High investment costs	3.88	1.04
10	lack of risk acceptance of precision farming by farmers	3.88	1.06
11	Existence of conservativespirit among farmers and producers	4.15	0.92
12	Non-humdrumness of planting systems	4.08	0.92
13	Lack of favorable attitude of experts and farmers towards the implementation of precision farming	4.06	0.95
14	Time-consuming being of the implementation process of precision farming	4.21	0.86
	Total Mean	3.94	3.94

**The Mean range is from 1 to 5Scales: 1=very low, 2=low, 3=average, 4=high, 5=very much*

Factorial analysis of challenges, barriers and difficulties affecting on the development of precision farming in the agricultural section of Iran

In order to do factorial analysis of challenges and problems affecting on the development of precision farming in the agricultural section of Iran, the Exploratory Factorial Analysis with summarizing approach of the datawas used. In order to determine the suitability of the collected data for factorial analysis the KMO coefficient (Kaiser Coefficient) and Bartlett statistics were used. in this section the value of KMO coefficient was equal to .725 that is indicator of the appropriateness of the existing correlations between data to factorial analysis, on the other hand, to ensure the

appropriateness of data for factor analysisBartlett's test were used. The value of this statisticswas equal to 749.432, which was significant at 0.1 so data were appropriate for factorial analysis (table, 3).

Table 3. KMO value and Bartlett's test and significance level

Sets to be analyzed		KMO value	Barlett's value	significance Leve
Affecting challenges and	Difficulties on the usage of precision farming	0.725	749.432	0.000

Four factors with special values obtained greater than 1 using factorial analysis technique..Andchallengesand difficulties variables that areaffecting onthe application ofprecision farming were classified through Varimax method based on factorial loadings and after orthogonal factorial rotation and these factors described 62.75 of the total variance and just less than 37.23 of the rest variance was related to the factors that were not identified through factorial analysis. The number of each obtained factors along with special values, variance percentage and cumulative variance percentage of each factors are shown in the Table (4).

Table 4. Obtained factors along with special values, their variance percentage and their cumulative variance percentage

Factors	special values	Percentage of the special values variance	Cumulative variance percentage
First	2.364	16.88	16.88
Second	2.326	16.61	33.49
Third	2.07	14.78	48.27
Fourth	2.028	14.48	62.75

The condition that the set of variables related to the determining factors of affecting challenges and difficulties on the diffusion of precision farming in the agricultural field in Iran has been presented in table 5, with regard to extracted factors with the assumption the variables with factorial loads with the value of more than .5 after the rotation of factors through Varimax method and naming factors. With respect to the special values of extracted factors, the "insight related" factor with variances value of 16.88 had a major role in description of the variables. After that, the "agricultural" factor, "educational and promotional" factors and "financial and equipment related" factors were respectively ranked in the next classes.

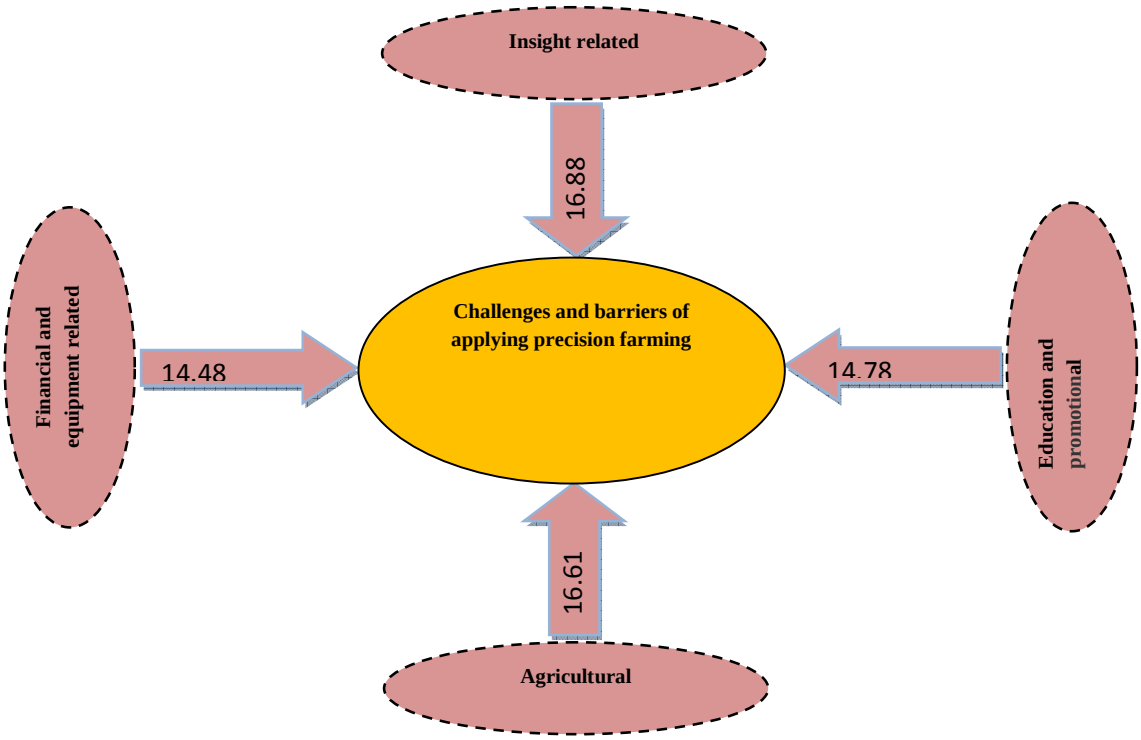

Figure 1. Determining factors of challenges and difficulties affecting the application of precision farming the explained variance percentage

Table 5. Variables related to each of the factors and the amount of factorial loads of the rotated matrix

Factor Name	Variables	Factorial Load
Insight related	Lack of risk acceptance of precision farming by farmers	0.653
	Existence of conservative spirit among farmers and producers	0.724
	Lack of experts' and farmers' favorable attitude towards the implementation of precision farming	0.737
agricultural	Subsistence related farming systems	0.660
	Non-humdrumness planting systems	0.544
	Smallness and distribution of land surface	0.760
Educational and promotional	Farmers being illiterate or low-literate	0.531
	Information poverty on precision farming technologies among farmers and experts	0.716
	diffusion problems of precision farming technologies	0.716
Financial and equipment related	High investment costs	0.750
	The lack of government financial support of precision farmers	0.778
	Being time-consuming of the implementation process of precision farming	0.832
	Lack of required equipments and infrastructures to the implementation of precision farming	0.564
	Lack of access to the facilities and satellite data	0.625

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