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Identify the Barriers to the Application of Precision Agriculture in Khouzestan Province, Iran

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Abstract

The purpose of this study is to identify the barriers of application of precision farming in the view of agricultural researchers in Khouzestan province. The research method was survey. Agricultural researchers in Khouzestan province considered as statistical population (N=136). All researchers considered as sample size by census method. After designing and validating the questionnaire, the questionnaire was pre-tested among 30 people and Cronbach alpha 0.753 was determined. The main tool was a questionnaire. In this study, after the collection and classification of data, data analysis and according to the type of research in two stages using descriptive statistics and inferential statistics were taken. All data processing and statistical analysis was performed using the software SPSS 19. For analysis data, correlative coefficients and factor analysis were used. The results of the factor analysis indicate that lack of educational activity and managerial practices, lack of knowledge and information, lack of technical infrastructure, lack of support services, non-compliance with the conditions of farmers are five factors that explains about 57.65% of the variance barriers to the application of precision agriculture.

1. Introduction

Precision Agriculture (PA) is a farming management concept based upon observing, measuring and responding to inter and intra-field variability in crops, or to aspects of animal rearing. The benefits to be obtained are chiefly due to increased yields and/or increased profitability of production to the farmer. Other benefits come from better working conditions, increased animal welfare and the potential to improve various aspects of environmental stewardship. Thus, PA contributes to the wider goal concerning sustainability of agricultural production (Zarco-Tejada et al, 2014).

The implementation of PA has become possible thanks to the development of sensor technologies combined with procedures to link mapped variables to appropriate farming management actions such as cultivation, seeding, fertilization, herbicide application, and harvesting (Zarco-Tejada et al, 2014).

Although spatial precision agriculture (PA) encompasses four key information technologies, farmers tend to use it in one of two major ways. The four PA technologies include location determination (via the Global Positioning System, GPS), computerized geographic information systems (GIS), computer-guided controllers for variable rate application (VRA) of crop inputs, and sensing technologies for automated data collection and mapping. The GPS and GIS technologies underpin both of the major PA practices that farmers have begun to adopt (Swinton and Lowenberg-Deboer, 2009). One of these is nutrient management; it involves spatially referenced soil sampling, often linked to VRA fertilizer spreading. The other is yield monitoring, usually tied to yield mapping. In North America adoption is emerging for variants of these, such as VRA seeding and pesticide spraying, as well as remote sensing of plant vigor (Daberkow and McBride, 2000).

Precision farming is a comprehensive approach to farm management and has the following goals and outcomes: increased profitability and sustainability, improved product quality, effective and efficient pest management, energy, water and soil conservation, and surface and ground water protection (Bobby et al, 2009). Precision agriculture (PA) is an approach to reorganizing the total system of agriculture production towards one that optimizes input use over space (Roberts, English, and Mahajanashetti, 2000).

Maheswari et al (2008) revealed that adoption of precision farming leads to about 80 per cent increase in yield in tomato and 34 percent in brinjal. Increase in gross margin has been found 165 percent and 67 percent in tomato and brinjal production, respectively. The contribution of technology for higher yield in precision farming has been recorded as 33.7 percent and 20.5 percent, respectively in tomato and brinjal. The elasticity of 0.39 for the adoption in tomato and of 0.28 in brinjal indicated that as the probability of adoption increases by 10 percent, the net return increases by 39 percent and 28 percent in tomato and brinjal cultivation, respectively. Lack of finance and credit facilities have been identified as the major constraints for nonadoption of precision farming.

Batte and Arnholt (2003) point out that precision farming has the potential to help farmers improve input allocation decisions.

Khosla (2010) revealed with increasing global population and limited or decreasing arable land available for crop production the question arises "will we be able to overcome the future challenges and seize them as opportunities?" Precision agriculture management coupled with genetic improvements in crop traits will play a crucial role in meeting global demand for food, feed, fiber and fuel in the near and distant future.

The purpose of this research was identifying barriers to the application of precision agriculture in Khouzestan province.

2. Materials and Methods

The research method was descriptive and correlative. Agricultural researchers in Khouzestan province considered as statistical population (N=136). All researchers considered as sample size by census method. After designing and validating the questionnaire, the questionnaire was pre-tested among 30 people and Cronbach alpha 0.753 was determined. The main tool was a questionnaire. In this study, after the collection and classification of data, data analysis and according to the type of research in two stages using descriptive statistics and inferential statistics were taken. All data processing and statistical analysis was performed using the software SPSS 19. For analysis data, correlative coefficients and factor analysis were used.

3. Results and discussion

One of the sections considered in this study, is to prioritize the barriers to the application of precision agriculture, therefore 19 items were used for this purpose. These items are based on a review of the research literature and the history of the subject.

As Table 1 demonstrates, obstacles such as lack of attention to precision agriculture in the agricultural development programs of the involved organizations, lack of technical knowledge of the experts using relevant technical software, lack of correct agricultural management in the use of the precision agriculture technology, wrong subjectivity of the users towards the infrastructure required to implement precision agriculture and how to use it, low-risk of farmers have higher priority than other components and barriers.

To categorize barriers to the application of precision agriculture, and to determine the variance explained by each factor, an exploratory factor analysis approach was followed. Data revealed that internal coherence of the data was appropriate (KMO =0.790), while and the Bartlett's statistic was significant at the 0.01 level (621.172).

The five commonly used decision rules were applied to identify the factors: 1) minimum eigenvalue of 1; 2) minimum factor loading of 0.5 for each indicator item; 3) simplicity of factor structure; and 4) exclusion of single item factors. According to Kaiser Criteria, there were seven factors that their extracted eigenvalues were greater than one. Later, the items were categorized into seven factors by using VARIMAX Rotation Method (Table 2).

After the varimax method rotation, 57.65% of the total variance was explained, and 42.34% of the remaining variance was related to factors that weren't identified by factor analysis. After reviewing the variables and factor loadings, the factors were named this order: lack of educational activity and managerial practices, lack of knowledge and information, lack of technical infrastructure, lack of support services, non-compliance with the conditions of farmers.

The Eigen value which in fact is the factor loads of each factor, explains the variance indicated by that factor. The total amount of variance, is the characteristic root or factor's Eigen value, the larger the specific factor the more the variance factor it explains. Based on this value in the current study, of factors with Eigen values greater than one were extracted, which were arranged by maximum variance. These factors were named according to the barriers of the application of precision agriculture.

The first factor indicated was lack of knowledge and management, this factor, according to its Eigen value (5.550) which is more than any other factor, explains

29.209% of the factors total variance. The second factor was the lack of knowledge, according to its Eigen value (1.659) explains 8.734% of the total variance of the factors. The third factor was the lack of technical facilities, due to its Eigen value (1.537) explains 8.090 % of the total variance. The fourth factor was the lack of support services, due to its Eigen value (1.126) explains 5.926% of the total variance. The fifth factor was the conditions conflict, due to its Eigen value (1.082) explains 5.695% of the total variance. Given the fact that the factor loadings on all variables is above 50%, most items were involved in the explanation of barriers to the use of precision agriculture.

Table 1. Prioritization of the application of precision agriculture in Khouzestan province

Barriers to the application of precision agriculture.	Mean	SD	CV	Priority
Lack of attention to precision agriculture in agricultural development programs.	1.97	0.756	0.383	1
Lack of technical knowledge of experts in the use of related software	2.37	0.924	0.389	2
Lack of suitable management of the farmers in using precision agriculture technologies	2.35	0.960	0.408	3
Farmers have wrong understanding of the infrastructures required to implement precision agriculture and its applications.	2.42	0.996	0.411	4
Farmers risk taking is low.	2.26	0.941	0.416	5
Experienced manpower constraints	2.17	0.913	0.420	6
Time consuming implementation of precision agriculture	2.31	0.980	0.424	7
Resistance to change by farmers	2.43	0.032	0.424	8
Lack of farmers technical knowledge in using the precision agriculture	2.29	0.976	0.426	9
Incompatibility of this technology with the conditions of smallholder farmers	2.44	1.050	0.430	10
Failure to provide consultation and assistance to the farmers from relevant organization and authorities	2.23	0.969	0.434	11
Lack of information about the applications of precision agriculture by farm	1.93	0.839	0.434	12
Lack of agricultural support services	2.32	1.018	0.438	13
High percentage of low-literate and illiterate farmers	2.32	1.027	0.442	14
Lack of understanding the benefits of applicable precision agriculture technology by farmers	2.25	1.004	0.446	15
Lack of basic information and general knowledge toward precision agriculture	2.32	1.044	0.45	16
Lack of equipments (hardware such as machinery and computers)	2.10	0.981	0.467	17
Small farm sizes.	2.44	1.188	0.486	18
Financial constraints and lack of financial capabilities for precision agriculture applications	2.10	1.053	0.501	19

Table 2. Extracted Factors with Eigen Values after Factor Rotation

Agent	Eigen values	Percentage of variance	Cumulative percentage
1	5.550	29.209	29.209
2	1.659	8.734	37.943
3	1.537	8.090	46.033
4	1.126	5.926	51.959
5	1.082	5.695	57.654

KMO = 0.790 Bartlett's test = 621.172 Sig = 0.000

Table 3. Classification of the Main Obstacles to the Application of Precision Agriculture in the Form of Basic Factors after Factor Rotation.

Factors	Factor load
First factor: Lack of educational activity and managerial practices	
Farmers risk taking is low.	0.686
Farmers wrong understanding of the infrastructure required to implement precision agriculture and its applications	0.676
Lack of suitable management of the farmers in using precision agriculture technologies	0.676
Lack of tendency to precision agriculture in agricultural development programs of the relevant organizations	0.551
Lack the technical knowledge in farmers to use the relevant software	0.530
Second factor: Lack of knowledge and information	
Time consuming of Precision agriculture implementation	0.749
Failure to provide consultation and guidance to farmers by relevant organizations and authorities	0.688
Lack of knowledge about the benefits of applicable precision agriculture technology by farmers	0.576
Lack of technical knowledge of experts in the use of related technological software	0.567
Third factor: lack of technical infrastructure	
Financial constraints and lack of financial capabilities for precision agriculture applications	0.823
Lack of equipments (hardware such as machineries and computers)	0.649
Lack of information about the applications of precision agriculture	0.540
Fourth factor: Lack of support services	
Resistance to change by farmers	0.731
Small farms	0.728
Lack of agricultural support services	0.580
Fifth factor: incompatibility with the conditions	
High percentage of low-literate and illiterate farmers	0.696
Incompatibility of this technology with the conditions of subsistence and smallholder farmers	0.575

4. Conclusion and recommendations

Results showed that the prioritization of barriers such as lack of attention to precision agriculture in agricultural development programs by relevant organizations, lack technical knowledge of experts in the use of related technological software, lack of suitable management of farmers in using precision agricultural technology, lack of understanding of infrastructure required to implement precision agriculture and its applications, low-risking of farmers have higher priority than other components. The results of the factor analysis showed that lack of educational activity and managerial practices, lack of knowledge and information, lack of technical inferastructure, lack of support services, non-compliance with the conditions of farmers explains about 57.65% of the variance barriers to the application of precision agriculture. It should be noted that low risking of farmers, time consuming of implementing precision agriculture, financial constraints and lack of financial resources for the application of precision agriculture, the farmers' resistance to change, a high percentage of low-literate and illiterate farmers has the largest part of barriers to the application of precision agriculture. Based on these findings, the following recommendations are offered:

Given the essential role of lack of education and management with barriers to precision agriculture applications, it is recommended that to raise the level of researchers' knowledge and to further introduction to precision agriculture, extension classes and workshops are recommended. In addition, training and empowerment of advocates and facilitators in managing the implementation of precision agriculture should be done in the province.

To raise the knowledge of researchers, experts and farmers its offered to use a extensional approaches, mass media, brochures.

The successfully implement precision agriculture, the technical facilities should be increased in the province therefore we suggest that the government provides facilities and services in this field to encourage and support farmers and researchers. Creating agricultural co-operatives also helps reducing costs of these technologies development. Providing appropriate and sufficient funding for the procurement of new technological equipment to use in precision agriculture research centers of the province can have a crucial role in the implementation process.

Development of support and research services, training and education of farmers should be considered as one of the programs and policies of agricultural programs in the province.

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