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SURVEYING THE APPLICATION OF PRECISION AGRICULTURE IN TEA PLANTATIONS OF LAHIJAN COUNTY

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ABSTRACT

The aim of this study was to survey the use of precision agriculture in tea plantations of Lahijan County. This study is an applied research in terms of purpose and is a correlation study as well. The study population consisted of all specialists working at Tea Research Institute and experts of the Agricultural Service Centers in Lahijan County who their number was 97 and they were counted through census method. Questionnaire was the main tool for measuring and collecting variables. The validity of the research instrument was established by a panel of experts and the reliability of research was determined by calculating Cronbach's Alpha Coefficient for the various sectors. The survey questionnaire is reliable with a total alpha of 0.819. In this study, collecting the required information was conducted through two parts of library research and field study. The results showed that the social background has the highest feasibility in the use of precision agriculture and the next priorities refer to economic, policy making, advocacy, education, and finally technological aspects. Respondents believed that the technological feasibility of precision agriculture in tea plantations is difficult. In order to identify and classify the use of precision farming's areas in tea plantations of Lahijan County, the exploratory factor analysis was used. The results showed that six factors of technical (19.41 percent), socio-economic (13.73 percent), supportive- policy making (11.29 percent), and educational (9.46%), environmental (8.64 percent), and research (3.89 percent) in total, explained 66.43 percent of the

variance associated with the use of precision farming's areas in tea plantations of Lahijan County.

Keywords: Precision agriculture, feasibility study, tea plantations, Lahijan County.

INTRODUCTION

At present, about 32 thousand hectares of the Country's northern farm land are dedicated to the cultivation of tea. Iran with a population of about one percent of the global population allocated to itself about 4 to 5.4 percent of the total consumption of tea and is of major tea consumers in the world. The study of the number of beneficiaries of Lahijan County shows that about 1505 units of operation are engaged in tea production of which 4617 units are smaller than one hectare and most of the manufacturing units are located in sub-montane areas. In Lahijan County, tea plantations are usually in form of smallholder possession and the majority of plantations have an area less than one hectare. According to the latest available statistics, 71.3 present of under cultivation tea plantations have an area less than one hectare, 23.4 between 1 to 5 ha and 5.3 percent over 5 ha that this issue makes the application of new technologies in improving tea production doubtful (Tea Organization of the Country, 2014: online).

In recent years, cultivation scientists have looked for new ways to manage farm in which in addition to optimizing the use of inputs, the production performance increases and ultimately, the economic efficiency to be improved as well. It was for this purpose that from the beginning of the resent decade, the subject of precision agriculture has raised (Omidi and Bahramnejad, 2010). Obviously, in the scale of a farm, though small, we are faced with different variables. Differences in soil characteristics in different parts of the field in one hand and the different needs of various plants of the farm on the other hand, as well as other variable factors at farm level; require a diversified and proper management for each part of the farm that the need for such a variable management has been the main philosophy of the advent of precision agriculture system (Bordbar, 2010).

Precision agriculture is a broad concept which includes the areas of precision horticulture, forestry and pomology with agricultural precision protection, precision fisheries and so on (Omidi and Bahramnejad, 2010). The concept of precision agriculture is based on information technology and becomes an attractive idea to manage natural resources and achieve sustainable development of modern agriculture, in

addition, provides a new concept of sustainable use of agricultural resources (Wang, 2001). This concept by allowing accurate management of inputs, provides various production methods to agricultural producers (Waston et al, .2005).

The aim of using precision farming in the fields is to optimize efficiency and increase revenue throughout the farm. Identifying changes in yield potential, chance of optimization and increasing the quantity of production in each region or within each area, will be reinforced by using a diagnostic and different management (Adrin et al, 2005). Thus, by reducing costs and detecting and choosing the right place in terms of economic and environment for farmers, they may find a possibility of cultivation in a wider range (Reichardt and Jürgens, 2009)

Precision agriculture refers to the application of the technology of spatial information in agriculture and this is sometimes called location-oriented agriculture in which the data obtained from various locations of a field is collected and analyzed to help farm managers to make appropriate management decisions according to the circumstances of each place or point of the farm (Sevier and Lee, 2005).

Bordbar and Bagheri (2013) emphasize that the six challenges of education and infrastructure, content, management, human resources, promotion, and planning explain about 50% of the variance of the challenges against the development of precision agriculture. Bordbar and Hussaini (2010) emphasize that there is a significant relationship between educational, economic, technical, managerial, and policy factors with the possibility of the use of precision agriculture. While there is no significant relationship between social factors and the possibility of the use of precision agriculture. Ashraf (2007) concluded that there is a significant positive correlation between age and work experience with knowledge of agricultural experts in terms of remote sensing concepts. Breazeale (2006) in a study in term of fertilizing by using precision agriculture, acknowledged that the application of this method is accompanied to advantages such as increased yield, improved economic productivity and cost return.

Jintong and colleagues (2002) concluded that the optimal investment in inputs, efficient use of natural resources, reduced pollution and high quality of products are of results of the use of precision agriculture. Schubert et al (2002) stated that using this method lead to increased yield, developed ability of mapping performance and improvement in taking managerial decisions. Batte (2008) showed

that the rate of adoption and the adoption of precision agriculture depend on factors such as farm size, individuals' annual income the type of plant.

Mishra et al. (2003) explained the main reasons for the low adoption of precision agriculture in India due to low risk taking of farmers, irrelevant socio-economic conditions and small size farms. Griffin et al. (2004) in a study, explained the reason of delay in the adoption of precision agriculture due to shortages of harvesting machineries, high cost of grid soil sampling, lack of understanding of the benefits of sensors and few number of consulting firms. Fountas et al. (2006) also considered the challenges of precision agricultural development as the lack of technical and faring skills and stated that to address the problem, achieving a comprehensive decision support system is proposed. In addition, in another study, they reported that the main barriers to the adoption of precision agriculture refer hardware incompatibility. Mondal et al. (2007) reviewing the adoption of technologies related to precision agriculture and precision farming in some developing countries, considered high level of technology used as one of the major challenges in the use of precision farming in these countries.

MATERIALS AND METHODS

This is an applied research in terms of purpose, non-experimental in terms of data collection and since investigates the relationship between the research variables, is an analytic and correlation study. In terms of implementation process, this is a quantitative study and in terms of logic, is a comparative work and in terms of time of doing research, is a longitudinal retrospective research. The study population included all specialists of Tea Research Institute and experts in Agricultural Service Centers of Lahijan County who are connected with tea farmers in Lahijan. The number of the experts was 97 who were counted through a census. The fields have been investigated in this research include economic, social, support, technical, educational and environmental areas. The main tool for measuring variables was a questionnaire. The validity of the research instrument was established by a panel of experts and the reliability of research was determined by calculating Cronbach's Alpha Coefficient for the various sectors. The survey questionnaire is reliable with a total alpha of 0.819. In this study, collecting the required information was conducted through two parts of library research and field study.

RESEARCH FINDINGS

- *Fields of the use of precision agriculture in tea plantations*: checking thefields ofthe use of precision agriculture in tea plantations showed that 16.5% of respondents believed that there is a low likelihood of existence of the economic fields of using precision agriculture and 49.5 percent knew it was moderate and 34% assumed it was high. So one can say that the economic areas of the use of precision agriculture can be considered moderate to high. 63.9 percent of respondents believed that there is a likelihood of existence of the social fields of using precision agriculture and 19.6 percent rated it as a low level. So one can say that the social areas of the use of precision agriculture can be considered moderate to low. In terms of policy making fields, 55.7 percentof respondents know it moderate and 26.8 percent evaluated it low. which it can be said that the feasibility of the policy making is moderate to low. In terms of educational, 45.4 present of respondents know it moderate and 30.9 percent evaluated it high. Prioritizing the aspects of the use of precision farming by applying the coefficient of variation showed that social areas were more feasible in the use of precision agriculture and next priorities are economic, policy making, supportive, education and finally technological aspects. Respondents believe that technological feasibility of precision agriculture in tea plantations is low. Results are given in Table 1.

Table 1: Determining the levels of the fields of using precision agriculture in tea plantations in Lahijan County

Field	Level	Quantity	%	Commutative percent	Mean	SD	CV	Rank
Social	Low	19	19.6	19.6				
	Moderate	62	63.9	83.5	2.98	0.654	0.219	1
	High	16	16.5	100				
	Total	97	100					
Economic	Low	16	16.5	16.5				
	Moderate	48	49.5	66	3.35	0.857	0.256	2
	High	33	34	100				
	Total	97	100					
Policy making	Low	26	26.8	26.8				
	Moderate	54	55.7	82.5	2.85	0.877	0.308	3
	High	17	17.5	100				
	Total	97	100					
Supportive	Low	28	28.9	28.7				
	Moderate	50	51.5	80.4	2.90	0.894	0.309	4
	High	19	16.9	100				
	Total	97	100					
Educational	Low	23	23.7	23.7				
	Moderate	44	45.4	69.1	3.08	0.956	0.310	5
	High	30	30. 9	100				
	Total	97	100					
Technical	Low	40	41.2	41.2				
	Moderate	39	40.2	81.4	2.68	0.922	0.344	6
	High	18	18.6	100				
	Total	97	100					

- Identification and classification of the fields of the use of precision agriculture: in order to identify and classify the fields of the use of precision agriculture in tea plantations in Lahijan County, the exploratory factor analysis was used with a view to determining the significant variables in each of the factors set out in the theoretical framework. Reviewing the results of analysis of the fields of application of precision agriculture in tea plantations of Lahijan County and to determine the suitability of the data for analysis, KMO and Bartlett's test were conducted and the results showed that the data is appropriate for this analysis. (KMO=0.705; Bartlett's test=5549.915, df=1326, sig=0.00).

With regard to the appropriateness of data, the categorization was conducted by using the approach of principal components analysis and the results are given in Tables (2) and (3). The results show that the six factors explain 66.44% of the use of precision agriculture in tea plantations in Lahijan County.

Table 2- extracted factors with eigenvalues, variance percent and the cumulative variance percent

No	Factor	eigenvalues	variance percent	cumulative variance percent
1	Technical	10.095	19.41	19.41
2	Socio-economic	7.13	13.73	33.14
3	Supportive-policy making	5.87	11.29	44.45
4	Educational	4.92	9.46	53.89
5	Environmental	4.49	8.64	62.53
6	Research	2.02	2.89	66.43

The results showed that the first and most important thing in the possibility of adopting precision agriculture refers to technological issues. This factor with an eigenvalue of 10.095, explains about 19.41% of the variance of factors and emphasize that technological fields are important for the establishment of precision agriculture. The second factor which called the socio-economic factor, explains about 13.73% of the variance and focuses on the capital needed to buy equipment for precision agriculture, precision agriculture profitability in tea plantations, possibility of participation of farmers, researchers and experts at all levels and social interest in the use of new technologies and the acceptance. The third factor with an eigenvalue of 5.87 explains about 11.29% of the variance of factors and has been named the supportive-policy making factor.

This factor emphasizes the existence of laws and policies supporting the development of precision agriculture, supporting precision farming technologies by financial and credit institutions, and political support of the

development and application of precision agriculture technologies. According to government policies in the agricultural sector and more attention to production, and lack of investment in agriculture sector, taking into account its aspects and policy making is of importance. The fourth factor with eigenvalue of 4.92, explains approximately 9.46% of the variance of the factors and is called the education factor. This factor emphasizes training classes for tea farmers, published books and articles regarding the implementation of precision agriculture, and training professional researchers and consultants in the field of precision agriculture. The fifth factor with eigenvalue of 4.94 explains about 8.64 percent of the variance of the factors and has been called the environmental factor. This factor

emphasizes the ownership of land and the exploitation and the possibility of the use of precision agriculture technology, and climatic characteristics of the region in addition to compatibility with precision agriculture technologies. The existence of low-scale exploitation systems as well as scattered sub plantations and problem to access them are of items must be considered in the use of precision agriculture. The fifth factor with an eigenvalue of 2.02, explains about 3.89 percent of the variance of the factors and has been called the research factor. This factor emphasizes the establishment and development of research centers in the field of precision agriculture and will be of initiatives in the use of precision agriculture in the tea plantations.

Table 3: the variables related to each factor and the amount of coefficients obtained from the rotated matrix

Factor	Item	Factor coefficients
Technology	Use of different fertilizers by variable rates	0.593
	Use of varied irrigation according to the amount needed	0.558
	Use of variable rates of seed	0.592
	Use of varied rates of insecticides with respect to insects	0.782
	Use of varied rates of frequent herbicides	0.669
Socio-economic	Capital requirements for precision agriculture equipment and machinery	0.562
	The profitability of precision agriculture in tea plantations	0.546
	The possibility of participation of farmers, researchers and experts in all stages	0.716
	Existence of social interests in the use of new technologies and accept it	0.514
Supportive-policy making	Existence of policies and legislation supporting the development of precision agriculture	0.554
	Financial and credit institutions support precision agriculture technologies	0.628
	Political support of the development and application of precision agriculture technologies	0.617
Educational	Training classes for tea farmers	0.615
	Published books and articles in terms of the implementation of precision agriculture	0.563
	Training professional consultants and researchers in the field of precision agriculture	0.502

Environmental	**Land ownership and the exploitation and use of precision agriculture technology**	**0.586**
	Climatic characteristics and compatibility with precision agriculture technology	**0.740**
Research	**The development of precision agriculture research stations**	**0.615**

CONCLUSION AND RECOMMENDATIONS

The results of the study suggested that the social background is of most feasibility in the use of precision agriculture and the next priorities are economic, policy, supportive, education and technical areas, respectively. The results of a study conducted by Bordbar and Bagheri (2013) showed that the education factor is more important in the use of precision agriculture, while in this study, the social factor has a higher priority. The results showed that there is a significant positive relationship between the factors of social, economic, educational, policy making and so on. The results obtained by Hosseini et al. (2010) confirm these results. The results indicated that there is significant relationship between the age and experience of experts with their opinions about the use of precision agriculture areas which is in line with Ashraf (2007.

The results showed that the field of technology (technical) is the most important factor in the use of precision agriculture which is in line with Griffin (2004). In addition, prioritization of the areas of implementation showed that the technological area are lower feasibility in tea plantations which is line with Fountas (2004) and Mondal and Tewari (2007) and stresses that the technological area is the most important constraint in adopting precision agriculture.

The results of the analysis of the application areas of precision agriculture in tea plantations of Lahijan County show that the technology factor is the most important factor in the use of precision agriculture in tea plantations of Lahijan County.The results obtained by Bordbar and Hussains (2012) also show that the technological aspects of precision agriculture are of high complexity that this reduces its rate of acceptance. The results obtained by Breazeale (2006), Jintong (2002), Schubert (2002), and Batte (2008) also focus on the technological aspects of precision agriculture and paid attention to investment in equipment and precision farming technologies.

The socio-economic factor is considered the second factor affecting the use of precision agriculture. The results obtained by Mishra (2003), Griffin (2004), Fountas (2004) and Mondal and Tewari (2007) also emphasize this item and evaluate the economic factors

as an important item in the use of precision agriculture technologies.

According to the results, the following suggestions are offered:

- Support from individuals, organizations and institutions that are active in the field of the use of precision agriculture and a context for creating more job opportunities to be provided;

- Conducting educational and facilicating training courses with existence of tea farmers and experts in order to provide the conditions required for the application of this technology in tea plantations

- Developing an accurate documentation of precision agricultural development in order to provide a good context for making policies in tea plantations.

- Research on application of appropriate technologies which can be used and realized in tea plantations and;

- Research centers to prioritize the precision agriculture in their research plans

- The Province's educational and agricultural service centers by employing professionals, to enable them to help policy-making, planning and implementation;

- Through establishment of demonstration farms and testing existing technologies, the conditions for being familiar with precision

farming technologies and applying them to be provided.

- The results of the analysis of the use of precision agriculture areas in tea plantations of Lahijan City revealed that the technological factor is the most important factor in the use of precision agriculture technologies. So it is recommended that first, by identifying appropriate technologies, to import these technologies and in next step, the precision farming technologies to be native-made.

- According to the results, the environmental factor is the fifth influential factor in the application of precision agriculture in the tea plantations. So this is proposed that by encouraging farmers to integrate the tea plantations and establishing production cooperatives or local organizations, a situation to apply precision agriculture to be provided. There is no possibility of using precision agriculture in small farms;

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