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Determinants of Iranian agricultural consultants' intentions toward precision agriculture: Integrating innovativeness to the technology acceptance model

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Abstract Environmental crises and global concerns toward the consequences and side impacts of conventional agricultural systems and agricultural activities on environment resulted in the viewpoint of the necessity of changing mental patterns regarding sustainable farming systems. Different agricultural methods such as precision agriculture have been presented to respond to environmental problems in recent years. The purpose of this research was to investigate factors influencing agricultural personnel and consultants' attitude and behavioral intention to use precision agricultural technologies. The survey research and multistage random sampling were used to collect data from 183 agricultural consultants in Agricultural Engineering and Technical Consulting Services Companies. The results of structural equation modeling indicated that agricultural personnel and consultants in Fars Province intended to use precision agricultural technologies. Based on the results the behavioral attitude is the most important determinant of experts' intention toward the use of the precision agriculture technologies. Also individual innovativeness, attitude of confidence, perceived ease of use and perceived usefulness of precision agricultural technologies affected on the behavioral attitude and behavioral intention to use. According to the results, practical suggestions have presented to use these technologies in Iran.

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1. Introduction

There are three steps in technology development, and three strategies for precision agriculture (PA). Step one is based on conventional farming technology, with intensive mechanization to reduce the labor input. Step two involves the development of mapping techniques, variable-rate technology machines, and introductory decision support system on the basis of information technology. Step three implies the maturity of wisdom-oriented technologies. Scenario 1 is based on

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a "high-input and high-output" conventional strategy. Scenario 2 has a strategy for "low-input but constant output", and scenario 3 aims at "optimized input–output" as the goal of precision farming (Shibusawa, 2002). Through the advent of environmental crises and global concerns toward the consequences and side impacts of some agricultural activities on environment most of the researches and experts brought up a huge global challenge, i.e. a motion toward environmentally friendly agriculture due to observing an agriculture profoundly as a national independence focus and an effective basis on the environmental balance. Taking action to an environmentally friendly agriculture requires that sustainability and sustainable agriculture as successful management of agricultural resources to satisfy changing human needs along with the environmental conservation and biologic resources increase would be taken into consideration (Chikwendu and Arokoyo, 1997). Sustainable agriculture is conceptually a system for successful management in taking advantage of resources for providing human foods as well as increasing the environmental quality conservation and natural resources. In a general concept the sustainable agriculture is an insight which depends on human goals and his recognition of the effects of agricultural activities on the environment. In fact, the sustainable agriculture emphasizes that not only nature should be regarded but also agricultural products should be developed along with environment. Thus, production process will last in the future. There is a general consensus among agricultural development practitioners in Iran that the goals of sustainable agriculture should include increasing production (for an ever increasing population), preventing soil erosion, reducing pesticide and fertilizers contamination, protecting biodiversity, preserving natural resources and improving well-being (Rezaei-Moghaddam et al., 2005).

Why precision agriculture is needed? In recent studies the formal reports of Iran's natural resources and environment are frustrating. It should be noted that after Australia, Iran has the second global rank in erosion and destruction of fertilized lands and natural resources. This is to say that 33 tons of soil has been destructed and eroded in each hectare. One of the major reasons is the excessive consumption of fertilizers and chemical pesticides in agricultural sector. In addition, the reports show that pesticides and chemical fertilizers (nearly 3 tons in each hectare) are used too much in Iran. Developing and modernizing agriculture in Iran has resulted in primary costs including water pollution by pesticides and transfer to the soil and livestocks, foodstuff and feedstuff contaminations, air pollution and excessive use of natural resources. Tendency toward modernizing agriculture has led to remove livestock and plant traditional procedures, hygiene risks and loss of job (Kashani, 2001). Also Iran is located in an arid and semi-arid region. Having an average annual precipitation of 250 mm, Iran receives less than one third of global average precipitation (750 mm). Bearing in mind such a climatic condition, many severe or mild droughts are inevitable. In recent years, Iran has experienced several droughts. The current severe, prolonged and extensive drought in Iran has not only affected agricultural productivity but also threatened water resource sustainability (Keshavarz et al., 2010). This crisis in agricultural development of Iran has demonstrated that conventional development strategies are fundamentally limited in their ability to promote sustainable agricultural development. Therefore, it emphasizes on forming a new agricultural model for achieving sustainable agricultural development (Rezaei-Moghaddam et al., 2005). Hence, it seems that the conceptual pattern dominating conventional agricultural systems should be changed and we should move toward the design of sustainable farming systems.

In recent years different agricultural methods have been presented in response to environmental problems and reach to sustainable agricultural development such as precision agriculture. The concept of precision agriculture, based on information technology, is becoming an attractive idea for managing natural resources and realizing modern sustainable agricultural development (Maohua, 2001). Precision agriculture is a management strategy that uses information technology to bring data from multiple sources to bear on decisions associated with crop production (National research Council, 1997). PA is conceptualized by a system approach to reorganize the total system of agriculture toward a low-input, high-efficiency sustainable agriculture. PA provides an ideal tool for agricultural risk assessment and rational farm-work scheduling (Zhang et al., 2002). In fact, precision agriculture is a management concept which combines information and communication technologies for management of temporal and spatial variability in agriculture (Fountas et al., 2005). The basic goal of PA to optimize yield with minimum input and reduced environmental pollution is highly required for developing countries to face the challenge of sustainability (Mondal and Basu, 2009). Precision agriculture techniques are enforceable in all aspects of production cycle of farming products, from pre-cultivation operation to harvest.

According to studies, various models and theories have been presented in the field of information technology acceptance including Theory of Reasoned Action (TRA), Theory of Planned Behavior (TPB), Theory of Planned Demand (TPD), Innovation Diffusion Theory (IDT), the Unified Theory of Acceptance and Use of Technology (UTAUT) and Technology Acceptance Model (TAM). Technology acceptance model is considered as the most widely accepted model among information researches for studying users' system acceptance behavior (Yi et al., 2006). This model was developed by Davis (1989) based on the theory of reasoned action as the most effective and fundamental human behaviors theory. It provides a basis for tracing the impact of external factors on internal beliefs, attitudes and intentions (Ghamatrasa, 2006). TAM posits two particular beliefs "Perceived ease of use" – it refers to the degree to which the prospective user expects the target system to be free of effort – and "Perceived usefulness" that is defined as the prospective user's subjective probability that using a specific application system will increase his or her job performance (Davis et al., 1989).

Different researches were carried out based on technology acceptance model for predicting individual behaviors, intentions, and attitudes toward information technology acceptance. The results of Davis et al. (1989) study indicated that perceived usefulness affected on information technologies acceptance while perceived ease of use had less effect on making decision to use those kinds of technologies. Different researches confirmed TAM needs to be given additional variables to provide an even stronger model. Adrian et al. (2005) noted that there was a significant relationship between attitude of confidence, perceived net benefit, farm size and education level with behavioral intention. Moreover, there was a significant relationship between perceived usefulness and perceived

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