EFFECTIVE FACTORS INVOLVED IN ADOPTION OF SPRINKLER IRRIGATION: A CASE STUDY IN WHEAT FARMERS IN NAHAVAND TOWNSHIP, IRAN

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Abstract

The purpose of this study was to examine effective factors involved in adoption of sprinkler irrigation about wheat farmers in Nahavand Township from Iran. Wheat farmers (n=15365) in the Nahavand Township from Iran were the target population for this study. The population frame was obtained from Nahavand agricultural organization. The sample obtained through proportional stratified sampling (n=375). The methodological approach of this study is twofold: descriptive-correlative and causal-comparative. The Ministry of Agriculture's Extension Organization Directory was used to locate the wheat farmers. Content and face validity were established by a panel of experts consisting of faculty members in irrigation, agronomy and extension and education at the Tarbiat Modarres University. Further, the questionnaire was validity by agricultural officers of Nahavand Township. A pilot test was conducted with 30 wheat farmers. A reliability analysis, conducted and alpha value were reported 84%. The results of the study showed that, among the individual characteristics, there is a significant difference between adoption of sprinkler irrigation with age, literacy, experience cultivating wheat and rate of farmland. Also the results indicate that among the social factors, there is a significant difference between rate of social participation, rate of communication canals and rate of extension contacts with adoption of sprinkler irrigation.

Introduction

It is estimated that the world contains about 1400 million km³ of water. Of this water, solely 35 million km³ (2.5%) are freshwater. The large amount of freshwater contained in ice caps, glaciers and deep in the ground, which is not easily accessible for use. The average annual rainfall overland amounts to 119000 km³, of which some 74000 km³ evaporates back into the atmosphere. The remaining 45000-km³ flows into lakes, reservoirs band streams or infiltrate into the ground to replenish the aquifers. Not all of these 45000 km³ are accessible for use because part of the water flows into remote rivers during the seasonal floods. Table 1 shows world water distribution (FAO, 2003).

Table 1. World Water Distribution

Water resources in world	Water volume (million km³)	Percent of freshwater	Percent of total water
Total water	1386	-	100.00
Freshwater	35	100.00	2.53
Glacier and ice caps	24.4	69.7	1.76
Groundwater	10.5	30.0	0.76
Lakes, rivers, atmosphere	0.1	0.3	0.01
Saline water	1351	-	97.47

Source: (FAO, 2003).

Over the last 30 years irrigated areas have increased rapidly, helping to boost agricultural output and feed a growing population. Irrigation uses the largest fraction of water in almost all countries. Globally, 70% of freshwater diverted for human purposes goes to agriculture, and irrigation water demand is still increasing because the area being irrigated continues to expand (Rosegrant and Ringler, 2000). The global water situation is becoming critical, as water resources grow increasingly scarce and demand continues to climb. The agriculture sector is the largest user of water resources, and there are social requirements to reduce agricultural water consumption, even though the augmentation of food production is very urgent in many parts of the world *(Unami et al, 2004)*. In some countries, the expansion of surface water use appears to be approaching the physical limit, and groundwater abstractions are increasingly exceeding rates of replenishment. Meanwhile, industrial and domestic water demand has been increasing rapidly as a result of increasing economic development and urbanization. In some countries and regions, water is already being transferred out of irrigation and into urban-industrial uses, putting additional stress on the performance of the irrigation sector (Rosegrant and Ringler, 2000).

Iran is water scarce country with a mean annual precipitation of 250 mm (30 % of global mean). Therefore, drought is a recurring phenomenon in Iran. So, irrigation projects have key roles in accretion of agricultural productions. Increasing water use efficiency through promotion of sprinkler irrigation system can help the country increase agricultural. Obviously this effort has been the aim of the ministry of agriculture in the past decade. In the other hand, Iran is concerned with wheat yield stability because wheat is its main source of food (Chizari et al, 2001). Therefore, in attention to, given the severe shortage of water resources in Iran, the expansion of irrigated land is expected to be limited. In the same path, increasing water use efficiency in both irrigated agriculture and promoting dry land farming through water conservation and efficient use of rainfall will play significant roles in maintaining food security. Nahavand Township is located on the semi-arid region of western Iran. The Township of Nahavand is a high mountainous region. The average annual rainfall is between 320 and 441 mm. Consequently For increasing use of sprinkler irrigation the Agricultural Office of Nahavand Township cooperates with Extension Organization to attempt develop and disseminate sprinkler irrigation among the farmers. However, the adoption of sprinkler irrigation by wheat farmers in Nahavand has been limited.

Adoption of innovations related to opinion of farmers regarding characteristics of new technology and factors such as cultural and need for change by farmers (Abeydeera, 1994). Research in the diffusion of agricultural innovations has demonstrated that awareness of a new technology is a necessary first step in the adoption decision-making process (Rogers, 1995). This line of research also indicates that adoption behavior in the past is often a useful indicator for predicting future technology adoption (H*ooks et al*, 1983). It is essential for national planners and extension educators to know what technology the wheat growers are using and determine effective social and extension factors involved in adoption of sprinkler irrigation in improvement of agricultural water consumption.

Theoretical Base

One of the greatest challenges for the coming decades will be to increase food production with less water, particularly in countries with limited water and land resources. The sustainable use of water for agriculture has become a global priority of vital importance, requiring urgent and immediate solutions in view of intensifying worldwide competitiveness (FAO, 2002). The problem is not only to develop more refined techniques and practices to apply water accurately to the crop according to its requirements. There still exists a large gap between the availability of technologies for effective water use and their adoption. One of the reasons is that relatively little attention has been paid to establish an effective support system to assist farmers in the adoption of new techniques and technologies (*Ortega et al, 2005*).

The empirical research on this issue followed, however, different tracks. Based on technical grounds several studies have attempted to analyze on-farm adoption of irrigation technologies using the engineering notion of irrigation water efficiency defined by Whinlesey, McNeal and Obersinner (1986) (i.e., ratio of water stored in the crop root zone to the total water diverted for irrigation). Moreover, by technically and economically evaluating irrigation technologies, some combinations of water savings and yield increase was found to be necessary in order to induce farmers to adopt water conserving technologies (e.g., Coupal and Wilson, 1990; Santos, 1996; Droogers, Kite and Murray-Rust, 2000, Arabiyat, Segarra and Johnson, 2001). Despite of the fact that these studies have been quite appealing in analyzing the changes and the diffusion of irrigation technologies in agriculture they lack economic intuition.

Several authors have empirically investigated technology adoption and diffusion taking into account farmer's perception about the degree of risk concerning future yield (e.g., Tsur, Sternberg and Hochman, 1990; Feder and Umali, 1993; Saha, Love and Schwart, 1994; Batz, Peters and Janssen, 1999). In particular, Saha, Love and Schwart (1994) identify the factors that affect technology adoption and its intensity, under incomplete information dissemination and output uncertainty. Their results emphasize the role of information (and education) in the adoption of emerging technologies. Nevertheless they explicitly assume that farmer's profits are non-random in the absence of adoption and therefore in their theoretical framework they assume that neither the risk of the new technology nor the farmer's attitude towards risk affect adoption decisions. It seems therefore that a relative dearth of research exists on the perceivable link between farmer's decision to adopt innovations and production uncertainty related to agricultural production.

Purpose

The main purpose of this study was to examine effective factors involved in adoption of sprinkler irrigation about wheat farmers in Nahavand Township from Iran. The specific objectives of the study were to:

1. Determining framers' opinions regarding the adoption and use of sprinkler irrigation.
2. Compare two groups of wheat farmers, those who adopted sprinkler irrigation and those who did not.
3. Determining the informational source of farmers regarding sprinkler irrigation.

4. Identifying relationships between extension activities and the adoption of sprinkler irrigation by wheat farmers.

Methodology

Wheat farmers (n=15365) in the Nahavand Township of Iran were the target population for this study. The population frame was obtained from Nahavand agricultural organization. The sample obtained through proportional stratified sampling (n=375). The methodological approach of this study is twofold: descriptive-correlative and causal-comparative. The Ministry of Agriculture's Extension Organization Directory was used to locate the wheat farmers. From review of literature, the researchers developed an instrument to collect data. Farmers' access to information sources were determined by providing the farmers with a list of information sources those farmers could possibly be furnished with needed educational facts and information regarding sprinkler irrigation. Wheat farmer's responses to each of the information sources ranged from "not at all" equal to zero, to a "very much" equal to 5. The sum of the 12 information sources determined wheat farmer's level of access to information sources.

Content and face validity were established by a panel of experts consisting of faculty members in irrigation, agronomy and extension and education at the Tarbiat Modarres University. Further, the questionnaire was validity by agricultural officers of Nahavand Township. A pilot test was conducted with 30 wheat farmers. A reliability analysis, conducted and alpha value were reported 84%. The independent variables of this study were: personal and farming characteristics (age, education level, distance between the farm and the agricultural service center, wheat farming experience and size of wheat cultivated land holding) and social characteristics (wheat farmers' social status, the extend of their social participation and the extend of their use of communication channels). The dependant variable of the study was wheat farmers' adoption and non-adoption of sprinkler irrigation. A response rate of 0/88 was achieved.

Findings

The results indicate that the mean age of wheat farmers in this study was 45 years, as shown in Table 2 amounts (28.5%) of wheat farmers (n=94) were illiterate. (34.8%) of respondents (n=115) had primary school education. About (16.7%) of wheat farmers (n=55), had guidance level education and less than (20%) of wheat farmers (n=66) had high school or post secondary education. On average, wheat farmers had 22 years of experience in cultivating wheat. A majority of respondents (90%) farmed 10 hectares or less of agricultural land. A majority of households (80%) had more than 5 members. Sixty percent of wheat farmers had secondary job.

Table 2. Personal Characteristics of Respondents (n=330).

Variables	Items	*f*	%	Variables	Items	*f*	%
Age (year)	Below 30	59	17.9	**Family Members**	3-5	67	20.3
	30-40	66	20.0		5-8	174	52.7
	40-50	88	26.6		8-11	74	22.4
	50-60	63	19.1		Above 11	15	4.5
	Above 60	54	16.4				
Literacy	Illiterate	94	28.5	**Secondary Job**			
	Primary school	115	34.8		Yes	200	60.6
	Guidance	55	16.7				
	High school	45	13.6		No	130	39.4

	Post secondary	21	6.4				
Experience Cultivating Wheat (year)	1-10	75	22.7	**Farm Land (Hectare)**	1-5	160	48.5
	10-20	110	33.4		5-10	119	36.0
	20-30	63	19.1		10-15	29	8.8
	Above 30	82	24.8		Above 15	22	6.7

As shown in Table 3, the average distance between the farm and the agricultural service center was 15.32 km. The wheat farmers' social status ranged from 0 to 10 (M=6.04; SD=1.30). The wheat farmers' extension contacts ranged from 0 to 24 (M=8.33; SD=4.45). The wheat farmers' social participation ranged from 0 to 30 (M=20.43; SD=2.46). The wheat farmers' use of communication channels ranged from 0 to 48 (M=10.53; SD=3.87).

Table 3. Social Characteristics of Respondents (n=330).

Variables	*Mean*	*SD*	*Range*
Extension Contacts	7.75	5.38	0-24
Communication Channels	16.53	4.58	0-48
Social Participation	20.16	4.58	0-30
Social Status	6.04	6	0-10

Also as Table 4 shows, was determined as described on the methodology section and for the purpose of characterization the score was transformed into three levels as "low", "moderate", and "high". As table 4 shows, majority of wheat farmers' (252) had a “high” level of social participation with social institutes. About 75.4% of wheat farmers' (n=249) had a “moderate” level of communication channels. About 49.7% of wheat farmers' (n=164) had a “moderate” level of extension contacts and majority of wheat farmers' (n=129) had a “high” level of social status.

Table 4. Level of Wheat Farmers Social Characteristics (n=330).

Variables	Items	Frequency	Percent
Social participation	Low	-	-
	Moderate	78	23.6
	High	252	76.4
Communication Channels	Low	61	18.5
	Moderate	249	75.4
	High	20	24.6
Extension Contacts	Low	105	31.8
	Moderate	164	49.7
	High	61	18.5
Social Status	Low	36	10.9
	Moderate	50	16.5
	High	129	39

Compare two groups of wheat farmers, those who adopted sprinkler irrigation and those who did not: as Table 5 shows that, among the averages of the variables of age, education level, wheat farming experience, size of wheat cultivated land holding, their social status, their extent contacts, their social participation and their use of communication channels, significant differences are exposed when the two groups of wheat farmers meaning, those who adopted sprinkler irrigation technology and those who did not, are compared together. While, among the averages of the variables of the number of family farmers and distance between the farm and the agricultural service center, significant differences aren't exposed when the two groups of wheat farmers meaning, those who adopted sprinkler irrigation and those who did not, are compared together. On the whole, among the individual characteristics the results of the study showed that there is a significant difference between adoption of sprinkler irrigation with age, literacy, experience cultivating wheat and rate of farm land. Also the results indicate that among the social factors, there is a significant difference between rate of social participation, rate of communication canals and rate of extension contacts with adoption of sprinkler irrigation.

Table 5. Compare Characteristics of wheat farmers (adopted and non adopted).

Variable	**Adopted n= 133**		**no Adopted n=197**		**T**	**P**
	Mean	**SD**	**Mean**	**SD**		
Age	35.69	9.99	52.91	12.33	5.828	0.016*
Education level	7.42	3.73	2.08	2.29	73.422	0.000**
Family farmers	6.90	2.34	7.51	1.89	1.160	0.282
Wheat farming experience	15.32	7.87	32.34	13.35	44.342	0.000**
Distance between the farm and the agricultural service center	2.91	2.11	3.70	2.30	1.107	0.294
Size of wheat cultivated land holding	8.40	5.32	5.95	2.88	62.484	0.000**
Extension contacts	11.30	4.09	5.36	4.81	46.85	0.000**
Use of communication channels	19.64	4.47	14.43	3.28	8.53	0.004**
Social participation	21.54	2.74	19.23	2.18	10.36	0.001**
Social status	6.07	1.14	6.02	1.46	5.020	0.026*

*p<0.05 **p<0.01

Educational Importance

Improving and managing agricultural water consumption by the sprinkler irrigation is main step and an effective approach in accretion of irrigation and agricultural productivity. To apply sustainable agriculture system we need to have knowledgeable farmers. Technology has increased production of many crops. However, a need exist for dissemination of appropriate technology such as sprinkler irrigation to wheat farmers in Iran. Based on the effectiveness ratings found in this study, farmers stated that extension agents should be able to improve their availability and contacts with the farmers. Direct contacts with extension agents appear important to wheat farmers suggesting that field-dependent learning styles need to be taken into consideration when planning dissemination efforts and seeking increased adoption rates. There has been little research done on adoption of sprinkler irrigation in Iran. Therefore, the result of this research will guide agricultural organization to enhance educational foundation of change agents as well as farmers through pre-and-in-service training and workshops. In order to reverse the negative consequences of conventional agriculture different forms of sustainable agricultural systems should be recommended by extension agents to farmers as alternatives for achieving the goal of an economically profitable and environmentally sound agricultural production system.

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