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Educational and Psychological Factors Influencing Application of Pro-Environmental Technologies Among Wheat Growers

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Abstract **– The main purpose of this study was to investigate educational-communication and psychological factors that influenced application of pro-environmental technologies among wheat growers in Karaj county, Iran. Research was applied by farmers who resident in Karaj, central district. Stratified proportional random sampling was used, and 97 wheat growers (by Krejcie & Morgan formula) were selected. Data were collected by questionnaire, which its validity (Face validity) was obtained by Jihad-e-Agriculture exports of Karaj County and panel of faculty members of agricultural extension and education, and exports of sustainability agriculture. To measure reliability of the questionnaire, Coronbach's Alpha formula was used (at greater than 0.7). The study found that educational level, familiarity with agricultural extension services, participation in extension- education courses, participation in FFS[1] programs, level of communication channels usage, contacts with extension experts, participation in local associations, and cooperation were positively and significantly correlated with application of pro-environmental technologies among wheat growers. Regression analysis indicated that about 64.8% of the variation in the extent regarding pro-environmental technologies among wheat growers, could be explained by variables consisting: level of knowledge toward pro-environmental technologies, level of communication channels usage, and level of attitude toward pro-environmental technologies.**

Keywords **– Pro-Environmental Technologies, Application, Sustainable Agriculture, Wheat Growers.**

I. Introduction

Environmental problems are serious threats to environmental sustainability, global issues, concern about warming, urban air pollution, water shortages, environmental noise, soil erosion, and biodiversity. Many of these problems due to human behavior [1],[2],[3].In recent years, demands are growing for sustainable agricultural development in response to the environmental impacts of conventional agriculture [4], and also maintaining the product, regarding environmental considerations coupled with reduce production costs, producing healthy crops and empowerment of farmers, were caused extension of widespread sustainable agriculture [5]. One of the major goals of sustainable agricultural systems is decreasing use of inputs in agriculture [6]. Sustainable and renewed resource management practices need to address the widespread soil conservation such as land degradation, declining soil fertility, unreliable and even desertification in a context of global climate change[7],[8].

Pro-environmental technologies application refers to farmer behavior that harms the environment as little as possible, or even benefits the environment [9]. Application of pro-environmental technologies among farmers consist of planting practices, harvest and post-harvest agricultural products with particular attention to soil conservation, plant conservation, water conservation that including technologies integrated pest management, agricultural conservation, good agricultural practices (GAP) together in order to achieve environmental, economic and social sustainability.

Integrated Pest Management (IPM) is an effective and environmentally sensitive approach for pest management and plant conservation that focuses on long-term prevention or suppression of pest problems with minimum impact on the environment, human health, and non-target organisms [10], [11], and [6].

Conservation agriculture is taken into consideration as a pro-environmental approach to improve stability, efficiency, increase profits, and protect. Additionally, this kind of agriculture enhances the food security resources and environmental context, and has three basic principles: 1) decrease soil disturbance or, if possible planting no-tillage, 2) maintaining soil cover, and 3) the use of crop rotation or integration product [12], [13].

According to the annual statistics on the conservation agriculture that was published by FAO between 2006 and 2011, Latin America and North America had the largest percentage of conservations treatment. They applied conservation agriculture to approximately 55 and 40 million hectares, while in African and Asian countries this number reached to five million hectares [14].

Good Agricultural Practices (GAP) were included a set of pro-environmental technologies such as IPM, agricultural conservation for soil management, water management, crop and fodder production, crop protection, animal production, animal health and welfare, harvest and on-farm processing and storage, energy and waste management, human welfare, health and safety, and wildlife and landscape conservation with aim to absorbent new market vantages and also by improving supply chain control, improving natural resource utilization, workers health, and working conditions, consumers and farmers

[1] Farmer Field Schools

families health and creating new market opportunities for farmers. Additionally, they require to obtain new skills and competencies.

[15] Found that conservation agriculture knowledge was acquired through seminars, educational and extension services. Furthermore, providing educational programs showed relative benefits of conservation technologies and also motivate farmers to adopt these technologies.

According to study done by [16] information sources such as FFS programs was the main determinant of adoption FFS programs, field days, and pamphlets. Moreover, they found that exposure to FFS participants, respectively were other important variable in adoption of IPM.

[17] Stated that application of FFS programs was influenced increasing IPM knowledge of farmers, and IPM knowledge was major factor in the adoption of IPM. According to study by [7], level of perception toward IPM practices, participation in extension-education courses, level of communication channels, information resource usage, level of motivation, level of awareness sustainable conservation practices were some major factors in the adoption of sustainable soil conservation practices among farmers. [6]'s studies indicated that major factors in adoption of technologies were included educational level, attitude, knowledge, perception toward IPM practices and participation in extension-education courses, level of communication channels, information resource usage, and income. Furthermore, they were some factors which correlated with the adoption of IPM practices by farmers. [13] concluded that information and communication resources for the dissemination of agriculture conservation information and knowledge of agricultural conservation including educational seminars and demonstration farms, sharing and exchange of information and knowledge from farmers to farmers through social meetings and association, community, FFS program, and contact with superior farmers and neighbors.[18] indicated that adoption of sustainable agricultural practices depends on socio-economic, ecological –farming, institutional, informational-psychological factors and features, and also nature of technologies. Especially understanding the fundamental policy should be considered. Table 1, displayed the summary of major factors of applying pro-environmental technologies among farmers.

Table 1. Displays the summary of major factors to application pro-environmental technologies

Variable			Source
Dependent Variable	Level of pro-environmental technologies	Soil conservation practices Water conservation practices Plant conservation practices	Rezvanfar et al.,(2009); Grabowski (2011); Tey et al.,(2014); Swinton et al.,(2015)
Independent Variable	Demographic characteristics		Rezvanfar et al.,(2009);Razzaghi Borkhani et al.,(2011); Lesch & Wachenheim(2014)
	Education-extension characteristics	Educational level	Rezvanfar et al.,(2009); Razzaghi Borkhani et al.,(2011)
		Familiarity with agricultural Extension services	Araya & Asafu (2001); Rezvanfar et al.,(2009); Razzaghi Borkhani et al.,(2011)
		Participation in extension - education courses	Araya & Asafu (2001); Rezvanfar et al., (2009); Razzaghi Borkhani et al.,(2011); Lugandu et al.,(2012)
		Participation in FFS programs	Yamazaki & Resosudarmo (2008); Lugandu et al.,(2012); Razzaghi Borkhani et al., (2013)
	Communication characteristics	Level of communication Channels usage	Barrera, et al.,(2005); Rezvanfar et al., (2009); Lugandu et al.,;(2012); Tey et al., (2014);Lesch & Wachenheim (2014)
		Level of communication with opinion leaders	Razzahi Borkhani et al.,(2013); Asghari & Hadi (2009)
		Contacts with extension experts	Razzahi Borkhani et al.,(2011); Rezvanfar et al.,(2009)
		Contacts with plant clinic experts	Kelly et al.,(2008); Boa et al., (2008); Bentley et al.,(2010)
		Participation in local associations and cooperative	Tey et al., (2014); (Razzahi Borkhani et al ., (2013) Lugandu et al .,(2012);Rezvanfar et al.,(2009);Asghari & Hadi (2009); Lesch & Wachenheim (2014)
	Psychological characteristics	Level of knowledge toward pro-environmental technologies	Kalineza et al.,(1999);Graaff (1996);Rezvanfar et al., (2009); Lugandu et al.,(2012); Araya & Asafu (2001); Razzahi Borkhani et al., (2011)
		Level of attitude toward pro-environmental technologies	Wauters et al.,(2010); Razzahi Borkhani et al.,(2011); Price & Leviston (2014)
		Level of motivation toward pro-environmental technologies	Winter & May (2001); Rezvanfar et al.,(2009); Lugandu et al.,(2012); Tey et al.,(2014)

In general, according to the aforementioned text, this is a fact that farmers were important in process of application of pro-environmental technologies. Therefore, the main purpose of the study was to investigate factors influenced application of pro-environmental technologies among wheat growers. The special objectives of the study were:

- Identifying characteristics of respondents;
- Identifying the extent of pro-environmental technologies application by respondents;
- Correlation analysis for independent variables and the extent pro-environmental technologies application by farmers;
- Regression analysis for the extent pro-environmental technologies application on independent variables.

II. Materials and Methods

This study was a descriptive-correlation research, and it was carried out in Karaj County. The population of the study consisted of wheat growers (N= 140) in central district of Karaj County. Statistical population of the study consisted of farmers who inhabited in central district. 97 wheat growers were selected through stratified proportional random sampling (by Krejcie & Morgan formula). From a review of literature, the researchers were developed a questionnaire divided into different sections.

A questionnaire divided into five parts to collect data from the experimental group. First, farmers were asked to specify their demographic information such as gender, age, agricultural experience, and etc. Second, farmers' education- extension characteristics were asked, such as educational level, familiarity with agricultural extension services, participation in extension - education courses, and participation in FFS programs. Questions of this part were measured by parametric scale. Third, assessed farmers' level of communication channels usage (13 questions), level of communication with opinion leaders (6 questions), contacts with extension experts, participation in local associations and cooperative (7questions), contacts with plant clinic experts were measured on a Likert-type scale ranged from 0 to 5 (0=no, 1=low, 2=very low, 3=intermediate, 4=high and 5=very high). Fourth, psychological characteristics including level of knowledge(17questions), attitude (12 questions) and economic motivation(6 questions); social motivation(4 questions); environmental motivation(5 questions) toward pro-environmental technologies application, were also measured on a Likert-type scale ranged from 0 to 5 (0=no, 1=low, 2=very low, 3=intermediate, 4=high and 5=very high).

The application of pro-environmental technologies practices was measured by wheat growers in three parts including application of soil conservation practices (22 questions), application of water conservation practices (10 questions), and application of plant conservation practices (21 questions), (accordance to studies done by [7], [19], [18], [20]. All of these parts were measured on a Likert-type scale ranged from 0 to 5 (0=no, 1=low, 2=very low, 3=intermediate, 4=high and 5=very high).

Validity of the instrument (Face validity) was obtained by Jihad-e-Agriculture exports of Karaj County and panel of faculty members of agricultural extension and education and exports of sustainability agriculture. Reliability of the questionnaire was measured by using Coronbach's Alpha formula, a measure of internal consistency. The reliability for various questions was more than 0.7, and it found to be acceptable. Data were collected through personal structured interviews (face to face interview) with respondents at their farms.

Data were analyzed using Statistical Package for the Social Sciences (SPSS). Descriptive and inferential statistics were used to analyze the collected data. Descriptive statistics were included frequency, percentage, mean, standard deviation, and so forth. Correlation coefficient and multiple regression analysis were used in the inferential analysis section. To categorize the farmers' view about questions by Interval of standard Deviation from the Mean[1] method, the following formula was applied:

Min<A<Mean-SD: A= Negative
Mean- SD <B<Mean: B = Relatively negative
Mean <C<Mean+ SD: C= Relatively positive
Mean+ SD <D<Max: D = Positive

IV. Results and Discussion

A) Characteristics of the Sample

According to the findings, participants were on average 52 years old. About 26.8.0% of participants were between the age of 51 and 60 years. 74.1% of the respondents were literate and 25.9% were illiterate. Participants' experience in agricultural activities was 29.67 years on average.

B) Application of Pro-environmental Technologies by Participants

Table 2, showed levels of application of pro-environmental technologies by wheat growers. As it can be seen, the farmers, 37.1%, 43.3%, 43.3% and 40.2% had relatively high level of pro-environmental practices application for plant conservation, soil conservation, water conservation and total pro-environmental technologies in three parts, respectively.

Table 2. Levels of pro-environmental technologies application

Practices \ Level	Low		Relatively low		Relatively high		High		Mean	SD
	F	%	F	%	F	%	F	%		
Plant conservation	20	20.6	26	26.8	36	37.1	15	15.5	59.10	9.09
Soil conservation	17	17.5	23	23.7	42	43.3	15	15.5	63.47	9.33
Water conservation	13	13.4	32	33	42	43.3	10	10.3	25.87	8.94
Total	18	18.6	24	24.7	39	40.2	16	16.5	148.45	25.23

C) Psychological Communication Characteristics of Participants

Table 3, showed that the level of knowledge toward pro-environmental technologies that 54.7 percent of farmers

[1] ISDM

had low and relatively low knowledge. In contrast, 45.3 percent of farmers had high and relatively high level of knowledge. About 42.3 percent of farmers had low and relatively low level of attitude. In contrast, 57.7 percent of farmers had high and relatively high level of attitude. Level of motivation in pro-environmental technologies indicated that 46.4 percent of farmers had low and relatively low Level of motivation. In contrast, 53.6 percent of farmers had high and relatively high level of motivation.

Level of communication channels usage in the field of pro-environmental technologies indicated that 49.5 percent of farmers had low and relatively low level of communication channels usage. In contrast, 50.5 percent of farmers had high and relatively high level of communication channels usage.

Level of communication with opinion leaders indicated that 54.6 percent of farmers had low and relatively low level of communication with opinion leaders. In contrast, 45.4 percent of farmers had high and relatively high level of level of communication with opinion leaders.

Table 3. Levels of psychological and communication characteristics toward pro-environmental technologies application

Items \ Level	Low		Relatively low		Relatively high		High		Mean	SD
	F	%	F	%	F	%	F	%		
Knowledge	15	15.5	38	39.2	27	27.8	17	17.5	41.80	11.10
Attitude	14	14.4	27	27.8	42	43.3	14	14.4	33.83	5.04
Motivation	11	11.3	34	35.1	36	37.1	16	16.5	31.85	6.06
Communication channels usage	17	17.5	31	32	36	37.1	13	13.4	21.56	7.26
Communication with Opinion leaders	7	7.2	46	47.4	33	34	11	11.3	26.40	2.49

D) Correlation Analysis

Correlation for independent variables and pro-environmental technologies application by respondents were presented in Table 4. It was recognizable that educational level was positively and significantly ($p<0.01$) correlated with the pro-environmental technologies application by wheat growers. This result is consistent with related research by [7], [6]. There was positive and significant correlation ($p<0.01$) between the extent of pro-environmental technologies application by wheat growers and familiarity with agricultural extension services. This result was is consistent with different researches done by [22], [7], and [6]. There was positive and significant correlation ($p<0.01$) between the extent of pro-environmental technologies application by wheat growers and participation in extension - education courses. This result is consistent with study done by [7], [6], and [13]. There was positive and significant correlation ($p<0.05$) between the extent of pro-environmental technologies application and participation in FFS programs. This result is consistent with different studies done by [23], [13], and [24].

As shown in the table 4, there was positive and significant correlation ($p<0.01$) between the extent of pro-environmental technologies application by wheat growers and level of communication channels usage ($p<0.01$). This result is consistent with different studies done by [16], [7], [13], [18], and [25]. There was no correlation between the extent of pro-environmental technologies application by wheat growers and level of communication with opinion leaders. This result was unlike different studies done [26], [24]. There was positive and significant correlation ($p<0.01$) between the extent of pro-environmental technologies application by wheat growers and contacts with extension experts ($p<0.01$). This result is consistent with different studies done by [7] [6]. Contacts with plant clinic experts were positively and significantly ($p<0.01$) correlated with the extent of pro-environmental technologies application by wheat growers. These results is consistent with the results of [27], [28], and [29]. Participation in local associations and also in cooperative way was positively and significantly ($p<0.01$) correlated with the extent of pro-environmental technologies application by wheat growers. These results are consistent to the results of [7], [26], [13], [24], [25], and [18].

There was positive and significant correlation ($p<0.01$) between the extent of pro-environmental technologies application by wheat growers and level of knowledge toward pro-environmental technologies application ($p<0.01$). [30], [15], [22], [7], [6], [13] are confirmed this correlation. There was positive and significant correlation ($p<0.01$) between the extent of pro-environmental technologies application by wheat growers and level of attitude toward pro-environmental technologies application ($p<0.01$). The studies by [31], [6], and [32] confirm this correlation. Also there was positive and significant correlation ($p<0.01$) between the extent of pro-environmental technologies application by wheat growers and level of motivation toward pro-environmental technologies application ($p<0.01$). The studies by [33], [13], [7], and [18] confirm this correlation.

Table 4. Results of correlation analysis

Factor	Variable	r
Education- extension characteristics	educational level	0.471**
	familiarity with agricultural extension services	0.444**
	participation in extension - education courses	0.624**
	participation in FFS programs	0.260*
Communication characteristics	level of communication channels usage	0.736**
	level of communication with opinion leaders	0.129
	contacts with extension experts	0.596**
	contacts with plant clinic experts	0.412**
	participation in local associations and cooperative	0.505**
Psychological characteristics	level of knowledge toward pro-environmental technologies	0.773**
	level of attitude toward pro-environmental technologies	0.562**
	level of motivation toward pro-environmental technologies	0.553**

* p<.05, ** p<.01

E) Regression Analysis

In order to explain variation in the extent of pro-environmental technologies application by wheat growers, stepwise regression analysis was applied. The R Square value of 0.648 revealed that 64.8 percent of variation in the extent of pro-environmental technologies application by wheat growers could be explained by three variables including level of knowledge toward pro-environmental technologies, Level of communication channels usage, and level of attitude toward pro-environmental technologies.

Based on the results shown in the table 5 and table 6, regression equation in standard situation was as follow:

$$Y = \text{constant} + B_1 X_1 + B_2 X_2 + B_3 X_3 \quad (1)$$

In this equation, (Y) was used as dependent variable that representing the extent of pro-environmental technologies application, (X_i) was independent variable that included X1= knowledge, X2= communication channels usage, and X3= attitude. Also, (B_i) was the coefficient of independent variable.

The findings showed that Level of knowledge toward pro-environmental technologies (Beta = 0.442) could be explained the most variation in the extent of pro-environmental technologies application by Wheat Growers.

Y = 57.276 + 1.005 KNOW + 1.019 CCU + 0.803ATTI

Table 5. An overview of stepwise model

Model	R	R Square	Adjusted R Square
1	0.773	0.597	0.593
2	0.794	0.631	0.623
3	0.805	0.648	0.637

Table 6. Regression analysis to explain variation in the extent of I pro-environmental technologies application

Description	label	B	Beta	t	Sig.
Constant		57.271	-	6.415**	0.000
Level of knowledge toward pro-environmental technologies	KNOW	1.005	0.442	3.969**	0.000
Level of communication channels usage	CCU	1.019	0.293	2.753**	0.007
Level of attitude toward pro-environmental technologies	ATTI	0.803	0.161	2.136*	0.035

* p<.05, ** p<.01

IV. Consultation and Recommendation

The findings revealed that farmers' attitude toward pro-environmental technologies and pro-environmental technologies application were correlated. For improving farmers' attitude, it is recommended that extension agents with using delivery methods such as field demonstration and farmer field schools (FFS) state clear advantages of pro-environmental technologies. So, reducing pesticide usage and application of pro-environmental practices, requires changing farmers perception. Hence, agricultural extension agent can affect farmers' perceptions and behaviors.

Results of regression analysis showed that level of knowledge toward pro-environmental practices could explain the most variation in the extent of pro-environmental technologies application. Therefore, it is recommended to use field demonstration, FFSs and extension workshops seminars as the major approaches to increase farmers' knowledge. Agricultural extension to strengthen social participation of farmers with agricultural institutions and organizations can create appropriate field to develop adoption and application of pro-environmental technologies application among farmers. Therefore, application of good agricultural practices requires changing farmers' behaviors, improving farmers' attitude, strengthening communication with farmers to extension experts. It is recommended that extension agents accompany with the empowerment of farmers and their participation in decision-making process by using delivery methods such as field demonstration and FFS, establish extension workshops are proper methods to achieve this purposes. They are combined new knowledge with their experiences and use in farm management decisions. Therefore, it is recommended that extension agents use experiences and indigenous knowledge of farmers in educational- extension programs, and with combining indigenous knowledge and modern knowledge, provide more appropriate educational – extension messages. Designing of development programs base on local knowledge as guidelines of perception of indigenous knowledge in orientation of rural sustainable development and to gain sustainable agriculture systems.

Obviously, opinion leaders impact on farmers in technology application, attention trusted people and local leaders to change behavior toward adoption of new technology is important as an effective strategy.

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