Asian Journal of Water, Environment and Pollution, Vol. 15, No. 2 (2018), pp. 195–202.
DOI 10.3233/AJW-180032

The Role of Extension Services on Farmers' Awareness and Knowledge about Conservation Agriculture Practices (Plant, Soil and Water Conservation)

Fatemeh Razzaghi Borkhani and Yaser Mohammadi[1]*

Department of Agricultural Extension and Education, Faculty of Agricultural Economics and Development, University of Tehran, Karaj, Iran
[1]Agricultural Extension and Education Department, Faculty of Agriculture, Bu-Ali Sina University, Hamadan, Iran
✉ y.mohammadi@basu.ac.ir

Received August 13, 2017; revised and accepted March 2, 2018

Abstract: The main purpose of this study was to investigate the role of extension services on farmers' awareness and knowledge about conservation agriculture in Karaj county of Iran. From the statistical population of the study which consisted of wheat growers of Karaj county the number of 97 farmers were calculated as a sample size according to Krejcie and Morgan table and selected by stratified proportional random sampling. Data were collected by a questionnaire, and its validity was confirmed by opinions of Jihad-e-Agriculture experts and faculty members of agricultural extension and education department. The reliability of the questionnaire also was calculated and confirmed through Coronbach's Alpha coefficient which was more than 0.70. The results of study showed that farmers apply relatively high levels of water conservation, soil and plant conservation. The mean results, however, indicate that water conservation practices are used less in relation to soil and plant conservation practices. The results also showed that wheat growers who participated in extension education courses, FFS programmes, educational workshops, and farm advisory courses of plant clinic had a higher level awareness and knowledge about agricultural conservation compared to those who had not participated in these classes.

Key words: Conservation agriculture practices, farmers' awareness and knowledge, agricultural extension, water conservation.

Introduction

Conventional production systems are not going to be responsible against environmental degradation (Mohanty et al., 2015); thus, a cropping system which is environmental friendly, socially acceptable and economically feasible is offered an alternative production system over the conventional production system (Paradkar et al., 2016). Based on the statistics of chemical insecticides consumption in 2012, Iran country with 5,6673 of active ingredients were ranked eleventh in the world and in 2013, fertilizer consumption have been 260,871 tons of nitrogen fertilizers (N total nutrients), 209,837 tons of phosphate fertilizers (P_2O_5 total nutrients) and 16,585 potash fertilizers (K_2O total nutrients) (FAOSTAT, 2015).

Conservation agriculture (CA) practices like minimal soil disturbance, permanent soil cover, organic farming and diversified crop rotation are becoming economically and ecologically more viable option (Choudhury et al., 2014). Chemical pesticides can pose serious threats to human health and the environment, so establishing of agricultural conservation practices have emphasized to decrease impact on environment, human health and

*Corresponding Author

achieve sustainable agricultural development goals. 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 context of global climate change (Rezvanfar et al., 2009; FAO and World Bank, 2001).

Conservation agriculture is able to improve stability and efficiency, increase profits, protect and enhance the food security resources and environmental through (1) reduction of soil disturbance or, if possible planting no-tillage; (2) maintaining soil cover and (3) the use of crop rotation or integration product (Shetto et al., 2007; Lugandu et al., 2012). The most important advantage of the conservation agriculture technology is crop yield alignment for years and reduction of dependency to weather conditions due to the efficient moisture accumulation and moisture saving, recovery of the soil fertility through the accumulation of organic residues in the topsoil, and improvement of farming standards (Nugmanov et al., 2017).

According to the annual statistics on the conservation agriculture between 2006 and 2011 by FAO, Latin America and North America have the largest percentage of conservation treatments approximately 55 million hectares and 40 million hectares, whereas African and Asian countries with five million hectares of conservation agriculture have low performance (Kenneth, 2012).

One of the important challenges in developing countries is accessing to agricultural knowledge among farmers (Eenhoorn and Becx, 2009). Access to agricultural information plays an important role in transforming livelihoods with relying on agriculture for a living and increasing food security (Lwoga, 2011). Owning agricultural knowledge is associated with acquiring skills and proficiencies for improving agriculture practices, sustaining the environment, and optimizing production at farm level (Wagey and Bucol, 2016). Therefore a strong link between agricultural research and farmers is required.

Agricultural research institutions come up with new technologies and developments should link to farmers' farms and homes through effective extension and communication channels, so that they can adopt and utilize new technologies (Nazari et al., 2011). Because all agriculture activities are knowledge-based, Understanding the needs of access to agricultural knowledge is very important. Farmers need to acquire new farming skills and new techniques for agricultural activities (Mtega et al., 2016).

Farmers have diverse needs and requirements of agricultural knowledge which are relevant to their day-to-day actions. Farmers need to know what to grow, when to grow it, how to grow more, how to store and preserve their produce, when to sell, where to sell and at what price to sell, and particular farming management skills (Abdon and Raab, 2005). Therefore an institutional infrastructure is needed to provide education and information through mobile messaging and commuter for farmers. In this context, educational-extension programmes use local knowledge and experience in order to produce a healthy crop with conservation agriculture. Agricultural extension agents' role is diffusing indigenous knowledge and combining it with modern knowledge and transferring information messages in minimum time to farmers (Lado, 1998).

Some studies in the case of sustainable agriculture, emphasized the role of educational-extension factors on increasing farmers' awareness and knowledge. These factors commonly were extracted from literatures and related to four kinds of agricultural extension and education programmes as follow: (1) Participation in extension-education courses; (2) Participation in FFS programmes; (3) Participation in workshops courses; (4) Participation in plant clinic programmes. In this context, one of the important programmes of extension system is Farmer Field School (FFS) approach which help farmers to develop and extend analytical skills, critical thinking and creativity, as well as appropriate decision-making for farmers (Kenmore, 2002).

According to results of Rogers (2003), knowledge/awareness of a technology leads to adoption of that technology. Furthermore, Rezvanfar et al. (2009); Lugandu et al. (2012); Araya and Asafu (2001); and Razzahi Borkhani et al. (2011) stated that there is a positive and significant relation between knowledge and adoption of sustainable agriculture practices. Indeed, studies of innovation adoption and diffusion have recognized educational-extension factors as a key variable and its availability is typically found to correlate with knowledge and subsequently application technologies.

A tangible public–private partnership is required to intensify agricultural knowledge among farmers. In this regard, the government should set up policies and strategies that motivate private sector investment and involvement in preparation of agricultural knowledge in rural areas. The private sectors should develop their environmental and agricultural activities to most rural areas so that more people can have access to agricultural knowledge (Mtega et al., 2016). Bonabana-Wabbi (2002)

indicated that membership in farmers' association, field demonstration and farmer field schools (FFS) is positively correlated with the awareness and knowledge of agricultural conservation. Luther et al. (2005) found that there was significant difference between the level of knowledge farmers who had participated in extension activities and farmer field schools (FFS) programmes and those who had not participated in farmer field schools (FFS) programmes.

Barrera et al. (2005) in their studies found that FFS programme was the main determinant in the adoption of sustainable agriculture. Hoque (2008) and Mahante and Singh (2008) indicated that membership in farmer field schools (FFS) is correlated with the awareness and knowledge toward agricultural conservation. Maraddi et al. (2005) in their studies found that participation in extension activities was the main determinant to extent of IPM practices application. Hashemi et al. (2008b) indicated potential of extension workshops to change farmers' knowledge and awareness of IPM. Table 1 displays the summary of extension factors influencing knowledge about agricultural conservation technologies (Table 1).

The literature review showed that in addition to demographic characteristics, participation in (1) extension-education courses, (2) FFS programmes, (3) farm advisory courses of plant clinic and (4) educational workshops influence on farmers' awareness and knowledge about agricultural conservation. Generally, the main purpose of this study was to investigate the role of educational-extension factors on farmers' awareness and knowledge about conservation agriculture. The special objectives of the study also were as follow:

- Identifying the demographic characteristics of respondents;
- Priority setting of conservation agriculture application by respondents;
- Priority setting of awareness and knowledge toward conservation agriculture pro-environmental practices; and
- Comparison of mean of knowledge toward conservation and pro-environmental practices in terms of participation in extension-education courses, FFS programmes, farm advisory courses of plant clinic and educational workshops.

Materials and Methods

This study was a descriptive-correlation research, carried out in Karaj county. The population of the study consisted of wheat growers ($N = 140$) in central district of Karaj county. From the statistical population of the study which consisted of wheat growers of Karaj county the number of 97 farmers were calculated as a sample size according to Krejcie & Morgan table and selected by stratified proportional random sampling.

Table 1: The summary of extension services affecting knowledge toward conservation agriculture technologies

Variable		*Source*
Dependent Variable	Level of knowledge toward conservation agriculture and pro-environmental practices	Kalineza et al. (1999); Graaff (1996); Araya and Asafu (2001); Rezvanfar et al. (2009); Razzahi Borkhani et al. (2011)
	Demographic characteristics	Rezvanfar et al. (2009), Razzaghi Borkhani et al. (2011); Lesch and Wachenheim (2014)
	Participation in extension - education courses	Bonabana-Wabbi (2002); Maraddi et al. (2005); Luther et al. (2005); Maraddi et al. (2005); Rezvanfar et al. (2009); Razzaghi Borkhani et al. (2011); Lugandu et al. (2012); Mtega et al. (2016)
Independent Variable	Participation in FFS programmes	Bonabana-Wabbi (2002); Luther et al. (2005); Barrera et al. (2005); Yamazaki and Resosudarmo (2008); Hoque (2008); Mahante and Singh (2009); Lugandu et al. (2012); Razzaghi Borkhani et al. (2013)
	Participation in Farm advisory courses of plant clinic	Kelly et al. (2008); Boa et al. (2008); Bentley et al. (2010)
	Participation in educational workshops	Bonabana-Wabbi (2002); Hashemi et al. (2008a); Hashemi et al. (2008b)

From a review of literature, the researchers developed a questionnaire divided into different sections. A questionnaire was divided into three parts and used to collect data from the target group. Part one asked farmers to specify their demographic information such as gender, age, agricultural experience, etc. Part two assessed farmers' level of knowledge toward conservation agriculture technologies and pro-environmental practices (17 questions), that questions 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). Part three was asked farmers' education-extension factors such as participation in extension-education courses (1 question), participation in FFS programs (1 question), participation in farm advisory courses of plant clinic (1 question); and participation in educational workshops (1 question).

All these parts were measured on a nominal scale ranged from 0 to 1 (0 = no, 1 = yes). And also, was asked farmers' education-extension characteristics such as educational level, familiarity with agricultural extension services. Questions of this part were measured on parametric scale. Comparison of knowledge toward conservation agriculture technologies among wheat growers was done by using *t*-Test based on education-extension factors. The validity of questionnaire was confirmed by opinions of Jihad-e-Agriculture experts and faculty members of agricultural extension and education department. The reliability of the questionnaire also was calculated and confirmed through Coronbach's Alpha coefficient which was more than 0.7. Data were analyzed using Statistical Package for the Social Sciences (IBMSPSS 21). To categorize the farmers' view about questions by Interval of Standard Deviation from the Mean (ISDM) method, the following formula was applied:

Min < A < Mean – SD: A = Low

Mean – SD < B < Mean: B = Relatively low

Mean < C < Mean + SD: C = Relatively high

Mean + SD < D < Max: D = High

Results

Characteristics of the Sample

According to the findings, respondents were on average 52 years old. About 26.8% of respondents were between the age of 51 and 60 years. 74.1% of the respondents were literate and 25.8% were illiterate. Respondents' experience in agricultural activities was 29.6 years on average. Figure 1 indicates frequency distribution of wheat growers based on experience in agricultural activities. According to findings 48.5 percent of farmers (47 farmers) have experience in agricultural activities less than 25 years (Figure 1).

Findings showed that wheat growers (61.9%) had lands less than two hectares in size for cultivation of wheat. While, 25.8%, 10.4% and 1.9% of respondents had lands 2-4, 4-6 and >6 hectares in size respectively. The average for cultivation of wheat was 2.71 hectares.

According to findings (Figure 2) frequency distribution of wheat growers based on familiarity with agricultural extension services showed that 37.1 percent of wheat growers have familiarity less than five years with agricultural extension services, also 20.6 percent have not familiarity with agricultural extension services. Therefore, it can be induced that familiarity with agricultural extension services plays a crucial role in knowledge toward conservation agriculture (Figure 2).

Application of Conservation Agriculture Practices

Table 2 shows the extent to which conservation agriculture practices are applied in terms of water, soil and plant conservation. As the results show, farmers apply relatively high levels of water conservation, soil and plant conservation. The mean results, however, indicate that water conservation practices are used less in relation to soil and plant conservation practices (Table 2).

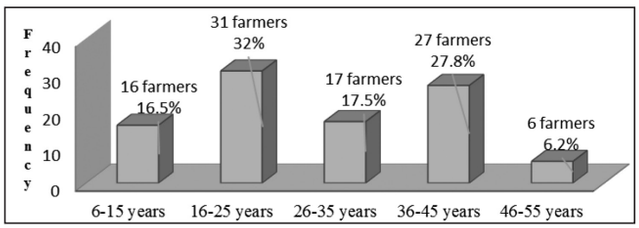

Figure 1: Frequency distribution of farmers based on experience in agricultural activities.

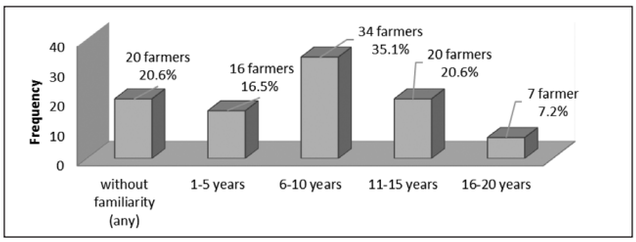

Figure 2: Frequency distribution of farmers based on familiarity with agricultural extension services.

Priority Setting of Knowledge about Conservation Agriculture Technologies

Table 3 shows that recognition of the seeding correct time had first priority because of having the lowest extent of coefficient of variation (CV = 0.228). Understanding the types of plant and animal manures (CV = 0.230), understanding the types of pesticides and use in appropriate time (CV = 0.271), crop rotation (CV = 0.278) and understanding the types of chemical herbicides (CV = 0.280), respectively, had allocated priorities from second to fifth. In addition, how to use light traps to mechanical control pests with the highest extent of coefficient of variation had allocated last priority to itself (Table 3).

Comparison of Mean of Knowledge toward Conservation Agriculture

Table 4 shows comparison of knowledge toward conservation agriculture among different group of wheat growers in terms of participation in extension-education courses, participation in FFS programmes, participation in farm advisory courses of plant clinic programmes and participation in educational workshops. Results of *t*-Test reveals significant difference ($P < 0.01$) in mean of knowledge conservation agriculture practices with regard to participation in extension-education courses, participation in FFS programmes, participation in farm advisory courses of plant clinic programmes and

Table 2: The levels of conservation agriculture practices 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

Table 3: Priority setting of awareness and knowledge toward conservation agriculture

Statement	*Mean*	*SD*	*CV*	***Priority***
Recognition of the correct time seeding	3.192	0.730	0.228	1
Understanding the types of plant and animal manures	3.134	0.719	0.230	2
Timely use of fertilizers and pesticides and due to crop need	3.371	0.916	0.271	3
Awareness toward crop rotation	3.242	0.904	0.278	4
Understanding the types of chemical herbicides and determine the correct use of them	3.175	0.889	0.280	5
Awareness from chemical fertilizers and determine the correct use of them	2.391	0.685	0.286	6
Understanding the biological controls for pest control	2.557	0.841	0.328	7
Understanding varieties resistant to pests and diseases	2.557	0.944	0.369	8
Understanding how fallow	2.505	1.001	0.399	9
How to use lime	2.371	1.175	0.495	10
Awareness from appropriate tillage practices	2.093	1.071	0.511	11
Awareness of canalization system	1.742	0.983	0.564	12
Understanding integrated cropping (wheat cultivation with other crops)	2.050	1.161	0.566	13
Awareness of suitable methods for uniform irrigation farm practices	1.987	1.192	0.599	14
Understanding water conservation practices of farm	1.830	1.154	0.630	15
Awareness tree planting (wheat cultivation incorporation with tree)	1.512	1.021	0.675	16
How to use light traps to mechanical control pests	1.72	1.168	0.679	17

participation in educational workshops. In other words, knowledge conservation agriculture level was different between participants in this education courses and non-participant (Table 4).

Discussion

Knowledge conservation agriculture level was different between participants in extension-education course and non-participant, that wheat growers who participated in extension-education courses had a higher level awareness and knowledge toward agricultural conservation compared with those who did not participate in these classes. This result is accordant to the results of Bonabana-Wabbi (2002); Maraddi et al. (2005); Luther et al. (2005); Maraddi et al. (2005); Rezvanfar et al. (2009); Razzaghi Borkhani et al. (2011); Lugandu et al. (2012).

According to findings wheat growers who participated in FFS programmes had a higher level awareness and knowledge toward agricultural conservation compared with those who did not participate in these programmes. Findings Bonabana-Wabbi (2002); Luther et al. (2005); Barrera et al. (2005); Yamazaki and Resosudarmo (2008); Lugandu et al. (2012); Razzaghi Borkhani et al. (2013); Hoque (2008); Mahante and Singh (2009) have confirmed these results.

Knowledge level of conservation agriculture was different between participants in educational workshops course and non-participant, that wheat growers who participated in educational workshops courses had a higher level awareness and knowledge toward agricultural conservation compared with those who did not participate in these classes. This result is accordant to the results of Bonabana-Wabbi (2002); Hashemi et al. (2008a); Hashemi et al. (2008b).

According to the record farmers have high level of experience in agricultural activities; on the other hand, unfortunately, familiarity with agricultural extension services is low. It can be induced that familiarity with agricultural extension services plays a crucial role in knowledge toward conservation agriculture, therefore suggest the effective role of strengthening communication and familiarity with agricultural extension services communication farmers with extension contacts for best adoption conservation technology. Therefore, it is recommended to provide measures and incentive programmes to increase cooperation and linking farmers with agricultural extension services, subsequently increase farmers' knowledge and encourage toward conservation practices.

According to findings wheat growers who participated in farm advisory courses of plant clinic had a higher level awareness and knowledge toward agricultural conservation compared with those who did not participate in these classes. Researchers Kelly et al. (2008); Boa et al. (2008) and Bentley et al. (2010) have confirmed these results. According to the findings of Keshavarz et al. (2016) communication characteristics such as communication with opinion leaders, contacts with extension experts, contacts with plant clinic experts, participation in local associations and cooperative play a crucial role in knowledge toward conservation agriculture. Therefore it is recommended the empowerment of farmers and their participation in decision-making process by using delivery methods such as field demonstration, FFS and establish extension workshops. Also recommended highlighting the role of

Table 4: Comparison of mean of knowledge toward conservation agriculture among wheat growers by using *t*-Test

Test variable	*Grouping variable*	*Item*	*Mean*	*Standard deviation*	*t*
Level of knowledge toward conservation agriculture	Participation in extension-education courses	Participants	46.47	10.761	5.38**
		Non-participants	35.69	8.28	
	Participation in FFS programmes	Participants	53.58	9.74	7.53**
		Non-participants	37.93	8.52	
	Participation in farm advisory courses of plant clinic	Participants	50.58	10.89	6.32**
		Non-participants	37.68	8.56	
	Participation in educational workshops	Participants	43.66	10.92	3.41**
		Non-participants	34.65	8.83	

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

facilitator and advice of extension agent and providing more appropriate educational-extension messages with integrating indigenous knowledge and modern knowledge and using in farm management decisions.

The findings revealed that participation in extension-education activities is the important role of agricultural extension agents which can affect farmers' perceptions and behaviours to participation in education courses. In this regard, use of extension-participatory methods such as farmer field schools is proper strategy for creating positive attitude of farmers towards conservation technologies. So, reducing pesticide usage and application of conservation practices require changing farmers perception. Hence, agricultural extension agent can affect farmers' perceptions and behaviours.

According to the results the same and similar are the findings of Razzaghi Borkhani et al. (2013). It can be said, opinion leaders are one of the best channels for delivering and application of sustainable technologies; afterwards importance of identification and training of opinion leaders by extension agents for effective conservation agriculture technology adoption plays a significant role.

It shows the important role of agricultural extension agents which can affect farmers' perceptions and behaviours to adopt and apply conservation agriculture technologies. In this regard, use of extension-participatory methods such as farmer field schools and workshops is proper strategy for creating positive attitude of farmers towards conservation agriculture technologies.

Since one of the barriers to adoption and application of sustainable technologies is farmers' low risk orientation, it is recommended to provide incentives such as loans and facilities for farmers to increase farmers' application level of sustainable technologies.

Finally according to findings participation in farm advisory courses of plant clinic to increase farmers' knowledge toward conservation is important. With regard to the impact of participation in farm advisory courses of plant clinic is to adopt and apply these technologies. So according to the results—the same and similar in the finding of Mtega et al. (2016)—suggestion is that a tangible public–private partnership is required to intensify agricultural knowledge among farmers. In this regard, the government should set up policies and strategies that motivate private sector investment and involvement in preparation of agricultural knowledge in rural areas.

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