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Canola Adoption Enhancement in Western Iran

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ABSTRACT

Canola production is an important alternative for agricultural policy-makers in Iran to reduce dependency on the imported vegetable oils. Nevertheless, the canola planted area is only increasing at a slow pace, indicating a low willingness-to-accept of farmers. The general aim of this study was to determine the factors influencing the canola adoption in the Kermanshah Province in Western Iran. Employing stratified random sampling method, 106 farmers from each adopter and non-adopter group were selected. Helping to reach a suitable extensional program, two main categories of variables were defined; i.e. "farmers' personal characteristics" and "extension parameters". The analysis of farmers' personal characteristics variables revealed that the adopters had larger farms and were younger. The results also show that 80% of the adopters were "highly" to "very highly" willing to cultivate canola. Furthermore, a logistic regression model estimated the influence of extensional parameters variables on the canola adoption. According to the regression model, the most effective factors are "contact with extension agents" and "participating in extension classes". As a conclusion, it is suggested that the focus of extension services should be to reduce the distance to agricultural service centers in combination with more contact with extension agents and classes.

Keywords: Extension services, Human Factor, Kermanshah, Logistic regression model.

INTRODUCTION

Agriculture as a complex production system uses a wide range of different technologies and inputs to produce enough food for the growing population in the world. New innovations, new technologies or inputs in the forms of farm machinery, irrigation systems, crops, fertilizers, chemicals, etc. should be "adopted" by farmers to create a significant change in their production yield (Feder and Umali, 1993; Dimara and Skuras, 2003; Lapple, 2010). The adoption of an innovation cannot be regarded only as farmers' personal characteristics. Indeed, adoption is a complex process containing several phases (Prager, 2002). Different technologies and innovations may involve different adoption phases. The relationship between the phases is not necessarily linear. Instead, there are some loops, short-cuts or interruptions (Prager and Posthumus, 2010). Additionally, some variables affect farmers' decision to accept/reject an innovation. Several studies have indicated that the main determinant variables are age, experience, size of farm, income, contact with extensional agents, distance to agricultural service centers and suitable extensional programs (Feder *et al*., 1985; Kassie *et al*., 2013).These variables are embedded in a number of categories; i.e. socioeconomic, demographic, human

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capital, and cropping pattern (Akkaya Aslan *et al*., 2007; Lahmar, 2010). Most studies on adoption of a new crop have a deficiency to support extension services clearly. To cover this defect, eleven variables are put in two categories to reveal what should be done by extension services. Additionally, the categories clear the effective farmers' characteristics on adoption.

Iran is largely dependent on the imported oilseeds to fulfill more than 1.5 million tons of its annual vegetable oil consumption (Negaresh, 2011). Currently, close to 80% of the needed vegetable oil is imported in the form of oilseed (Association of Vegetable Oil Producers, 2010). Already two decades, one of the main governmental food policies was self-sufficiency in oilseed. Among others, canola as an oil reached crop, has received much attention. It is estimated that Iran's current canola production capacity can be up to 5 million tons/year while the current production is only 190,000 tons year^{-1} (Negaresh, 2011). The area under this crop is increasing continuously but slowly with a yearly increase of 20% over the last decade (Ministry of Jihad-e- Agriculture, 2012).

The low increasing pace of the canola planted area reveals that in spite of many extensional efforts, farmers have not been much willing to plant this crop during the last decade. Since different variables including human and extension factors are effective on the adoption, a comprehensive extension program is needed to encourage farmers to adopt canola (Sunding and Zilberman, 2001; Daku, 2002; Rogers, 2003; Zavale *et al*., 2005; Maart-Noelck and Musshoff, 2012). Accordingly, the main objective of this study was to determine the effective variables on the canola adoption, including two main categories: "farmers' personal characteristics" and "extension parameters". The categories are defined in such a way that covers major human and extension factors, which would affect the canola adoption. Furthermore, a logistic regression model is employed to estimate the influence of "extensional parameters" on the farmers' decision. The estimation shows the magnitude of the influence to support extension services and decision makers toward a suitable extension program, which would lead to more canola cultivation.

MATERIALS AND METHODS

Hypotheses

The general aim of this study was to determine the factors influencing the canola adoption in the Kermanshah Province in Western Iran. Accordingly, the main hypotheses of this study were formulated as follows:

Farmers' personal characteristics are different between the adopters and non-

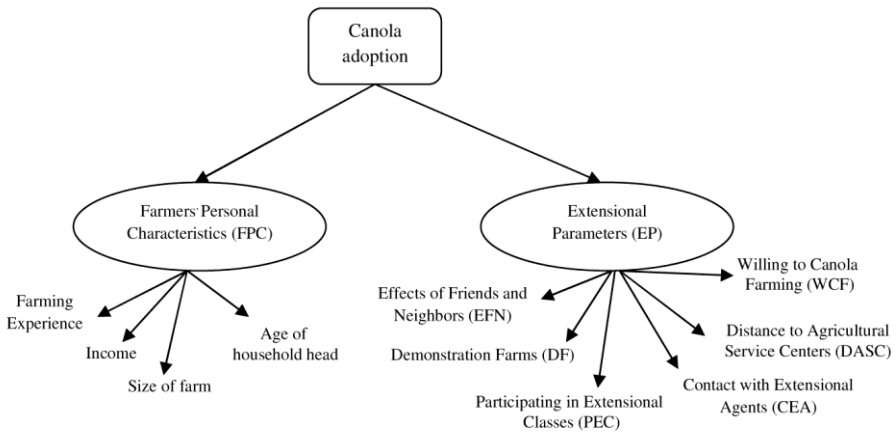

Figure 1. Conceptual framework of the study.

adopters.

Extensional parameters are different between the adopters and non-adopters.

Farmers' personal characteristics and extensional parameters influence the adoption of canola.

To test the above-mentioned hypotheses, the following steps were taken: first, the details on the methodology of this study were determined. Next, the effects of "Farmers' Personal Characteristics" (FPC) and "Extensional Parameters" (EP) on the canola adoption were evaluated. Afterwards, a logistic regression model was used to determine the influence of FPC and EP on the adoption. Finally, a conclusion was drawn and presented at the end.

Using a survey research, this study was conducted in the Kermanshah Province located in the western part of Iran (Figure 2). The province, with the total area of 24,980 km^2, was chosen since it is one of the main canola growing regions in the country. The region receives an average annual precipitation around 375-500 mm. The total cultivated area of this province is around 820,000 ha of which 3,500-4,500 ha was allocated to canola in 2012 (Ministry of Jihad-e- Agriculture, 2012).

Sampling Method and Data Collection

The population of the study comprised the farmers who lived in Kermanshah Township containing six rural districts, i.e. Kermanshah (central district), Bala-Darband, Mahidasht, Jaghanarges, Haft-Ashian and Koozaran (Figure 2). The population of the study included 11200 farmers, with some farmers trained to select canola for planting. Using stratified random sampling method and Bartlett *et al.* (2001) table of sampling, a total of 212 farmers

Figure 2. The study area.

were recognized as adopters and non-adopters. Although the sample size was estimated to be larger than 212, accessible sampling was use to collect data. A researcher-made questionnaire was used to collect the data. The questions were formulated based on the relevant literature on the agricultural innovation adoption (Caswell *et al*., 2001; Homayonfar and Malekdar, 2006; Akudugu *et al*., 2012) to address the main objectives of this study.

As described, two main categories were defined; i.e. FPC and EP (Figure 2). The categories were taken into account to contain essential human and extension factors. Accordingly, FPC variables were "age of household head", "farming experience", "size of farm", and "income" of the farmers. The EP includes "Willing to plant Canola" (WCF), "Distance to Agricultural Service Centers" (DASC), "Contact with Extension Agents" (CEA), "Participating in Extension Classes" (PEC), "Interest in Canola Farming" (ICF), "Demonstration Farms" (DF) and "Effects of Friends and Neighbors" (EFN). It should be noted that "interest in canola farming" may not be related directly to the extension services. Nonetheless, it was considered in this category in order to find if other variables such as "distance to agricultural service centers" and "contact with extension agents" might have some effects on "interest in canola farming". The close farmers and extension agents who would affect the farmer's decision are considered as the friends and neighbors.

According to the two main categories, the final questionnaire consisted of two main sections. The focus of the first section was on the information related to the respondents' personal characteristics. The second was designed to investigate factors influencing the adoption of canola cultivation with regard to the extension parameters. The respondents were asked to indicate their dis/agreements by marking their response on a dichotomous ("yes" and "no") or a five-point Likert scale ("very high" "high", "medium", "low" and "very low") (Likert, 1961). The "participating in extension classes" was evaluated by a dichotomous question and "willing to canola farming", "contact with extensional agents", "effects of friends and neighbors" and "demonstration farms" were measured by five point Likert questions. The validity of the questionnaire was assessed by a panel of agricultural experts affiliated with either universities or agricultural organizations. The reliability of the questionnaire was assessed using Cronbach's alpha coefficient. Revising the questionnaire, the final coefficient was estimated at 0.83 which confirmed the "highly reliable" questions of the questionnaire.

Data Analysis

The collected data were grouped and analyzed using SPSS 16. To find out the differences between the adopters and non-adopters, some descriptive and inferential statistics were employed. The latter consists of independent sample *T*-test and Mann-Whitney test which were used for the continuous and ordinal data, respectively.

The T-test as a parametric method was used to find the statistical difference between continuous data, i.e. age, income, farm size and farming experience. The non-parametric Mann-Whitney test was applied to statistical analyses of the ordinal data, i.e. distance to agricultural service centers, contact with extension agents, interest in canola farming, participating in extension classes, and effects of friends and neighbors. This method was used to rank the data of each group and see whether there was a statistically significant difference in the mean ranks for each group. The Mann-Whitney test is based on a comparison of every observation x_i and corresponding y_j in the samples. The null hypothesis is that two samples come from the same population, which means that each x_i has an equal chance of being greater or smaller than each y_j. Accordingly, the hypotheses are (Shier, 2004):

Ho: $P(x_i > y_j) = 0.5$

H1: $P(x_i > y_j) \neq 0.5$

Logistic regression model was applied to determine the influence of the EP on the adoption of the canola cultivation. The magnitudes of the influence show the importance of each EP. This approach supports the extension service centers to focus on the most essential parameters to enhance farmers' adoption. The logistic regression was employed since it is the most appropriate model to estimate a dichotomous dependent variable (Greene, 1997; Schumacher *et al*., 1996). In the current study, the dichotomous codes ("1" and "0") correspond to "yes" and "no", respectively, which show farmers' agreement and disagreement with canola cultivation. In the logistic regression model, the canola adoption was considered as the "dependent variable" and DASC, CEA, ICF, PEC, and EFN as the "predictor variables". The dichotomous codes result in Bernoulli distribution of dependant variable (yi). It means that $P(yi = 1) = \pi i = \pi i\ (xi)$ and $P(yi = 0) = 1 - \pi_i$. Accordingly, the logistic model in the simplest form is (Rao and Toutenburg, 1999):

$$\ln\left(\frac{\pi i}{1-\pi i}\right) = \propto + \beta x_i$$

and $\left(\frac{\pi i}{1-\pi i}\right) = \exp(\propto + \beta x_i) = e^{\propto}(e^{\beta})^{xi}$

RESULTS AND DISCUSSION

Adoption of Canola Cultivation: Farmers' Personal Characteristics

Statistical analysis using *T*-test reveals significant differences between most of the FPC variables; i.e. age, experience and the size of farm. However, income was not significant and thus it is not reported (Table 1). The results indicate that the adopters are younger with less farming experience compared to non-adopters. However, they own bigger farms. Seemingly, all these four variables affect the adoption of canola as confirmed by some reports like the study of Türkyılmaz *et al*. (2003) and Kutlar and Ceylan (2008) who showed that "age" can influence the adoption of agricultural innovations. Similar findings obtained by Million and Belay (2004) and Shiferaw and Tesfaye (2006) represented that the "higher age" had a significant negative influence on the adoption of agricultural innovations. The age distribution of the respondents revealed that around 75% of the adopters were between 20 and 35 while non-adopters were above 35 years old. Obviously, the older farmers were more experienced. Similar to the distribution of the farmers' ages, around 68% of the adopters and non-adopters had a farming experience of 10-30 and 20-45 years, respectively. Accordingly, the older and more experienced farmers were more reluctant to change their farming techniques/crops. This is similar to the results by Upadhyay *et al*. (2004), Pezeshkirad *et al*. (2006), and Barreiro-Hurle *et al*. (2008). Seemingly, the experiences of the older farmers on their traditional crops and technologies may lead to their resistance to accept the cultivation of canola.

The average farm size of the adopters was approximately two times higher than the non-adopters (respectively, 20.301 and 9.148). Most studies on the adoption of

Table 1. Farmers' personal characteristics: A T-test comparison between the adopters and non-adopters.

Farmers' personal characteristics	Adopters [a]	Non-adopters[a]	*T*-test	
			T-value	*P*-value
Farming experience (Year)	21.54	28.444	1.589	0.003
Age of household head (Year)	41.121	47.254	1.232	0.002
Size of farm (ha)	20.301	9.148	2.453	0.000
Income level (1000$ ha^{-1})	32.215	31.526	0.852	0.142

[a] The values are mean value.

innovations confirm that the farm size is one of the most effective factors which affect the acceptance of the agricultural innovations (Green and Ngongola, 1993; Nkonya *et al*., 1997; Baidu-Forson, 1999; Boahene *et al*., 1999; Doss and Morris, 2001; Gabre-Madhin and Haggblade, 2001; Daku, 2002; Harper *et al*., 1990). Two other essential issues are the ownership status and the level of income. The data show that respectively 85 and 56% of the adopters and non-adopters plant in their own farms. According to Table 1, the canola adopters hold larger farms and have almost more income. These farmers usually have some of necessary farm machineries and implements (i.e. one or two tractors, a plough and a disc). Seemingly, higher income besides available necessary farm machines would result in higher adoption in larger farms (Azadi *et al*., 2010). It can be suggested that cooperative farming operation between small and large farms would result in higher canola adoption in small farms. It should be noted that around 70% of the canola farms are harvested by ordinary wheat harvesters in the region. It can be concluded that, perhaps, lack of access to canola harvester inhibits farmers from adopting canola as their major crop pattern.

Adoption of Canola Cultivation: Extension Parameters

The results of Mann-Whitney test in Table 2 show that five out of the six EP variables are significantly different between the adopters and non-adopters. Table 2 displays that the adopters are more willing to plant canola, participate more in the extension classes, have more contacts with the extension agents, and are more affected by the friends and neighbors. The result is based on the farmers' responses using a five-point Likert scale. The data reveal that 39 and 41% of the adopters were "highly" and "very highly" willing to plant canola, respectively. In contrast, only 11.7 and 4.3% of the non-adopters were "highly" and "very highly" willing to plant canola, respectively, while 61% remained around "low" to "medium" willingness.

The canola adopters had twice as much contact with extension agents as the non-adopters. The farmers and also the agricultural experts in the region believe that "contact with extensional agents" brings the farmers to suitable situations to take enough advice and information related to the agricultural innovations like new technologies, inputs, agricultural practices and crops. Several studies (Nkonya *et al*., 1997; Tesfaye *et al*., 2001; Doss *et al*., 2002) show that "contact with extension agents" has a significant positive effect on the farmers' decision to accept new innovations. In the most cases, transferring the information from extension agents to farmers is a challenging issue and affects farmers' attitude toward accepting new technologies. According to International Food Policy Research Institute (IFPRI, 1998), a new technology is only as good as the mechanism of its dissemination to the farmers. Hence, it is proposed that the canola cultivation can be expanded by establishing "demonstration

Table 2. Extensional parameters: A Mann-Whitney test comparison between the adopters and non-adopters.

Extensional parameters	Mean rank [a]		*Z*	*P*
	Adopters	Non-adopters		
Willing to Canola Farming (WCF)	95.90	46.10	-7.48	0.000
Distance to Agricultural Service Centers (DASC)	45.27	89.20	-6.75	0.000
Contact with Extensional Agents (CEA)	97.77	44.51	-8.19	0.000
Participating in Extensional Classes (PEC)	74.14	59.52	-2.26	0.000
Demonstration Farms (DF)	60.32	20.79	-2.86	0.000
Effects of Friends and Neighbors (EFN)	96.02	46.00	-7.65	0.000

[a] The values are the mean rank score of each group.

farms" as an effective practical extensional method to transfer the new innovations to farmers. Such farms would be established by extension organizations in the region or by encouraging innovative farmers who are more willing to practice new innovations. Effective "contact with extensional agents" in addition to demonstration activities would enhance the adoption trends in the region (Maddison, 2006; Mengstie, 2009).

Furthermore, Table 2 reveals that the effect of friends and neighbors on the canola adopters is around two times more than the non-adopters. It is worth to note that the frontier farmers who establish the "demonstration farms" have also an impressive role as the learned farmers to convey the information from extension services to the farmers. Hence, it is strongly proposed that these farmers could be served as a good example to encourage other farmers to accept canola and to transfer relevant information to them.

The results also show that the effect of "distance to agricultural service centers" on the farmers' non-adoption is two times higher than their adoption. Several studies (Nhemachena and Hassan, 2007; Mengstie, 2009) confirm that the DASC has a significant impact on the adoption of innovations. It is also found that closer farmers to agricultural service centers are more willing to accept canola due to more CEA and PEC. Despite independent evaluation of "extension parameters" variables on the canola adoption, the local extension experts predicted that more CEA would result in more PEC. Hence, it is proposed that more agricultural service centers might be needed in the region since DASC would affect CEA, PEC, and "demonstration farms" significantly. As noted by Feder and Slade (1984), the acquisition of information about a new technology is important for the farmers as it clears their mind to decide on its acceptance or rejection. Information reduces the uncertainty about the performance of a technology and, hence, it may change the individual's assessment from purely subjective to objective over time (Caswell *et al.*, 2001). Exposure to information about new technologies as such can significantly affect farmers' choices about it. However, establishing more agricultural service centers would be expensive and needs governmental financial supports. Therefore, the extension experts suggest that the mass media, especially television, radio, and extension journals, can be used to some extent instead. The primary information related to the new innovation and "demonstration farms" can be widely dispread on the media. The farmers would be more encouraged to directly contact with extension agents afterwards. The farmers' access to the extension agents and the media as the information resources would strongly enhance the rate of the innovation adoption (Bekele and Drake, 2003; Egge *et al*., 2012). Consequently, it is expected that establishing enough agricultural service centers in addition to utilizing media would enhance the adoption of canola by increasing CEA, PEC, and "demonstration farms" in the region. Furthermore, low DASC in addition to high CEA, PEC and "demonstration farms" would improve "interest in canola farming" in such a way that all these variables influence canola adoption positively.

Influence of Extensional Parameters on Adoption of Canola

Table 3 shows the result of logistic regression model which was run to estimate the influence of the extensional parameters components on the adoption of canola. As the table shows, the model is significantly reliable (X^2= 45.887, P< 0.001) accounting for 64% of the variance of the canola farming adoption. Furthermore, Table 4 displays that the model can predict 83.96 and 58.49% of the canola adoption for the adopters and non-adopters, respectively. The estimation of non-adopters might seem rather low since the model only incorporates exogenous factors. Nonetheless, as this table shows, the overall prediction is high (71.22%).

The coefficients in the logistic regression model reveal that all the variables are

Table 3. Model summary.

Step	Log likelihood	Cox and Snell R^2	Nagelkerke R^2
1	84.495	0.464	0.621
2	76.774	0.559	0.747
3	69.875	0.609	0.814
4	58.542	0.635	0.840
5	21.231	0.648	0.866

significantly effective in the prediction of the farmers' agreement to canola cultivation (Table 5). The coefficient "B" shows that four variables out of the five (i.e. interest in canola farming (B= 0.605), contact with extension agents (B= 2.345), participating in extension classes (B= 2.031), effects of friends and neighbors (B= 0.886)) have positive effects on the canola adoption, while one has a negative effect (distance to agricultural service centers (B= -1.180)). The variables CEA and PEC have the highest contribution to explain the adoption of canola farming and the least belongs to ICF, based on the model. Accordingly, the best estimator model to predict the adoption of canola could be formulated as follows:

Logit (∂_i) = - 9.574+0.605 (ICF)–1.180 (DASC)+2.345 (CEA)+2.031 (PEC)+0.886 (EFN)

The effect of the CEA is around four times more than ICF in the adoption of canola. Therefore, it can be concluded that the focus should be on the ICF and PEC to encourage farmers toward enhancing the canola cultivation. It is also essential to emphasize that the effect of the DASC on the adoption is negative and almost large. Accordingly, enough agricultural service centers in addition to media application should be used in the region to encourage farmers to cultivate more canola.

CONCLUSIONS

The results of this study showed that younger farmers were more willing to accept canola cultivation. Moreover, the large-scale farmers were found to be better adopters than the small-scale ones. On the contrary, the older and more experienced farmers were rather reluctant to change their common crops and accept canola as a new crop for cultivation. Hence, it is recommended that the introduction and

Table 4. Classification table.

Observed		Predicted		
		Canola adoption behavior		% Correct
		Yes	No	1.00
Canola Adoption	Yes	89	17	83.96
	No	44	62	58.49
Overall Percentage				71.22

Table 5. Variables and their coefficients in the logistic regression model.

Variables	*B*	*SE*	Wald	*df*	*Sig*	*Exp(B)*
willing to Canola Farming (WCF)	0.605	0.285	4.486	1	0.034	1.831
Distance to Agricultural Service Centers (DASC)	-1.180	0.441	7.146	1	0.008	0.307
Contact with Extensional Agents (CEA)	2.345	0.705	11.080	1	0.001	10.436
Participating in Extensional Classes (PEC)	2.031	0.809	6.296	1	0.003	7.622
Effects of Friends and Neighbors (EFN)	0.886	0.437	4.109	1	0.012	2.424
Constant	-9.574	2.763	12.005	1	0.000	13.523

adoption can be much more successful if the extension agents focus first on younger farmers. Additionally, it may be suggested that the adoption of this crop would be enhanced if the necessary farm machines including canola harvesters are made available in the region.

The analyses of extensional parameters revealed that around 80% of the adopters were highly to very highly willing to plant canola. The adopters were more willing since they contacted extension agents twice as much as the non-adopters. The effects of friends on the adopters were also two times more than the non-adopters. Accordingly, it can be suggested that those farmers who establish "demonstration farms" would play a significant role to convey the information and encourage other farmers to accept canola as a new crop for cultivation. The result of logistic regression model also cleared that direct effect of "distance to agricultural service centers" on the canola adoption was almost large, but negative. Accordingly, it is recommended that more attention should be given to "distance to agricultural service centers". For example, demonstration farms can enhance canola adoption as farmers can observe the steps in canola production.

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توسعه پذیرش کلزا در غرب ایران

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چکیده

تولید کلزا در ایران با انگیزه کاهش وابستگی به واردات دانه‌های روغنی در دستور کار سیاست-گذاران بخش کشاورزی قرار گرفته است. اما توسعه سطح زیر کشت این محصول، محدود و نشان از عدم تمایل کشاورزان به پذیرش کلزا بوده است. هدف از این مطالعه، بررسی عوامل موثر بر پذیرش کلزا در استان کرمانشاه در غرب کشور می‌باشد. در این مطالعه با بهره‌گیری از نمونه‌گیری تصادفی طبقه‌ای، ۱۰۶ کشاورز شامل دو گروه پذیرنده و غیرپذیرنده انتخاب شدند. به منظور تبیین روش‌های ترویجی مناسب، متغیرهایی همچون ویژگی‌های کشاورزان و پارامترهای ترویجی به عنوان پیشگو کننده‌های پذیرش مورد بررسی قرار گرفتند. نتایج نشان داد که پذیرندگان دارای مزارع بزرگتر و به لحاظ گروه سنی، جوان‌تر بودند. نتایج هم چنین نشان داد که ۸۰ درصد پذیرندگان به کشت کلزا تمایل زیادی نشان دادند. نتایج رگرسیون لوجستیک نشان داد که تماس با مروجین و شرکت در کلاس‌های ترویجی به عنوان عوامل ترویجی موثر بر پذیرش کلزا معرفی شدند. بر اساس یافته‌های این مطالعه پیشنهاد می-گردد که دسترسی به خدمات ترویجی را آسانتر و شرکت در کلاس‌های آموزش کلزا را در بین کشاورزان نهادینه سازیم.