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Determinants of Adoption of Mini-Tuber Seed Potato: A Case in Ardabil Province of Iran

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Abstract

The aim of this study was to examine factors affecting adoption of mini-tuber seed potato. Survey research design was used in this study. A sample of 100 potato growers who were informed about mini-tuber was selected and divided into adopter and non-adopter groups. Questionnaire was used as the instrument for data collection and was validated by a panel of experts. A pilot study was conducted for reliability and Cronbach's alphas obtained 0.77- 0.87. Results revealed that other farmers were the main source of information for respondents. Higher yield, healthy seeds, marketability and high quality of potato produced from mini-tuber seeds were the main important reasons of adoption. Non-adopters mentioned high cost of mini-tuber seed as the main factor for rejection. The result of t-test showed that adopters had used more farm machineries and equipments. Result further showed that among farming unit characteristics, the number of pieces of owned farmland had negative effect on the adoption. However, the adoption was positively affected by the extent of owned farmlands and extent of owned potato acreage. Among personal characteristics, education level, number of literate household members had positive effect while farmers' age and farming experience had negative effect on the adoption, respectively.

Keywords:
Potato, Mini-tuber seed, Adoption, Ardabil

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INTRODUCTION

Potato is one of the tuber crops grown in Iran and is used as third staple food after wheat and rice. It is grown by about 50 thousand farmers in 180 thousand hectares with average yield of 22 ton/hectares (FAO, 2008). Potato is regarded as a high-potential food security crop because of its ability to provide a high yield of high-quality product per unit input with a shorter crop cycle than major cereal crops like maize (Hirpa *et al.,* 2010). Potato farmers are faced with several problems. Shortage of healthy and good quality seed, high use of tuber seeds, lack of suitable storages and fridges, lack of improved, high yielding and disease-resistant/tolerant varieties are among the major constraints faced by potato farmers (Deffo and Demo, 2003; Lal *et al*., 2011; Zarghami, 1999). Increase in potato acreage and yield calls for improvement of the quality of seed potatoes supplied to the ware potato production systems (Hirpa *et al.*, 2010).

Moreover, tuber seed production cost is the key problem in potato production. Depending on the region/country, it accounts for 30- 50 percent of production cost. To resolve this problem, mini-tuber seed production system became prominent and this is efficient and inexpensive because it produces low cost tuber seeds (Struik, 2007). Dissemination of mini-tuber seed technology can improve productivity of potato production systems. However, farmers' adoption of improved technologies is one of the most crucial factors affecting productivity of a cropping system which is affected by many factors (Neupane *et al.,* 2002; Rogers, 2003).

Keshavarz *et al*. (2010) found that price volatility, low quality and marketability, and low profitability of High Yielding rice Varieties (HYV) in comparison with local varieties, unavailability of inputs, long period of production cycle, more water and fertilizer needs, and susceptibility to pests/diseases had negative impact on the adoption of HYV in Guilan province of Iran. Kafle and Shah (2012) examined determinants of adoption of improved potato varieties in Bara district of Nepal. They found household size has negative influence on the adoption while land tenancy, contact with extension agents, age and level of education have positive influences. Lal *et al.* (2011) found that involvement of middle men, low sale price of potato, shortage of electricity, gluts, poor quality and adulterated fungicides, lack of cold storage facilities, low risk bearing ability of the potato farmers, lack of motivation from State Department of Horticulture and unavailability of good quality potato seed to the farmers were the most serious constraints perceived by potato growers in Bihar state of India. Ekwek and Onunka (2006) evaluated farmers' adoption of sweet potato production technologies in Abia State of Nigeria. They found that adoption of the technologies was relatively at a medium level. They found that accruable farm income; farm size cultivated as well as sweet potato output was positively related to farmers' adoption of the technologies. Mbanaso *et al.* (2012) assessed the adoption of potato production technology in Nigeria. Their findings showed 79.63% of the farmers were aware of the technology. Majority of the farmers had adopted most production practices. The constraints to increased adoption of the technology were scarcity of land, difficulty in integrating production technology into existing production system, low consumer preference associated with sweet potato products, lack of market, and unavailability of inorganic fertilizer. Deffo and Demo. (2003) characterized progress and constraints faced by potato farmers in adopting the new potato varieties in the main potato-producing regions of Cameroon. Results indicated that 98.6% of the potato farmers were aware of the new cultivars. Their main source of information was other farmers. These farmers reported that the resistance of Cipira to late blight was higher than that of local and European cultivars. The farmers' average yearly potato production increased during the period when these varieties were being adopted. The main constraint to the adoption was bacterial writ susceptibility. Another major problem was the lack of technical guidance for potato farmers from the agricultural extension service. Hirpa *et al.* (2010) analyzed seed potato systems in Ethiopia. They found informal, alternative and formal seed systems co-exist. The informal system, with low quality seed, is dom-

inant. The formal system is too small to contribute significantly to improve that situation.

Despite numerous studies conducted on the adoption of agricultural technologies, there is dearth of information on the adoption of potato seed technologies and factors hindering or promoting their adoption in Ardabil province. This study was, therefore, conducted to assess adoption of mini-tuber seed potato technology and identify factors associated with its' adoption in Ardabil province of Iran.

MATERIALS AND METHODS

Study area

Ardabil province is located in North West of Iran (37°04' to 39°42' N. and 47° 02' to 48° 55' E.). There are 9 counties in this province. From which, potato is grown in 24000 hectares by 3500 farmers in Ardabil plain, i.e. Ardabil, Namin and Nir Counties. Figure 1 shows the study area. There are two mini-tuber producing cooperatives in this region. Some of their products are sold to local farmers but most of it goes to other potato producing regions of the country.

A sample consisting 100 potato growers who were informed about mini-tuber was selected randomly and the data collected using a questionnaire as the main instrument of study. It was validated by specialists and potato field experts. A pilot study was conducted using 30 farmers for reliability and Cronbach's alphas obtained 0.77- 0.87. Data was analyzed using SPSS and Excel software.

Adoption of mini-tuber seed potato was the dependent variable which measured by binary variable of adoption (1) and non-adoption (0). Adopters were potato growers who were using mini-tuber as seed potato and non-adopters were farmers who informed about mini-tuber seeds, but did not use it in their farms or rejected after using in one cultivation year. Independent variables include socio- economic and farming systems characteristics i.e., age (year), farming experience (year), number of household members, literate members in households, education level, marital status, potato owned farm lands (ha), potato rented farm lands (ha), irrigation water resources, main job, production target, extension activities, and farmers' reason for adoption, Logistic regression was used for analyzing factor affecting adoption of mini-tuber seed potato technology.

RESULTS AND DISCUSSION

Demographic results (Table 1) showed that mean age and potato farming experience of the respondents were 47.9 and 25.6 years, respec-

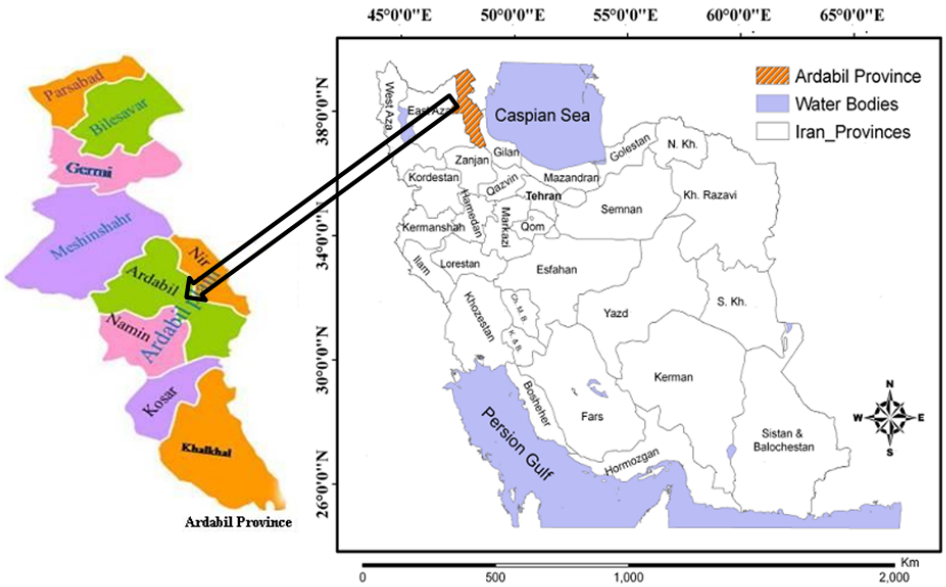

Figure 1. The area of study

Table 1: Socio-economic and farming system characteristics of respondents (n=100)

Variables	Means	SD	Variables	Means	SD
Age (year)	47.9	12.02	Potato owned farm lands (ha.)	8.45	7.02
Farming experience (year)	25.6	10.54	Potato Rented farm lands (ha.)	2.36	4.41
Number of household members	5.33	1.96	Irrigation water resources	Name of resource	Frequency
Literate members in households	2.24	1.69		Well	60
				Well and Aqueduct	10
	levels	Frequency		dam	13
Education level	Illiterate	5		Well and dam	17
	less than diploma	60	The main job	Agriculture	94
				Others	6
	diploma	23	Production target	Sale	94
	Above	12		Self-consumption	6
Marital status	single	97	Extension activities	Participation in Extension	49
	married	3			

tively. The main job of 94% was farming, 38% of them had not any off-farm income. All of them had owned farm lands. 33% of studied farmers had 1-9 hectares of cultivated area. Because of smallness of farm size, 45% of farmers were cultivating in rented lands in addition to their own farm operations. Education level of 67% of them was less than diploma certification.

Average potato growing area was 8.45 hectares in 9 pieces of farmlands. Regarding irrigation water resources, 60, 13, and 10 percent of them were using Well, Dam, Joint use of Well and Aqueduct, respectively. Other farmers were using two or more water resources jointly. There was not any seed producer among the respondents. Potato produced by 70% of the farmers was sold for consumption. A part of potatoes produced by other farmers were used as seed for planting in their own farms or to sell to other farmers. Six percent of them produced it for self-consumption. According to the results, there was not any developed system for management of production, distribution and plantation of certificated and suitable seed. As Hirpa *et al.* (2010) noted, there are several problems in non-formal and traditional systems of seed production such as high use of tuber seeds, yield decline and pests/diseases spread.

As depicted in Table 2, their main source of information for seed potato was other farmers. This result is in line with Deffo and Demo (2003). However, because of technical nature of mini-tuber seed technology, the other farmers had not enough experience of mini-tuber seed potato plantation and acted as a barrier to adoption. Information source of 31% of the studied farmers was mini-tuber producing cooperatives. Despite 49% of respondent who participated in extension programs, only 14% of them claimed that their main source of information was extension. It implies that extension programs did not aim at adoption and application of this technology in the region.

Farmers' reason for adoption and non-adoption of mini-tuber seed potato

Adopters were asked to rate their reasons for adoption and non-adoption of mini-tuber seed potato using a five continuum scale, from 0 for unimportant to 4 for very important, respectively. As depicted in Table 3 higher yield, healthy

Table 2: Information sources of respondents for mini-tuber seed potato (n=100)

Information sources	Extension training	Extension materials	Internet	Radio -TV	Researchers	Farm advisors	Other farmers	Seed cooperatives
Frequency	13	1	1	10	25	23	34	31

Table 3: Farmers' reasons for adoption of mini-tuber seed potato

Items	Mean	SD
Higher yield	3.62	0.681
Healthy seeds	3.35	0.900
Marketability and higher quality of potato	3.32	0.849
Durability compared with other varieties	3.20	0.947
Higher product prices compared with other varieties	3.09	0.945
Absorption of the more fertilizer for more yield	2.96	0.960
More profitable compared with other varieties	2.73	0.880
Priority in the use of farm advisors	2.22	1.058

Mean range: (0= Unimportant, 4= Very important)

Table 4: Farmers' reasons for non-adoption of mini-tuber seed potato

Items	M	SD	Rank
High costs of mini-tuber seed	3.50	0.820	1
Lack of information about mini-tuber seed cultivation	2.99	0.962	2
Lands fragmentation and dispersion	2.95	1.052	3
Technical nature of mini-tuber seed	2.94	0.979	4
Price uncertainty and volatility in potato market	2.94	1.058	5
Lack of timely supply of inputs and access to seed	2.93	0.991	6
Lack of machinery for mini-tuber seed cultivation	2.89	0.975	7
Lack of price guarantee	2.73	1.159	8
Lack of product market	2.66	1.096	9
Susceptibility of mini-tuber seed to pests and diseases	2.45	1.003	10
Higher water requirement	2.22	1.089	11
More fertilizer Need	2.17	0.966	12
Long period of mini-tuber seed cultivation	1.85	0.877	13

Mean range: (0= Unimportant, 4= Very important)

seeds, marketability and high quality of potato produced from mini-tuber seed were placed in higher importance. Priority of mini-tuber seed growers in the use of farm advisors was placed in the last importance.

In contrast, non-adopters mentioned the high costs of mini-tuber seed as the most important reason for rejection, followed by technical nature of mini-tuber seed and lack of information, land fragmentation and dispersion. Other reasons such as more water and fertilizer needs and cultivation duration problem were perceived as lower important reasons (Table 4).

The results also showed that infrastructural reforms of lands and credit facilities and the development of extension education programs can facilitate the adoption and application of mini-tuber seed potato by farmers.

The result of t test showed that there was significant difference between the two groups regarding farm mechanization (Table 5) and adopters had used more farm machineries and equipment in their farms. This result implies that poor mechanization is a barrier to adoption.

Logistic regression was used to examine the effect of selected variables on adoption of mini-tuber seed potato (Table 6). For this reason, respondents were divided into technology adopter (1) and non-adopter (rejecters and abandoners) (0) groups

Table 5: Comparing the two groups of farmers on the use of farm mechanization

Variable	Adoption	n	M	SD	t	p-value
Farm Mechanization	Yes	46	8.46	2.66	2.94	0.004
	No	54	6.50	3.78		

Table 6: Logistic regression analysis of factors affecting the adoption of mini-tuber seed potato

Variables	B	S.E.	Wald	Exp (B)
Age	-0.136**	0.048	7.980	1.146
Farming experience	-0.134**	0.048	7.776	0.875
The number of household members	-0.07	0.159	0.194	0.932
The number of literate members in households	0.191**	0.180	1.132	1.210
The main job	0.254	0.461	0.303	1.289
Education level	0.343**	0.221	2.407	1.409
Total area of owned farmland	0.041*	0.026	2.476	1.041
Total area of rented farmland	0.043	0.080	0.289	1.044
Extent of owned potato acreage	0.048*	0.058	0.674	0.953
Extent of rented potato acreage	0.060	0.100	0.358	1.062
Number of pieces of owned farmland	-0.035*	0.036	0.938	1.036
Number of pieces of rented farmland	-0.060	0.139	0.189	0.941
-2 Log likelihood		107.894		
-2 Log likelihood		75.645		

**p<0.01 *p<0.05

As depicted in Table 6 the model correctly predicted 86.4 percent of the observations. It implies that high percentage of the dependent variable was correctly separated by the model and the adoption was explained by variables in the equation. According to the model, the extent of rented land and rented potato farms, household number and farmers' main job had no significantly effect on the adoption of mini-tuber seed. -2 Log likelihood acts as goodness of fit and decreases when model is well matched with data. As shown in Table 6, it decreased from 107.894 to 75.645 which confirm the goodness of fit of the model.

Among farming units characteristics, number of pieces of owned land negatively impacted on the adoption. The adoption was also positively affected by the extent of owned farmlands and extent of owned potato acreage. Among the personal characteristics, education level and number of literate household members positively impacted while farmers' ages and farming experience negatively impacted on the adoption, respectively.

CONCLUSION

Although potato is the fourth staple crop in Iran, its ability to provide high yield of product per unit input with a shorter crop cycle than major cereal crops like maize gives it a high potential for food security (Hirpa *et al.*, 2010). However, in the conventional farming systems, farmers utilize high amount of seed tuber that threatens food security. For this reason mini-tuber seed potato get more importance.

According to the result, respondents perceive higher yield per unit of mini-tuber seeds in comparison with other seed tubers as the most important factor affecting adoption and use of the technology. Higher quality and marketability of potato produced from mini-tuber, production of healthy seed, and more durability of mini-tuber compared with other varieties were placed in the next ranks. As average yield per hectare of potato in Iran is 22 tons (FAO, 2008), there is high potential for enhancement of potato production and its' cost reduction. This result is in line with Hirpa *et al*. (2010) and Struik (2007).

According to logistic regression analysis, age and farming experiences had negative effect on adoption of mini-tuber technology. In this line, Iqbal *et al.* (1999) found age as an affecting factor on adoption. Furthermore, Faraji and Mirdamadi (2006), Ommani and Chizari (2006), Tabarraei and Hasannejad (2009), reported that there is negative and significant relationship between age and technology adoption. In contrary, farmers' education and literacy levels of family members were important factors affecting the adoption. Evidence has shown education level as a positive affecting factor on the adoption of innovations Joshi and Pandi (2005), Pezeshki

and Masaeli (2002), Rajaei and Najafloo (2011). Negative effect of land fragmentation and dispersion on adoption of mini-tuber technology was the other finding of logistic regression. Many other studies conducted in Iran Bagheri and Malek-mohammadi, 2005; (Kohansal *et al.,* 2009; Pezeshki-rad and Masaeli, 2002) revealed the negative effect of land fragmentation and dispersion on the adoption of agricultural technologies. Based on the findings of the study, the following recommendations are presented:

High participation of studied farmers in extension programs and their satisfaction from farm advisors' performance despite no effect of these programs on adoption and use of mini-tuber technology imply that this technology overlooked by extension program planner that should be reconsidered. Adoption was negatively affected by lack of technical information of respondents. Other farmers were the main information source of respondent. Because of technical nature of the technology, special extension program is needed to promote potato growers' technical knowledge. Considering the results related to the effect of land fragmentation and dispersion on adoption as well as sensitivity of mini-tuber seed potato to water tension, improvement of land infrastructure, i.e. land consolidation and irrigation technology is necessary.

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