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Effective Factors on Adoption of Soil Testing for Farm Fertilizer Nutrition in Shahreza Township of Esfihan Province, Iran

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Abstract: Soil testing is a general soil productivity evaluation program that helps farmers touse chemical fertilizers wisely. The purpose of this study was to investigate the effective factors on adoption of soil testing for fertilizing farms. The research instrument was astructural questionnaire with close ended questions which confirmed its validity andreliability. The target population included all farmers in the Shahreza township of Esfihan Province (N = 9,825). Among of them, 215 persons were chosen by using the Cochran formula through stratified sampling as the statistical sample and finally 195 questionnaires were analyzed (n = 195). There was a significant difference between the personal, farming and educational characteristics of adopters and non-adopters of soil testing. The result of discriminate analysis showed that knowledge about soil sampling principles, the amount of extensional contacts about soil testing and educational level were identified as the most discriminative factors (74.40% of population) affecting the adoption of soil testing.

Key words: Adoption, soil testing, fertilizer nutrition, farmers, educational level, Shahreza

INTRODUCTION

Many natural resources are godsend resources that are dedicated to human beings for ensuring their necessities such as food, clothes and houses. Among these, soil is known as one of the most important natural resources of each country. Now a days, soil erosion has influenced 1/3rd of earth lands (PRAEI, 2005). Reports show that the soil formation process is between 0.01-7.7 mm in 1 year (Morgan, 1996) whereas it's possible that 1 inch (2.56 cm) of topsoil erodes in 1 year (Triphati and Singh, 2001).

Iran can't protect itself from soil erosion over time and it's one of the countries that has a high volume of soil erosion. Some reports show, a soil erosion rate of 20-30 million tons per year (Chizari *et al*., 2003). According to the research of three international institutes estimating the cost and volume of soil destruction in south Asia, 94% of Iran's farm soil is destroyed and Iran has the worst soil destruction condition among studied countries (FAO, UNDP and UNEP, 1994). Furthermore this study expressed lack of soil management as the most important problem that threatened Iran's farms.

Parvizi (2005) described soil management as an optimal use of farm soil resources for improving production management and achieving sustainable goals. Cramb (2004) suggests that soil management is the best method to prevent destruction of soil and to farm crops sustainably. Lal (2003) indicated that soil management can play important roles in improving utilization increasing self-sufficiency of nutritious crop, decreasing poverty levels and providing food and sustainable agriculture.

Soil Testing (ST) is known as a precise management method for determining and assessing soil fertility that enables farmers to assess the impact of management methods and identify what changes are needed each year (Malakoti and Tehrani, 1999).

Srivastava and Pandey (1999) believed that most farmers continuously use a great deal of chemical fertilizers for increasing production without awareness of their farm fertility condition. ST is a general evaluation program of soil fertility that helps farmers to use chemical fertilizers wisely. In fact, this method is a mechanism that facilitated economical fertilizer assessment. Until now, the necessary amount of nutrition's per surface for each crop was determined according to fertilizer suggestion which was approximately the same for all areas regardless of different soil and weather conditions.

Now a days experts emphasize that fertilizer suggestion (especially nitrogen and phosphorus fertilizers) including amount, source, kind and time of using fertilizer must be done according to soil analysis of

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each area (Mylavarapu, 2003; Oldham, 2007). Thus, costs of extra use of fertilizer in fertile farms are decreased and the lack of nutrients in less fertile soil is recompensed (Goshchi, 2004). Yadav *et al.* (2006) stated that ST has exposed some information about the accurate amount of nutrients of special kinds of plants and also other information such as acid and saline-alkali soil. Neufeld and Davison (2000) knew ST as the only necessary and available tool for determining the amount of soil nutrients.

A question that researchers and planners face is this: Why does farmer X uses ST in his farm but farmer Y doesn't use ST in his farm in spite of its benefit? Researchers know the answer to this question exists in some factors like: knowledge about sampling principles of soil (Pilbeam *et al*., 2005; King, 1999; Yadav *et al*., 2006), attitude toward ST (King, 1999; Yadav *et al*., 2006), the amount of extension contacts (Cramb *et al*., 2006; Mylavarapu, 2003; Oldham, 2007; King, 1999; Cramb, 2004), the use of information resources (King and Rollins, 1999; Tucker and Napier, 2002; Yadav *et al*., 2006), size of farm (Cramb, 2004; Tadesse and Belay, 2004; Cramb *et al*., 2006) size of renting land (Tarawali *et al*., 1999; Lipper and Osgood, 2001; Lapar and Pandey, 1999), number of household members (Esilaba *et al*., 2005; Tadesse and Belay, 2004) and educational level (Lapar and Pandey, 1999; Cramb *et al*., 2006).

No research could be found about the effective factors on adoption of ST in Iran. Hence, the purpose of this research is to investigate effective factors on adoption of ST by farmers in Iran. Some important objectives of this research are:

- To describe the amount of farmers knowledge about soil sampling principles
- To describe farmers attitudes toward ST
- To compare personal, farming and educational characteristics of adopter farmers and non-adopter farmers
- To identify the major components of independent variables for discriminating adopter farmers from non-adopter farmers

MATERIALS AND METHODS

This research involved a descriptive-correlation and a causal comparative survey study. The population of this study consisted of 9,825 farmers of the Shahreza township in the Esfihan Province. Using a stratified proportional random sampling technique, 195 farmers were chosen as a sample for the study and were divided into two groups (adopters = 68 and non-adopters = 127) based on their adoption status of ST. Sample size was obtained and supported by the study of Cochran (1977) which offers a formula for determining sample size for a given population. Shahreza township is one of the largest townships of the Esfihan Province of Iran.

The township is located between 32°N and 51°E and it has an area covering 3088 km^2. Its rainfall is little as it's in a dry zone and it has two kinds of climate: arid in the east area and semi-arid in the south and southwest area which receives much more rainfall than other areas. Agriculture is common in this township because of fertile farms and all kinds of crops such as grape, wheat, grain, millet and chickpea are planted there.

Content and face validity were established by a panel of experts consisting of faculty members in soil sciences and extension and education at Tarbiat Modares University and Islamic Azad University (Researches and Sciences Branch) and agricultural officers of the Shahreza township.

A pilot test was conducted with 30 farmers in the Esfihan township in the Esfihan Province 3 weeks before the study. Minor changes in wording were made as a result of the pilot test. Questionnaire reliability was estimated by calculating Cronbach's alpha. Reliability for the instrument was estimated between 0.71 and 0.85.

Data were collected by personal interviews with farmers on their farms. The data were coded and analyzed by using the statistical package for the social science (SPSS, 14) for Windows. Descriptive statistics (frequency, percent, mean, standard deviation, minimum and maximum) were used to describe analyzed data. Independent sample t-test, the Mann-Whitney test and discriminate analysis were employed to analyze the differences among variables.

RESULTS AND DISCUSSION

Farmers personal and farming characteristics: The mean age of farmers in the study was 51 years old (SD = 14) the majority (76 farmers or 39%) ranged from 58-72 years old. On average, farmers had 30 years of experience in agriculture (SD = 17) the majority (n = 61 or 31.30%) ranged in agricultural experience from 17-28 years. The mean of household members was 5 persons (SD = 2).

The mean of farm lands was 17 ha and 4 plots that farmers have 13 ha on average. Farmers educational level average was 4 years, 146 farmers (74.90%) had elementary level education. On the other hand, the average distance of farmers land to the nearest agricultural service centers was 6 ha and its standard deviations was 5 ha (Table 1).

Table 1: Respondents personal and farming characteristics (n = 195)

Variables	Mean	SD	Min.	Max.
Age (year)	51.04	14.56	25	72
Agricultural experience (year)	29.67	16.82	5	60
Farm size (Hectare)	16.28	24.34	20	130
Farm plots (Number)	3.69	2.60	1	9
Distance between farm and agricultural service centers (km)	5.99	4.76	1	15
Educational level (year)	3.98	2.31	1	12
Household members (Number)	4.63	2.16	3	10
Size of owning land (Hectare)	13.02	23.93	0	130
Size of renting land (Hectare)	2.62	5.15	0	20

Table 2: Classification of farmers knowledge about sampling principles of soil (n = 195)

Classification of score knowledge	Category	Frequency	Percent
0-3	Weak	0	0.00
4-8	Moderate	73	37.40
9-13	Good	122	62.60

Farmers knowledge about sampling principles of soil: ST is a precise method that can quickly indicate appropriate fertilizer suggestion. Suitable and punctual soil sampling is the first step of ST that farmers performed and it's the most important and sensitive work. For evaluating the farmers' knowledge about sampling principles of farm soil scale, 13 statements about ST concepts, principles and methods are propounded. Farmers were asked to indicate their opinion about the statement being true or false. One score is given to true items and 0 score is given to false and non-respondent items.

Hence, farmers knowledge about sampling principles of soil ranged from 0-13. As shown in Table 2, farmers knowledge about sampling principles of soil is divided into 3 levels with equal distance according to scores range. These results show that all farmer had modarate (n = 73 and f = 37.40%) and good (n = 22 and f = 62.60%) knowledge about sampling principles of soil.

Farmers attitudes toward ST: The ability of performing one special technology depends on farmers attitudes toward the reality of technology (Wayessa, 2003). Farmers were asked to indicate their attitudes toward ST for 13 statements. The 13 statements were measured on a five point, Likert-type scale that ranged in eight positive statements from completely disagree = 1, disagree = 2, no opinion = 3, agree = 4, completely agree = 5 and in 5 negative statements from completely disagree = 5, disagree = 4, no opinion = 3, agree = 2 and completely agree = 1.

Means and standard deviations for the 13 attitude statements are shown in Table 3. Four of the 26 statements had a mean value of over 4.00 indicating agreement. The highest mean was for the statement of I must use ST to improve and protect farm soil (Mean = 4.59 and SD = 0.62). Another five statements had a mean score closer to 4.00 indicating agreement. One statement had a mean score of <3.00 indicating disagreement about their attitude toward doing ST just by government.

Table 3: Farmers attitudes toward ST (n = 195)

Items	Mean	SD	Rank
I must use ST to improve and protect farm soil	4.59	0.62	1
I must accept new agricultural technologies to improve lifestyle	4.48	0.50	2
Soil as a life resource is forming during a long time	4.36	0.53	3
I want to learn about soil sampling methods to improve and protect farm soil characteristics	4.22	0.41	4
Soil erosion is an important problem	3.90	0.88	5
Too much use of fertilizer causes water, air and nutrient pollution	3.88	1.04	6
I prefer ST for fertilizer suggestions against the farm soil observations	3.84	0.83	7
If one of the zone farmers does ST I won't do ST and use his results	3.80	1.47	8
The use of the amount of chemical fertilizer suggested based on ST is not useful	3.76	1.30	9
I can't use ST because of the high cost of ST	3.54	1.23	10
Heavy use of chemical fertilizer is the proper method to increase agricultural crops	3.44	1.41	11
I encourage other farmers to use ST	3.36	0.48	12
ST is an agricultural technology that must be done by government	2.95	1.07	13

Completely disagree = 1, disagree = 2, no opinion = 3, agree = 4 and completely agree = 5 *completely disagree = 5, disagree = 4, no opinion = 3, agree = 2 and completely agree = 1

Table 4: Classification of farmers attitudes toward ST (n = 195)

Classification of score of attitude	Category	Frequency	Percent
1-2.49	Not favorable	0	0.00
2.5-3.5	Relatively favorable	32	16.40
3.51-5	favorable	163	83.60

As shown in Table 4, farmers attitudes toward ST are divided into three levels with equal distance according to scores range.

These results show that the majority of farmers attitudes (n = 163 or 83.60%) toward ST are at a favorable level and approximately 16% (n = 32) of their attitudes toward ST are relatively favorable.

The amount of extension contacts of farmers about ST: Grossman (2003) research has shown that extension-education programs about soil management have influenced increasing proper adoption of soil management methods, utilization and farming soil quality. Karbasioun *et al.* (2006) expressed that one of the important roles of agricultural education-extensional programs is helping farmers in sustainable use of farms and other agricultural resources with

Table 5: The amount of extension contacts of farmers about ST (n = 195)

Items	Mean	SD	Rank
Visiting with extension agents and experts at agricultural service centers and agricultural officers	3.52	1.04	1
Attending extension-education classes	3.20	1.33	2
The existing amount of extension agents and agricultural experts in fields	2.92	1.33	3
Showing extension films	2.38	0.85	4
Visiting sample fields and extension-research projects in that zone	2.30	1.20	5
Reading extension publications	2.29	0.86	6

Very little = 1, little = 2, moderate = 3, high = 4, and very high = 5

Table 6: Classification of farmers extension contacts about ST (n =195)

Classification of farmers extension contacts	Category	Frequency	Percent
1-2.49	Weak	74	37.90
2.5-3.5	Moderate	91	46.70
3.51-5	Good	30	15.40

sinformational, educational and advising support. Farmers were asked to indicate the amount of their extension contacts about ST for six statements. The six statements were measured on a five-point, Likert-type scale that ranged from very little = 1, little = 2, moderate = 3, high = 4 and very high = 5.

Means and standard deviations for the six extension contact statements are shown in Table 5. Four of the 26 statements had a mean value of over 3.00 indicating high, the highest mean was for the statement of visiting with extension agents and experts at agricultural service centers and agricultural officers (Mean = 3.52 and SD = 1.04). Another four statements had a mean score of <3.00 indicating little use of extension contacts about ST.

As shown in Table 6, the amount of extension contacts of farmers about ST is divided into 3 levels with equal distance according to scores range.

These results show that the amount of extension contacts of the majority of farmers (n = 91 or 46.70%) about ST are at moderate level and nearly 38% (n = 74) of their extension contacts is at weak level.

The amount of farmers use of information resources about ST: Information is an important factor in the adoption of technology because farmers usually believe that technologies aren't usable. Farmers were asked to indicate the amount of their use of information resources about ST for 11 statements.

The 11 statements were measured on a five point, Likert-type scale that ranged from very little = 1, little = 2, moderate = 3, high = 4 and very high = 5. Means and standard deviations for the 11 information resources statements are shown in Table 7. Four of the

Table 7: The amount of farmers use of information resources about ST (n = 195)

Items	Mean	SD	Rank
Neighbor farmers	3.21	1.30	1
Progressive farmers	3.15	1.17	2
Local leaders	2.81	0.99	3
Agricultural production cooperatives	2.80	1.27	4
Private sectors	2.59	1.03	5
Extension volunteers	2.55	1.01	6
Agricultural offices	2.48	1.15	7
Radio agricultural programs	2.37	0.91	8
Television agricultural programs	2.33	1.09	9
Agricultural publications, books and magazine	2.22	0.89	10
Research stations	1.83	0.84	11

Very little = 1, little = 2, moderate = 3, high = 4 and very high = 5

Table 8: Classification of farmers use of information resources about ST (n = 195)

Classification of farmers use of information resources	Category	Frequency	Percent
1-2.49	Weak	93	47.70
2.5-3.5	Moderate	96	49.20
3.51-5	Good	6	3.10

26 statements had a mean value of over 3.00 indicating high. The highest mean was for the statement of Neighbor farmers (Mean = 3.21 and SD = 1.30). Another nine statements had a mean score of <3.00 indicating little use of information resources about ST.

As shown in Table 8, farmers use of information resources about ST is divided into 3 levels with equal distance according to scores range. These results show that the use amount of the majority of farmers (n = 96 or 49.20%) of information resources about ST are at moderate level and nearly 48% (n = 93) of them use information resources at a weak level.

To compare the selected independent variables between adopter farmers and non-adopter farmers of ST: An independent sample t-test was conducted to evaluate the differences between adopter farmers and non-adopter farmers. As shown in Table 9, there was a statistically significant difference between adopter and non-adopter farmers regarding educational level, distance between farm and agricultural service centers, farm plots, household members, size of renting land and knowledge about sampling principles of soil.

Findings indicate that non-adopter farmers had more farm plots and greater distance between their farm and agricultural service centers than adopter farmers. Furthermore, these findings indicate that adopter farmers had more size of renting land, size of owning land, household members, educational level and knowledge about sampling principles of soil than non-adopter farmers. This finding is consistent with the results of various published literature (Tarawali *et al*., 1999; Lipper and Osgood, 2001; Lapar and Pandey, 1999;

Table 9: Comparison of adopter and non-adopter farmers regarding independent variables

	Adopter farmers (n = 68)		Non-adopter farmers (n = 127)			
Variables	M	SD	M	SD	t-test	p-value
Age	50.33	14.61	51.42	14.58	-0.496	0.621
Agricultural experiences	31.47	19.33	28.70	15.30	0.310	0.519
Farm size	19.84	29.65	14.37	20.83	1.353	0.179
Farm plots	3.04	2.26	4.03	2.71	-2.720**	0.007
Distance between farm and agricultural service centers	5.09	4.63	7.67	4.61	3.721**	0.000
Educational level	4.45	1.77	3.10	2.43	-4.040**	0.000
Household members	4.02	2.77	2.05	1.87	5.260**	0.000
Size of owning land	16.05	29.76	11.39	20.08	1.156	0.250
Size of renting land	3.77	5.97	2.00	4.56	2.310*	0.022
Knowledge about sampling principles of soil	10.19	0.69	8.77	1.49	9.017**	0.000

Variables	Rank mean	Rank mean	Z-test	U-test	p-value
The amount of favorable attitude toward ST	113.03	89.95	-2.732**	3296.000	0.006
The amount of extension contacts about ST	134.54	78.44	-6.651**	1833.500	0.000
The use amount use of information resources about ST	119.17	86.67	-3.850**	2787.500	0.000

$p \leq 0.01$**, $p \leq 0.05$*

Table 10: Discriminative dependent variables affecting adoption of ST

Variables	Willks lambda	F-test	p-value
Knowledge about sampling principles of soil (X_1)	0.776	29.176**	0.000
The amount of extension contacts about ST (X_2)	0.737	20.616**	0.000
Educational level (X_3)	0.697	9.328**	0.000

$p \leq 0.01$**

Table 11: The results of classification according to discriminate functions

	Adopter farmers		Non-adopter farmers		Total	
Adoption situation	f	Percentage	f	Percentage	f	Percentage
Adopter farmers	59	86.80	9	13.20	68	100
Non-adopter farmers	37	29.10	90	70.90	127	100

Esilaba *et al*., 2005; Yadav *et al*., 2006; Pilbeam *et al*., 2005; King, 1999; Tadesse and Belay, 2004; Cramb *et al*., 2006). A Mann-Whitney test was conducted to evaluate the differences between adopter and non-adopter farmers.

As shown in Table 9, there was a statistically significant difference between adopter and non-adopter farmers regarding their attitudes toward ST, the amount of extension contacts about ST and the use of information resources about ST.

Findings indicate that adopter farmers had more favorable attitudes toward ST, more extension contacts about ST and more use of information resources about ST than non-adopter farmers. This finding is consistent with the results of various published literature (King, 1999; Yadav *et al*., 2006; Cramb *et al*., 2006; Mylavarapu, 2003; Oldham, 2007; King and Rollins, 1999; Tucker and Napier, 2002; Cramb, 2004).

To identify the major components of independent variables for discriminating adopter farmers from non-adopter farmers: A stepwise discriminate analysis was employed to identify the major components of independent variables for discriminating adopter farmers from non-adopter farmers. The statistically significant dependent variables in an independent t-test and a Mann-Whitney test (Table 9) were used as independent variables in discriminate analysis. The findings indicated that the discriminate analysis stopped on the third step and variables such as knowledge about sampling principles of soil, the amount of extension contacts about ST and educational level were found as the most important discriminative components of adopter farmers, Table 10 shows the details of discriminate analysis.

These factors (knowledge about sampling principles of soil, the amount of extension contacts about ST and educational level) made a valuable distinction among 76.40% of population (Table 11).

CONCLUSION

Based on the finding of this study, the following conclusions were drawn. This study shows that farmers knowledge about soil sampling principles and their attitudes toward ST are at suitable condition. Also, these results show that the extension contacts situation and the use of informational resources by farmers for gathering information about ST are at a moderate condition.

The results of an independent sample t-test show a significant difference in farm plots, farm distance to the

agricultural service centers, educational level, number ofhousehold members, size of renting farm and knowledge about farming soil sampling principles.

Results of a Mann-Whitney test show a significant difference between adopter and non-adopter farmers attitudes toward ST, the amount of extensional contacts about ST and the amount use of informational resources about ST. The other results of this research can point to models of farmers behavior about adoption or non-adoption of ST by using the three variables of knowledge about soil sampling, the amount of extensional contacts about ST and educational level that agricultural planners can use to forecast ST use in relation to educational costs.

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