Factors Affecting the Soil Analysis Technique Adopted by Farmers

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Abstract:

This study aimed to show the reality of farmers and determine the extent of their adoption of the recommendations of the fertilizer and the difficulties and problems they face. The study was conducted on a random sample, consisting of 95 farmers, who had analyzed their field soil in scientific research centers in the southern agricultural region through the form, which is specially prepared for this purpose. The results showed that the rate of adoption of the whole fertilizer recommendations reached an average of 36.9% in the southern region. The degree of adoption was 34.7% in the region. The results showed that 41% of farmers did not apply the recommendations because of the non-convenient analysis, and 34% due to neglect, and 15% due to the weather and environment, while 10% of them for lack of manure at the suitable time.

The study also revealed that the independent factors affecting the continuing adoption of soil analysis are: a farm's experience, the sampling method in the farmer schools, the irrigated area, and the personal knowledge of farmers in analyzing the soil. Also, it shows that the application of fertilizer recommendations led to an increased production of 15-20%. This analysis emphasizes the importance of soil analysis and adherence to the recommendations of the research centers.

Keywords: Soil Analysis, Adoption, Recommendations of the fertilizer

- Studies of Reference:

The southern region covers about 15.7 percent of the total area of the country. It includes Dara, Sweida, and Al-Qunaytirah. It is famous for its fruit production, especially apricots, apples, and grapes, but it also produces crops such as chickpeas and tomatoes, in addition to raising cattle. Between 2011 and 2012, the region's contribution to the national production was 36 percent for chickpeas, 51 percent for apples, 31 percent for grapes, and 62 percent for apricots (FAO, 2015).

Agricultural soils are formed from the fragmentation of volcanic rock, limestone, sand, or gypsum over millions of years by rain and variations in temperature, which consist of small granules mixed with organic material decomposed by micro-organisms in the soil to form a combination surface layer (easy tillage and with different thickness) and this thin surface layer (soil) is a valid and suitable environment for the growth of the roots of plants. (Abdel-Latif, 2015).

The soil is considered one of the main factors for the growth of plants and its production. The types of soil vary according to their physical and chemical and biological properties. Good fertile soil is able to supply the necessary plant nutrients and a suitable environment for root growth and proliferation. The soil could be fertile but not productive when climatic conditions are not suitable for growth and production. (NAPC, 2014).

It is needed to continuously conduct analyzes of the soils in order to know the decreases or increases in the elements of major and minor components and physical and chemical properties, as well as the vitality and its ability to provide a plant with mineral elements essential in order to add fertilizer to optimize and maintain the fertility of the soil according to different growth stages and thus get high productivity.

The non-representative sample of the field has been wrongly taken, the result of its analytical data becomes useless, or in the best case, becomes difficult to interpret. (Ryan, 2013).

Deep indicates (1999), that the accuracy of the results of soil analysis depends on how representative samples of the soil are studied. The depth of tillage is enough (from 0 to 30 cm) for land cultivated and the depth (5 - 6 cm) of pasture land for taking samples for the purpose of conducting chemical analyses and to indicate the degree of fertility, after being drawn sampling and calibration of nutrients and compounds estimate of the soil constituents (GCSAR,2015) .

But still farmers are facing many problems in complying with the recommendations of scientific research (MOAR, 2015), so it is necessary to have a follow-up study and evaluation of the impact of these recommendations in farmers' fields, in terms of productivity per unit area and to sustain soil fertility.

Goals:

The research aims to study the economic and social characteristics of farmers who analyzed the soil, and measuring indicators of adoption of the recommendations of fertilizer and evaluate the impact of adoption of soil analysis in the fields of farmers in the area studied, as well as identify the most important factors influencing the adoption of the recommended fertilizers, and finally shed light on the most important problems and obstacles faced by farmers in the field of soil analysis .

- Materials and Methods:

We depended on two data:
- The preliminary data - through a designed questionnaire for this purpose after rapid rural surveys a list of questions was prepared for farmers including social and economic characteristics of farms and data on farm crops and other information relevant to the topic.
The questionnaire was tested on a sample of farmers and adopted as the final form. After the total number of analyses of farmers for soil from previous years, it was 950 farmers. The study was conducted on a random sample of 95 farmers which consists of 10% of the total farmers, who analyzed their soil at the soil analysis laboratories in the southern region in Syria.
- Depended on the secondary data collection from the annual statistical groups issued by the Ministry of Agriculture and Agrarian Reform, and laboratory analysis of soil data deployed in the southern region.
Data has been entered into the statistical programs - Excel and SPSS and conduct the necessary analysis (quantitative and descriptive). Using the logistic regression Model duo in the study hypotheses research for the continued adoption and expresses the dependent variable (Y) about the possibility of a particular occurrence, and accordingly take (Y) values only, namely:
(1) When they occur (positive), and (0) in the absence of occurrence (negative).
The model uses the following equation:
$Y = b0 + b1x1 + b2x2 + ... bnXn$
X1, X2 ...Xn: Independent factors used in forecasting. (b0, b1, b2 ... bn) are constants independent factors.
To estimate the efficiency of the model an accuracy test was used (Hosmer-Lemeshow), which is based on the use of the test statistics (Chi-Square) to examine the Zero hypothesis, which says that there is no significant difference between the values seen and values forecasted with the variable's, where increasing the accuracy of the model whenever such differences are small.
b: non-standard logarithmic for independent factor.
SE: standard error of the independent factor.
It is then tested (Y) by Chi-Square within the confidence interval (5% and 1%).
Laboratory samples of farmers were taken in two ways:
1. The direct method where the farmer has taken and brought samples to the closest laboratory personally and when the results are issued, they are discussed directly with the farmer in order to get the best recommendations.
2. An indirect way where the workers in the extension units collect samples from farmers' fields (especially for strategic crops) and sent it to the laboratory closest to them supplied with all the necessary data about the farms and are to send the results and recommendations to the interests of agricultural extension after analysis of the samples. This method does not achieve the direct contact between the farmer and the laboratory.
The laboratory analyzes all elements necessary to assess the fertility of the soil in addition to some of the elements that have a negative impact on the soil, such as heavy metals, sodium, chlorine, and others, which are as follows:
Determination of the pH and electrical conductivity - Determination of organic material - Determination of total carbonate - Cationic exchange capacity - Determination of major elements (nitrogen , phosphorus , potassium , calcium , magnesium) - Determination of trace elements (iron , copper , manganese , zinc , boron) - soil - and other analyzes as heavy

metals (lead , cadmium, chromium , nickel , cobalt) for samples from the areas of pollution and gypsum plaster in soils (Eastern Region) , cations and anions of salt-affected soils.
The laboratories also carry out the following other tasks:
- Participation through various tests in identifying programs contamination of soil, water, and vegetation heavy elements and nitrogen compounds and other pollutants.
- Analysis of the heavy elements and elements of impact on soil, plants, fertilizer, and water pollution in order to detect pollution in these elements.
- Fertility analysis of dust samples to give a true perception of the nutrient content of the plant.
- Complete physical and chemical analysis of soil in order to monitor the changes that accompany the various experiments and research.
- Analysis of mineral chemical fertilizers and imported organic fertilizers and domestically produced in order to ensure quality and compliance with the accompanying prospectus.
- Analysis of plant specimens to investigate the different elements shortages, minor and major, in addition to the analysis of plant samples in order to monitor the changes that accompany the various experiments and research.
- Analysis of water samples associated with the design of irrigation systems and irrigation research and experiences.

- Results and Discussion:

1- Descriptive analysis of the study sample:

The average age of the farmers was 50 years and the average experience in agriculture was 22 years. The average family size was 7 members. In education, the sample consists of 37.9% who had primary qualifications and 17.2 % who had preparatory, and in the same proportion had secondary schools and 10.3 % of those who have literacy and 10 % of those who have post-secondary education.
A large number of farmers working on livestock, the percentage of farmers who use compost 75.9 % and more commonly used types of compost are the remnants of cows and sheep primarily in addition to poultry waste.
The majority of the analyzed soil is from olive, grape, and apple trees by 63.8 % and 18.3% vegetables and the rest were other crops.
The average agricultural holding was 48 Donum, (1 Donum = 1000 m^2), reaching the highest area of 180 Donum and analyst least of which 2 Donum with a standard deviation of 49.1 Donum.

2 - Analysis of the adoption of farmers to fertilizer recommendations:
The definition of rate of adoption is the number of adopters of soil analysis divided on the number all farmers adoptions overall recommendation fertilizer (i.e. nitrogen, potash, and phosphorus) based on the results of soil analysis 36.9 %, which is considered very low, which calls for follow-up and a stand on the reasons for the low percentage, and to find out who the farmers analysts of the soil are and the reason for their analysis and non-application of the recommendations given. There are about 46.9 % who add the nitrogen only, but those who add superphosphate fertilizer as recommended are approximately 57.4 % and 61.8 % sulfate of potash.
We note here that the farmers applied one or two recommendations, which indicates a lack of conviction of the soil analysis and they apply only what they believed in, therefore awareness

and guidance does not depend on their opinion to analyze the soil, but the extent of its compliance with the fertilizer recommendations.
Due to ignore this index the farmer's areas, we need to included it.. We used the indicator degree of adoption, which measures the percentage of an area applied by the recommendation of the total area analyzed. The ratio was 34.7 % of the total area of the farmers and this shows that the area applied to them very little and reached the highest 59.5 % for the use of superphosphate and potassium sulfate 58.6 %.
There are another indicators, the adoption density is multiplied by the degree of the adoption rate of adoption and this indicator collects the indicators together and in our sample this amounted to 22.5 %.

3- The results of the standard analysis for adoption:
The independent variables which could affect the adoption of the fertilizer recommendations were (10) variable, which is supposed to have an impact on the variable factor, in the regression model logical duo continuing adoption (Y), using the method (Stepwise-Backward WALD), which is based on the introduction of all the variables together in the first step, and then excludes one variable at each step in a particular order based on the basis of estimates of the maximum likelihood at every stage, so that the exclusion of a variable according to the value of statistical resulting from test (WALD).
The program SPSS has been to rely on this task using (6) steps, and it was the last step that is best excluded from all the independent variables is moral, and according to the test (Score), as shown in the table (1). Accordingly, the number of independent variables excluded (5) independent variable, which does not affect the adoption.

Table (1) Variables that are not included in the regression equation rationale continuing (Y) according to Test Scores

Score test variables that did not enter the regression equation	test Score
Total Area	0.011
Use compost	0.008
Depend on researchers in the sample taking	1.864
Depend on neighbors or acquaintances in the analysis of soil sampling	0.046
The number of sites taken from the soil sample	1.099

Source: the Sample survey

To estimate the efficiency of the model test (Hosmer and Lemeshow) was used, which showed no significant differences between the values predicted for the dependent variable (Y) and the values seen, where the fallen value of chi-square to (7.717) level of significance (Sig = 0.05) which to some extent unacceptable, and therefore the resulting model is proportional to the data seen and able to predict the status of adoptions in the sample.
This model was able to predict the rate (76.8%) of the values seen for the dependent variable, depending on the predictive variables, as shown in Table 2.

Table (2): Measuring the predictive ability of the model used and approved for variable (Y)

Cases (frequencies)		predictive frequencies		total	Proportion of correct (%)
		Adopter	Non adopter		
frequencies observation	Non adopter	13	39	52	75
	Adopter	34	9	43	79.1
Total		47	48	95	76.8

Source: Sample Survey

• Factors affecting the function of adoption (Y):

The results showed the presence of (5) independent variables significantly affect effectively on the function adoption as shown in the Table (3), while the other independent variables were ineffective.

The Wald test indicated that all the constants for predictive variables in the model within the areas of significant on the confidence (5% and 1%) have a significant effect on the likelihood of adoption.

Table (3): Independent factors affecting the function adoption of soil analysis (Y)

Variables affecting	kind of impact	CONSTA (B) NT	TEST WALD	EXP (B)	The possibility of adoptions per unit (%)	Probability of adoption%
X1: farmers experience	positive	0.065*	5.846	1.067	1.626	51.6
X2 :personal knowledge of farms in analyzed soil	negative	-0.062*	4.814	0.940	-1.547	48.5
X3 :irrigated area	negative	-0.091**	9.382	0.913	-2.269	47.7
X4:source sampling Extension	positive	1.115*	3.956	3.050	25.309	75.3
X5: source sampling farmers schools	positive	2.039	2.731	7.683	38.483	88.5
Fixed (Constant)		-2.096	3.306			

(*: 5% level of confidence, **: 1% confidence level)

The Constant refers to the expected value of the likelihood of adoption when all predictor variables are equal to zero, and so it is not useful in practice, while constants (B) measure the estimate predictive of independent variables to predict the logarithmic likelihood of adoption (Y = 1), where increasing or decreasing in the logarithm refer to the likelihood of adoption with the increase or decrease independent factor, after keeping all other factors independent are constant, at the same time a reference constant refers to the nature and direction of the relationship between the variable predictive and variable adoption, where all the predictive variables affect the likelihood of adoption.

The values of the constants are in logarithmic so it is often difficult to interpret, so values have been converted to exponential (e^B) each of which reflects the odds ratio (Odds Ratio) occurs due to the increase adoptions independent factor by one unit. And also determine the relative importance of the independent variables corresponding, where percentage more than (1) refers to an increase in the likelihood of adoption, while percentage less than (1) refers to

a decrease in these odds, the percentages near (1) refer to a weak predictive factor corresponding effect on the likelihood of adoption, at the same time indicating the equal ratio of one to the lack of this effect.
The independent factors are:
- Farmers experience (x_1): The experience of the farmers in their farm is increasing the likelihood of adoption to 51.6 %, specifically, the increase of farm experience for one year leads to an increase in the likelihood of adoption by 1.6 %.
- Personal knowledge of farms in analyzes soil (x_2): The knowledge of farms in analyzed soil from indicative impacted negatively on the adoption of soil analysis which leads to the lower likelihood of adoption (48 %).
- Irrigated area (x_3): increase in irrigated area leads to decrease the likelihood of adoption to (47.7 %) and in particular the increase in irrigated agricultural land by one Donum will lead to decrease the possibility of adoption to (2.3% only) with the fixed of other influencing factors constant and this to interpret why the farmer who has irrigated land, had the conviction that increasing the amount of fertilizer leads to increased production so it does not comply with the recommendations.
- Source taking sample through Agricultural Extension (x_4): The knowledge of farms analyze the soil through agricultural extension in the region increases the likelihood of adoption to 75.3 %.
- Source taking sample through the farmers' schools (x_5): The adoption of farmers on farmer's schools as a source of analysis raises the possibility of adoption to 88.5 %.
Depending on the constant independent factors included in the model, we can write the logarithmic regression equation for the adoption of the following form:

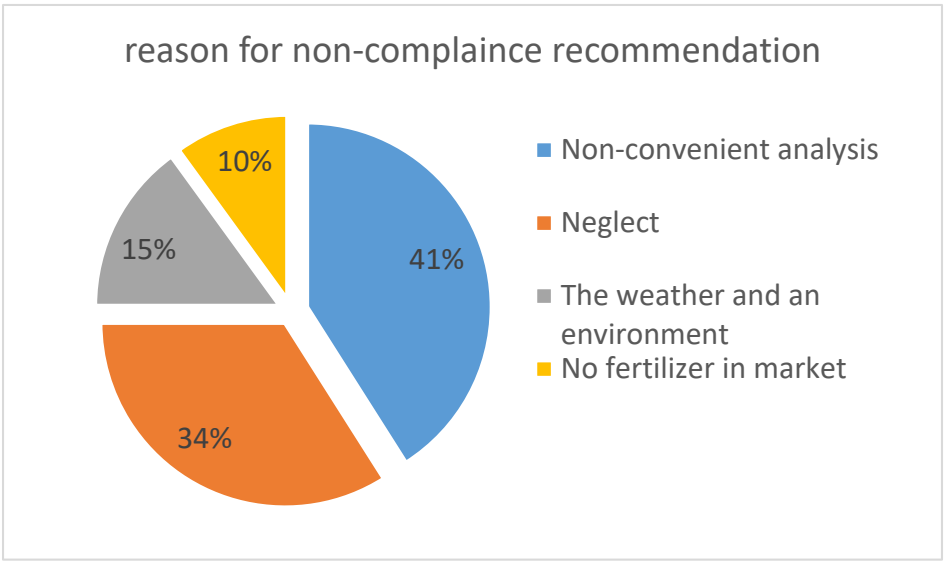
$$\mathbf{Log(Y/1-Y)} = -2.096 + 0.065\mathbf{X_1} - 0.062\mathbf{X_2} - 0.091\mathbf{X_3} + 1.115\,\mathbf{X_4} + 2.039\,\mathbf{X_5}$$

4- Diseases caused by non-compliance with the recommendation fertilizer to the farm in the southern region:
The given fertilizer recommendations to the farmer by the content of the soil of nutrients and the results of laboratory analysis of the sample are based on the tables of private required elements for crops and fruit trees.
When farmers are non-compliant with the fertilizer recommendations given to the farmers, this will reflect negatively on the plant, soil, and manifested symptoms of the lack of elements on the plant and general weakness, which allow for a plant to become susceptible to attack, insect pests, pathogens, and therefore death, that in the event of the poor soil of nutrients either if the content of the soil is good, including more nutrients, advised not to add fertilizer except nitrogenous for soil and if you did not comply with the fertilizer recommendation accumulate nutrients in the soil and produces the so-called contradistinction between them and discourage grow and prevent absorption of another element so appear symptoms shortage on the plant and it is also reflected on the soil where eventually it leads to degradation of the soil and a lack of productivity.
Organic fertilizer is obtained by purchasing directly from breeders or facilities breeding cattle, sheep, and poultry. It is added during the fall and winter, and the method used for the fermentation of organic fertilizers by placing them in a suitable hole form and to add to them the appropriate amount of urea 46%, and flooded with water and then covered by Polyetelin and leave for three months (July - August - September), while it became wet from time to time, and then get it from the hole and then added directly to the soil.
Some farmers have an incorrect opinion that fertilizer can stay on the land without any processing and thus it will become a fermented fertilizer. While more farmers are adding

animal waste in its fresh form to the soil causing weed growth in abundance because the seeds live in fresh waste.
The sample taken related to land area and topography and crop grown and the purpose of the analysis, according to a spot of injury or illness in the field, and taken into account when sampling from the fields of fruit trees to be deep depth proliferation maximum of roots which are up to 90 cm, which is divided into three horizons, each 30 cm. If the ground is homogeneous and there is no disease in the plant, but if the opposite must representation of the entire field (high - low - injury ...), while field crops sample shall be taken at a depth of 30 cm only, and should be taking into account the above-mentioned conditions to the nature of the field.
The farmers do soil analyses after the end of the season and prepare for the new season, and for each crop separately to get the equation of fertilizer to keep the earth in balance and good productivity.
The farmer's answers varied about the amount of the increase in the production, which varied according to the type of crop and the age of the trees and the rainy season, which ranged between 15-20% increases in the event of a complete fertilizer application recommendation.

5- The reasons for non-compliance with fertilizer recommendation:
The reasons for non-compliance with the analysis and recommendations of the laboratory analysis, from the opinion of farmers, are 41% non-convenient analysis and in particular quantities of fertilizer recommended, because the farmers convinced that increasing the amount of fertilizer results in an increase in production, also 34% of the answers were the cause of non-compliance is the neglect and indifference, and 15% of the answers were the cause of bad weather, and 10% because they didn't find fertilizer in the market. Figure1 shows these reasons.

Figure (1) Reasons for non-compliance with fertilizer recommendation by farmer's opinion

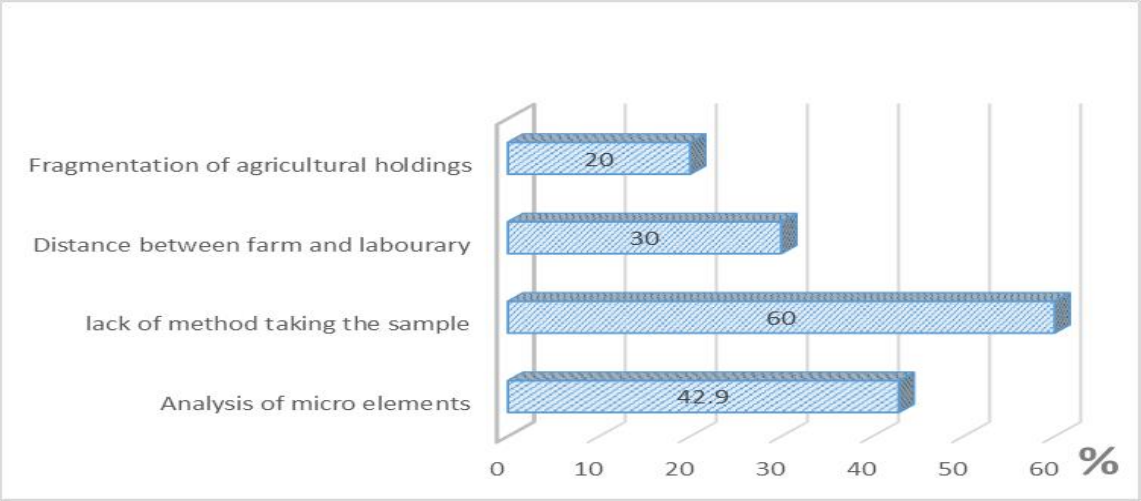


Source: Sample Survey

When we asked farmers about the most important problems they suffer in the field of soil analysis, responses varied between the provinces and were confined to four basic problems. First is the lack of analysis of microelements, to know minor elements in the soil, it forms 42.9 % of the farmers, and this shows the interest of farmers in the subject of analysis of trace

elements in the soil, due to the presence of diseases caused by lack of or increase these elements in the soil. The second problem was the difficulty of sampling or lack of knowledge in a way taken correctly, as believed in it more than 60% of them depend on their personal experience in taking the sample. While 30 % said that the distance from their fields plays a vital role for the farmer and the lack of supervision on the process of collection and bringing the samples to the laboratory in a timely manner. And the problem of fragmentation of agricultural holdings formed 20% of farmers' problems in the analysis of the soil.

Figure (2) Problems faced by farmers in soil analysis by the farmer's opinion



Source: Sample Survey

When farmers were asked for their suggestions and views on the most important solutions that can help them in the field of soil analysis, the answers were as follows:
45% of farmers who have analyzed their soil indicated the need for devices to analyze the components of soil, especially small ones and 15 % of the farmers suggested the need for scientific publications and periodicals about the most important diseases facing the crops due to lack of or increase in micronutrients and major in soil and 10 % of the farmers found that it is better if the laboratory takes the samples. As reported by 15% of the farmers, need for guidance courses or field days to teach farmers the correct way to take a sample. And 5 % of them stressed the importance of giving fertilizer by the Agricultural Bank building on the results of soil analysis.
- Most farmers 76% will continue dealing with laboratories to analyze the soil and will continue to analyze soil even if the analysis were not free.

- Conclusions:
- The lack of fertilizer in the market or available some of them or provided in a period is not suitable as additional fertilizer and a link to this add-on for some amount of rainfall and the non-return of some farmers to take the results of the analysis are the most important reasons for non-compliance with the recommendations fertilizer recommended by the laboratory or the lack of trust between farmers and technicians and guidance are other reasons for non - compliance with the recommended fertilizer.

- Most farmers, 76%, will continue dealing with laboratories to analyze the soil even if analysis were no longer free.

- Most farmers surveyed in the sample refer that the extension staff and agricultural research centers have guided them to take soil sampling method for analysis centers and finally to rely on personal experience.

- The regression equation to adopt a soil analysis showed that the experience of farmers sampling by extension, the farmer schools positively affect and are significant at the 5% level, while a negative impact on both the irrigated area and the lack of knowledge of farms analyzed the soil.

- The application of a complete fertilizer equation according to the recommendations of laboratory analysis gives an increase in production estimated at 15-20 %, depending on the crop grown.

Recommendations

- More seminars and workshops for farmers to show the importance of conducting an intensive analysis of the soil for farmers to demonstrate its usefulness in providing fertilizer and increase production and thus achieve an economic return.

- The need for scientific and periodic bulletins about the most important diseases facing plants as a result of a decrease or increase in the minor and major elements in the soil.

- Conduct extension sessions or days of the intensive field to teach farmers the correct way to take a sample from the laboratory and the extension staff.

- Give the fertilizer to the Agricultural Unit for farmers at low prices, based on the results of soil analysis and provided in the appropriate period.

- Increase trust between the farmers and the laboratory, and encourage farmers to follow the instructions for the sampling method for the analysis and apply of fertilizer recommendations, which ensures an increase in production on farms ranging between 15-20% per unit area.

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