AN ANALYSIS FOR ADOPTION OF SUBSURFACE IRRIGATION TECHNOLOGY AND ITS ROLE IN AGRICULTURAL DEVELOPMENT IN IRAQ

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Abstract

Tomato production consider the main source of income of most farmers in Abo Graib district, and with scarcity of water in Iraq and in this district in particular there is necessity to finding alternatives working to saving irrigation water to increasing the productivity of tomato. The study aims to knowing the influencing factors of adoption sub- surface drip irrigation technique and forecasting of time period it needed to spread in wide range of farmers by applying this technique on group of tomato farmers in study district via Water and Livelihoods Initiative project (WLI). The random sample of study from farmers from Abo-Graib district in province of Baghdad which was one of the important middle region in Iraq in producing tomato within the agricultural season 2019. The results showed that level of adoption of sub- surface drip irrigation technique can reach to (%90) of farmers within (10.6) years, and that came from analyzing recent situation. Sensitivity analysis showed the most important influencing variables on level of adoption and reaching to peak of adoption of technique were: short run financial constraints, easiness of applying the technique in limited range, degree of complexity, extent of vision the technique, percentage of depending of farmers on extension of private sector, participation in working groups to discussing agricultural operations those relating with technique, needs of farmers to develop new skills and knowledgments to using technique, rate of knowing of the farmers about using the technique and finally ratio of primary investment to annual return, all these factors working together in influencing on needed time to reaching to peak of adoption.

Keywords: Subsurface Irrigation Technology, sensitivity analysis, Adoption.

Introduction

Adoption of subsurface irrigation can help the farmers, especially in the lands which suffer from of water resources, to reducing quantity of the using water to irrigate the crops and plants and to increase productivity of crops. We use here (ADOPT) program to evaluate rate of adoption of the sub surface irrigation and to determine the main problems which reduce the adoption, because it is represent a tool of adopt of the adoption results and to distributing the results among the farmers, and this program will adopt of percentage of the targeting farmers those adopted the technique over the time. We use here procedure of Focus Group Discussion (FGD) and we obtain the related information of (ADOPT) program via participation groups of the farmers and specialists technician researchers, by answering set of focusing questions about (22) question (Akroush and Dhehibi, 2015). Which con concerning four sets of influences on the adoption which are: The characteristics of innovation, characteristics of the targeting farmers, comparative advantage of using the innovation, and knowing the comparative advantage of innovation. Adoption of agricultural techniques in general were function of characteristics of farm and farmer and the distinguishing characteristics of the technique (Hadi and others, 2010).

The problem of this paper focus on that application sub-surface irrigation in Abo-Graib district showed positive technical results during its application, thus we decided to study economical analysis to evaluate that technique from socioeconomic approach and show range of possibility to adopt it among farmers and knowing the time period which need to separate in abroad range among the farmers. The research aims to recognizing about the influencing factors of adoption of sub- surface drip irrigation and forecasting about the time period which need to separating in abroad range. The data collected via using method of the opinions participation via groups of the farmers and specialists researches to discussion questions of the program which contain analytical questions (the discussion and the rules took place plural about what they think it is suitable answer), and the specialists researches explain the questions (helping the farmers and explaining why they choose this answers), and they ask the farmers to thinking about our problems those relating with applying sub- surface drip irrigation technique and the most important positive and negative indicators of adoption this technique.

Materials and Methods

Adopt program as a tool of forecasting of adoption and declaring the results

Adopt is a tool to forecast of the adoption and declaring the results, and it is depending on (MS Excel) program in entering data and analyzing, the program will estimate and predict the probability of adopting and declaring the agricultural innovations and shed light on the targeting farmers. This tool using the experience of many specializations to make the knowldgments of the innovations adopting more easily, more understanding and applicable by the researches, extensions and research management (Timmons. 1948). This program predicted of percentage of the targeting farmers those who adopt the innovation over the time. Adopt as tool will make the relating features of the innovation, it make adoption more easier, and it will help the agricultural research organizations and concerning people to understanding the mechanisms of the innovation of modern technique. The tool designed to obtain (Kuehne & others, 2011):

1. Forecasting about the possible level of peak (top) to adopt the innovation and needed time to reach it.

2. Encouraging the users about taking care with factors those affecting the adoption in the same time of project designing.

3. Participate mangers of research and development and extension and users via making the knowledgments and principles of adoption more understanding (Ali and Farhan, 2015).

Adopt program depend on answers of the quantitative and qualitative questions of each variable from (22) variables those influence on adoption and analyzing the data will lead to increasing the knowledgment about the relation among variables and there influence on adoption.

This program focus on (22) questions four categories on the influencers on the adoption which they are (Shideed, 1995):

- Characteristics of the innovation.
- Characteristics of the targeting people.
- Comparative advantage of using the innovation.
- Learning from the comparative advantage of innovation.

The final theoretical framework assumes there is interaction relationship between influences on the adoption which are visible from view of development of the targeting group and the technique, thus it is considered an approach of thinking of the variables which related to influence on the adoption of new techniques. We expect this will make the theoretical framework as diagram chart and that will increase number of the people those can easily understand the causality of this frame work, therefore it is permit to communicate between experts and no experts, and it will increase the ability to find more active communication among the economists, specialists in extension and the specialists in agricultural system because they are consist one teamwork, and we will choose more active variables which they depend by (Boz and Akbay, 2005). They are related with networks, expectations of the profits, size of agricultural areas, cost of the adoption in short run, impact of applying the technique on the profits, the influences on the production risk, complexion and complication of the technique. To insure the maintenance of the environment during applying the technique, we can applying it as a case study (small scale) to see the influences more easily, the studies of adoption show that either they related with learning about comparative benefit or real comparative benefit as show in table (1).

In the same way, each impact can see on base of its relating with people (targeting sample) or with technique, and the influences on adoption can explain there concepts by using quadrant which contain:

Table 1: Determine impacts of adoption via quadrants

Specific influences of the targeting group (people) of the ability of learning the technique	The comparative benefit of people (targeting group)
Characteristics of the ability of learning the technique	The comparative benefit of the technique

Source: (Rogers. 1995).

We design quadrant (simple case) about mechanize of working of the theoretical framework, it is simple description about decision of adoption. The theoretical framework as shown in Fig. (1) shows that two quadrants in left side are specific influences of people (targeting sample) of ability of learning the technique don't impact on level of adoption peak (Rahm and Huffman, 1984).
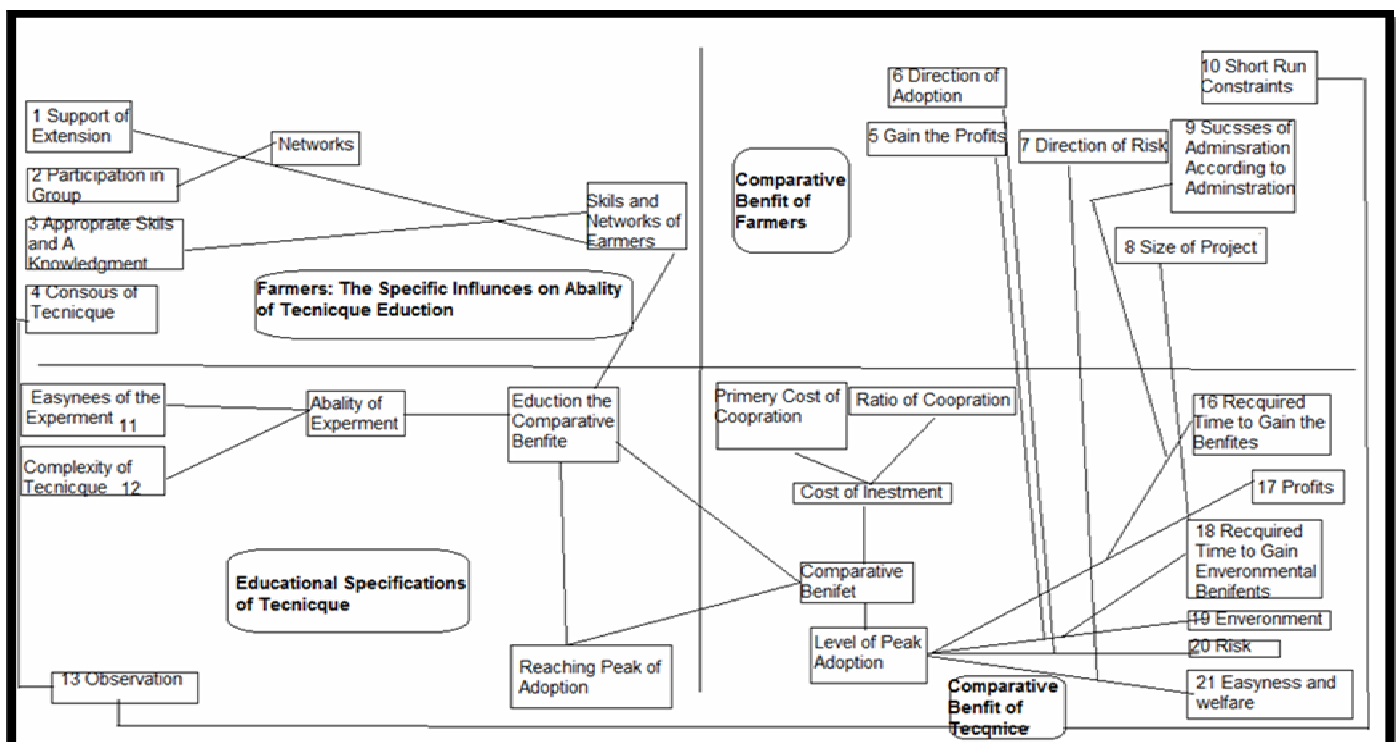

Fig. 1: Theoretical framework about decision of adoption.
Source: Kuchne & others, 2011.

The comparative advantage of people (targeting group) and comparative advantage of technique influence on each of the needed time to reach the peak of adoption and level of adoption peak, its impact on the time needed to reach to adoption peak in two ways (Grilichesm, 1957). The constraints of short run were have direct influence, while the other variables will have more accuracy impact in this comparative advantage which influence on learning from knot of comparative advantage.

Results and Discussion

The sub-surface drip irrigation technique is a modern irrigation way from (WLI) project in Iraq with participation of group from tomato farmers in Abo Graib district, province of Baghdad. This technique is an irrigation method using pipes of irrigation putting under soil surface and the dripper should be near from roots of plants, and this technique will contribute in increasing productivity of water unit and reducing waste and increasing efficiency of using the fertilizers because the pipes will distribute the fertilizers to the root directly and this will allow to plant to benefit from the fertilizers (Ali and Abboud, 2013).

This technique is very simple in applying and we can have directly results after applying. The results expect that (%95) from farmers will adopt sub- surface drip irrigation technique after (11.2) years as shown in table (2).

Table 2: Expected level of Adoption

Levels of adoption	Expectations
No. of expected years to reach to peak of adoption	10.6
Expected top level of adoption	%90
Expected adoption level after first 5 years	%60.2
Expected adoption level after first 10 years	%90

Source: Results of analyzing Adopt program.

Now, we will discuss in details the basic indicators of adoption of sub- surface drip irrigation. After analyzing answers of targeting farmers (30 farmers) via questions of (Adopt), we see the results in table (3):

Table 3: Answers of farmers on questions of Adopt

Question	Response
Learn ability of Population	
What proportion of the target population uses paid advisors capable of providing advice relevant to the innovation?	A majority use a relevant advisor
What proportion of the target population participates in farmer-based groups that discuss farming?	A majority are involved with a group that discusses farming
What proportion of the target population will need to develop substantial new skills and knowledge to use the innovation?	A majority will need new skills and knowledge
What proportion of the target population would be aware of the use or trialing of the innovation in their district?	About half are aware that it has been used or trialed in their district
Learn ability Characteristics of the Innovation	
How easily can the innovation (or significant components of it) be trialed on a limited basis before a decision is made to adopt it on a larger scale?	Very easily treatable
Does the complexity of the innovation allow the effects of its use to be easily evaluated when it is used?	Slightly difficult to evaluate effects of use due to complexity
To what extent would the innovation be observable to farmers who are yet to adopt it when it is used in their district?	Easily observable
Relative Advantage for the Population	
What proportion of the target population has maximizing profit as a strong motivation?	A majority have maximizing profit as a strong motivation
What proportion of the target population has protecting the natural environment as a strong motivation?	About half have protection of the environment as a strong motivation
What proportion of the target population has risk minimization as a strong motivation?	A majority have risk minimization as a strong motivation
What proportion of the target farms is there a major enterprise that could benefit from the innovation?	Almost all of the target farms have a major enterprise that could benefit
What proportion of the target population has a long-term (greater than 10 years) management horizon for their farm?	Almost all have a long-term management horizon
What proportion of the target population is under conditions of severe short-term financial constraints?	About half currently have a severe short-term financial constraint
Relative Advantage of the Innovation	
What is the size of the up-front cost of the investment relative to the potential annual benefit from using the innovation?	Large initial investment
To what extent is the adoption of the innovation able to be reversed?	Moderately difficult to reverse
To what extent is the use of the innovation likely to affect the profitability of the farm business in the years that it is used?	Very large profit advantage in years that it is used
To what extent is the use of the innovation likely to have additional effects on the future profitability of the farm business?	Very large profit advantage in the future

How long after the innovation is first adopted would it take for effects on future profitability to be realized?	Immediately
To what extent would the use of the innovation have net environmental benefits or costs?	Moderate environmental advantage
How long after the innovation is first adopted would it take for the expected environmental benefits or costs to be realized?	3 - 5 years
To what extent would the use of the innovation affect the net exposure of the farm business to risk?	Moderate reduction in risk
To what extent would the use of the innovation affect the ease and convenience of the management of the farm in the years that it is used?	Very large increase in ease and convenience

Source: Questionnaire of Adopt program.

As we said, the expected rate of peak of adoption of sub- surface drip irrigation was (%90) after (10.6) years, and percentage of the adoption will reach to (%60.2) from the targeting farmers after (5) years of adoption.

We expect that percentage of adoption will reach to (%94) of farmers after (10) years from adoption, by depending on several factors such as : profit of farmers, the economical view, risks, number of farmers they expect using the technique environmental profits and advantage, easiness in using and applying, costs of risks, investment and comparative advantage, so the level of peak of adoption will be (very high) as shown in fig. (2).
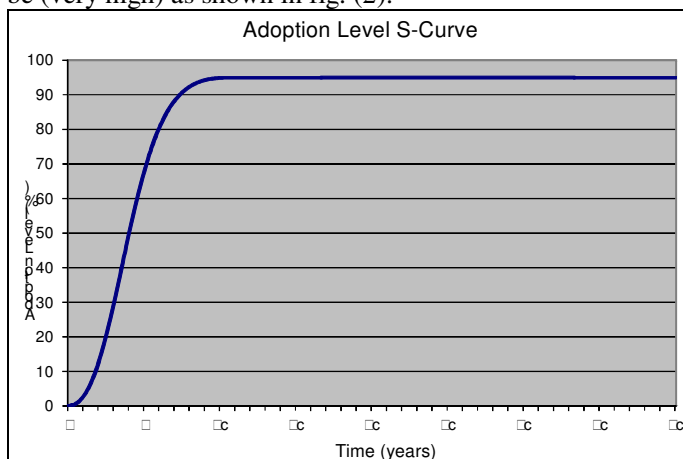

Figure 2: Adoption Level S- Curve**.**

Source: Prepared by researches.

Sensitivity Analysis

About interpretation of sensitivity analysis to the main factors those affecting level of adoption and reaching to peak of adoption, we that most important influence variables are (Andreas. 2012):

1. Short run financial constraints.

2. Easiness of applying technique in limited range.

3. Degree of technique complexity.

4. Range of ability of vision of technique.

5. Percentage of depending of farmers on the private sector extension.

6. Participation in work groups to discuss the agricultural operations relating with technique. As shown in table (4), all these factors working together to influence on the time needed to reach to peak of adoption, Fig. (3) represent level of degree of influence of each variable, the columns in red colour represent range of the variable influence in increasing the time needed to reach to peak of adoption in case of inefficient management or neglecting high impact variables, while green color represent range of the influence of variable in reducing needed period to reaching to peak of adoption by controlling on these variables and attempting to provide the suitable conditions to reducing from influence of those variables. The results showed that half of farmers sever from financial shortage in short run, and if the farmers can jump on this constraint, they can reduce period of adoption by one year, while in case of they cannot broke that constraint and it don't wide spread among farmers, that will lead to increasing period of adoption by one year.

About the ability of using the technique in limit range, the results showed that we can use this variable to reduce period of adoption by (1.9) year, and about degree of the technique complexity, if the technique is easily simple using, that will lead to reducing the needed period of adoption by (1.9) year and vice versa. Also we found that the extension support to farmers will lead to reduce the period by (1.7) year and vice versa in case of no support. The initial cost of investment to returns if it is not high, the needed period to reaching to peak of adoption will decrease by (1.8) years as shown in table (4).

Table 4: The influence factors on level of adoption and period to reach to peak of adoption

| No. Question	Variable	Expected Time of impact/Year
6	What proportion of the target population is under conditions of severe short-term financial constraints?	±1
7	How easily can the innovation (or significant components of it) be trialed on a limited basis before a decision is made to adopt it on a larger scale?	+1.9
8	Does the complexity of the innovation allow the effects of its use to be easily evaluated when it is used?	±1.9
10	What proportion of the target population uses paid advisors capable of providing advice relevant to the innovation?	±1.7
14	What is the size of the up-front cost of the investment relative to the potential annual benefit from using the innovation?	±1.8

Source: Questionnaire of Adopt program.
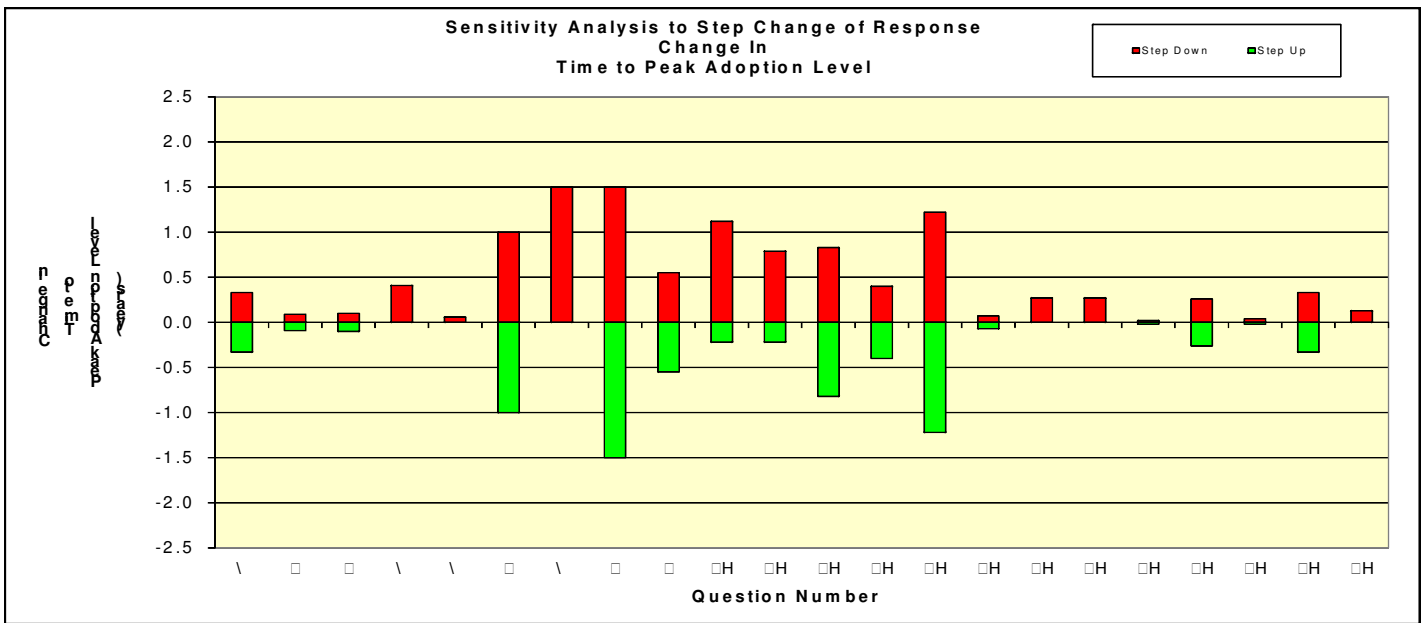
Fig. 3: Sensitivity Analysis.
Source: Results of Adopt program.

When we see table (4), we find that period of the influence of the variables vary about the period needed to reach to peak of adoption, we see that long period was about (ability of technique to applying in limited range and degree of complexity of technique) by about (1.9) year, thus the taking care of those two variables has a priority by reducing time period of influencing via following set of procedures such as reducing degree of complexity of technique throw training the farmers and intensive the felids days about method of technique working and simplified its using, and focusing on capability to applying it in reduced range in small areas to insure its success and its achieving of goals and ability of expanding it in wide range. While the factors which have low impact time were (time period needed to achieving profits and expected time period to achieving environmental benefits) so we should keeping short period or reducing it as possible to those two variables via intensive programs and plans which participate to reducing time needed to reach to peak of adoption, while the other variables, there influence time were (0.9- 1.7) year and they are (short run financial constraints, participation in work groups, consultant supporting, skills and knowledgments relating with technique and relative primary cost of technique) and these variables represent together very necessary elements we should taking care of them and improving there performance and providing suitable conditions to reducing the influence to reduce the needed time period to reaching to peak of adoption of sub- surface drip irrigation technique.

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