

Investigating Factors Affecting Adoption of Mechanical Technology in the South of Iran

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Abstract: Low yield per area unit in many developing countries and in Iran express that use of technology, new knowledge in agriculture is limited to mechanical technology by conquest on technical and climate constraints besides the time constraints provide possibility of increasing in area and production of agricultural sector. The main objectives of this study were to investigate the factors affecting adoption of mechanical technologies by farmers. For this purpose, we noted application of a new mechanical technology named Mechanical technology for wheat cultivation in Marvdasht city of Fars province. Logit models were used for these purposes in this study. Results showed that individual and farm factors have anticlimactic and insignificant effects whilst some factors such as promotion and insurance facilities have positive effects on adoption of Mechanical technology. Therefore, we, recommend that necessary investment in increasing of promotion facilities as premium mobile of developing of Mechanical technology usage is accomplished, by more activity of agricultural insurance organization; we must provide background of farmer's attitude toward adoption of new cultivation mechanical technology, too.

Key words: Technology adoption • Logit model • Mechanical technology • Wheat • Insurance

INTRODUCTION

Low yield per area until now in many developing countries and in Iran expresses that the use of technology and new knowledge in agriculture is limited, so it is expressed that traditional farmers are not aware of the new methods of farming. In addition, their usable technology is in the initial stages but if we equal technology with economic and social welfare, there are many documents that show petty landowner farmers in developing countries who desire a good level of life. Therefore, among the farmers, there are enough stimuli for using modern technology [1-6]. However, the main subject is why the technology has not been developed. The reasons of technology stagnation can be divided in to four groups as below:

- The lack of suitable technology.
- Farmers unawareness of the better methods.

- The lack of stimulus. Not disposing towards risk and of the expense of adoption of technology.
- Other obstacles for accepting technology because of shortage of market regardless of the discussions, which are related to the distribution of, obtained interests from the progress of technology.

There is no doubt that all of the groups in society enjoy the benefits of the development of technology, because of the restriction of some of them of source of agricultural, especially earth, the growth of agricultural production depends on the rate of developing technology. Besides this, for the vital rule of agriculture to accelerate, the economical development of the obtained interests from the sufficient rate of technologic development in agriculture is ultra important direction of this part of agriculture and includes all of the economy.

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The developed countries have capitalized in the direction of the search for increasing the production of food articles and by changing the agricultural structure and establishing a suitable substructure and by using the new technologies get to this good. In agriculture, the technology is divided into two groups: mechanical and biological. The mechanical technology will create more use from the machines, like the tractor and combine harvester, etc. and facilitate the replacement of machine over worker. The biological technology includes the development of new figures of seeds and it has a high reactivity to the use of chemical fertilizer. Thus, this type of technology increases the yield operation of the unit [6-12].

Thus, so it would be a replenishment of earth. In the countries, which the placed worker is relatively restricted and the replaced capital is unrestricted, the use of mechanical technology is more useful. In return for this in the countries, which the land is restricted and the worker is relatively abundant, the use of mechanical technology is more useful. In return, in the countries in which the land is relatively restricted and workers are relatively in abundance, the use of biological technology is more useful [12-18].

Mechanical technology with predomination with the climatic and otherwise the technical restriction makes possible the possibility of increasing the land under cultivation, in fact, mechanical technologies offer the possibility of becoming applied in the investigative collaborations of different agricultural branches. Therefore, the mechanization agriculture from one choice and simply replacing man with machine has changed into a requirement for increasing the revenue usage from the other store but the technology merely cannot help the policy markets goals and the more important problem is that the technology be accepted and used by the farmers. Otherwise, accepting technology and using from in the farm may accelerate getting to other goals and/or prevent from getting to those goals. About the process of accepting technology by the farmers, we can point to the monotony of accepting technology [18-22].

This theory is according to the basis that most of the innovation technologies for profitability require the minimum of level of production. Therefore, it seems that the greater farmers have a better chance for accepting the new technologies. Based on some studies, the innovation technologies decrease the expected expenses of the yield per unit and so, will remove the function of final expense toward downturn and the right way comes instead. It also provides the stimulus of accepting technology for each person, upon condition that the expected price of yield be fixed. The first accepters make a temporary profit from

their yields. With increasing the publishing of innovation in agriculture, the new technology will improve and the general recipients will increase and thus decrease the price of yields. In addition, since most of the yields have low marker price so the general income will decrease. The income decrease forces the other farmer to accept the new technology or forces them to leave the part as if the last accepters are those whom that, for preventing from the loss accepting technology by all of the farmers will not change their conditions; but the farmers have yet to receive stimuli for accepting the new technology [1-5].

Nevertheless, according to some of the authorities, there is belief in the positive effect of investing in and accepting mechanical technology (mechanization). The agriculture will cause great structural changes in agriculture, the increasing of some of the yields such as wheat and rice is encompassed in some of these changes. In addition, it is clear that mechanization of the farming is one of the most important factors in increasing the farming production [22-25].

Not withstanding, with regard to the goal, which is the increasing of producing a suitable research base to question which of the activities in any area should be mechanized. In addition, each kind of necessary change, which is required, is undertaken for introducing the mechanization [6]. Nevertheless, the different aspects of doing the new methods should be considered before getting any decision on the characteristics of revenues order, farming pattern, physical conditions and the penology of the farming lands, be employed. Doubtless, one of the most important results that mechanization application could have in an area besides the increasing of production in farming yields is the change of revenue of the different factors of production such as worker, machinery, land and fertilizers [25-30].

Therefore, the examination of effective factors for accepting technology by the farmers has been important for the economists. In addition, some studies have been done in Iran, too. In the present study, the effective factors for accepting the mechanical technology have been examined. For this purpose, the application of one of the mechanized new technologies which is known as the Combinat has been examined for producing the grains and this mechanized technology by gathering some activities such as the preparation of bed and planting the seed in a clouding disk, furrower, sowing and fertilization will decrease the traffic of machinery in the farm and so decrease the use of stores, in this manner from a technical point and this type of technology will prevent formation of a hard layer on the top soil and thus a better condition will be provided for the growth of plants [1-2, 10, 18, 30-43].

In this study Marvdasht city in the south of Iran and the wheat farming there have been chosen as an example. Marvdasht is one of the basic areas in the south of Iran for producing wheat and this province has been allocated the first place in producing the wheat during 16 recent years and produces about 15% of all of the wheat of the country [9]. One of the long-term purposes of a national document of improving the agriculture in the forth program is important.

MATERIALS AND METHODS

Measurement is the technique, which has been considered for this research. After the determination of the place according to the sampling, the capacity of the sample is determined. Then by studying a guide and by analyzing its result and by doing the required adjustment in the measurement tools was resorted to gathering information about the sample of population and then these information by the considered methods were analyzed.

The south of Iran was considered as the area of study and this province with about 126489 km² encompassing Marvdasht city, which is a large and important city in Iran [7]. Wheat is a strategic yield and it is the main food of the people and the south of Iran and during the recent years from the view point of production has devoted the first place to itself thus, farmers who plant the wheat, in the south of Iran that use the Combinat and those whom have not used from this technology have been considered as the area of examination in this study. The plan of sampling was the method of categorized cluster sampling so the statistical society has been categorized according to the used technology for planting the wheat seed (the users of combine and those who do not use the combine).

Then, some raceme was chosen randomly and these racemes are the chosen villages and these villages according to their size of entered population in sample some farmers were chosen randomly and sampling took place. The tool for gathering information was the questionnaire, which was recently initiated and the method was that an interview was done by a presence contact with about 138 farmers who were entered into the sample population, in the agricultural year 1984-1985. With attention to this problem in this study the dependent variant includes the quantitative 0, 1 so, regression form on the models with the restricted

dependent variant be used. Among these models, the linear model (LPM) is one of the models that has some defects and so makes the use of it restricted. However, the models like profit and legit can grant the expectations of the research. One of the easiest and largest models with restricted dependent variant is the logit model. The guide of this model is due to this fact that the used formula for calculating the possible of choosing each selection has a closed form and it is open to simple interpretation. The logit model for considering the effect of explanatory variants on the dependent variant is shown as follows:

$$Y = X\beta + U \quad (1)$$

In this model the chosen variant observation dependent y, is calculated form the flow relation:

$$P_i = F(Y_i) = F(X, \beta) = \frac{1}{1 + e^{-X, \beta}} \quad (2)$$

And therefore the possibility of choosing the variant observation of dependent quantity is achieved by the following relation.

$$1 - P_i = \frac{1}{1 + e^{X, \beta}} \quad (3)$$

In the above relations, P and F represent the possible and the distributed associating function and are represent in the base of natural logarithm. In these models, the estimated coefficient can show the relation between the dependent variant and planetary variant but a better criterion and a better guide for determine the level of impact on explanatory variants on the dependent variant is the variant of final effect. Final effect shows the possibility of choosing number one on the possibility of unity of the selected choice instead of a mutation unit in each variable. The calculation of the final effect should be done in a definite number of the explanatory variables and for calculating the final effect we can use from the average of an explanatory variable. It means that the mount of final effect should be calculated from the dependent variable [20].

For calculating the final effect of each dependent variable in logit model, the following model is used:

$$MF_{x_i} = \frac{e^{x\hat{\beta}}}{(1 + e^{x\hat{\beta}})^2} \hat{\beta}_i \quad (4)$$

For calculating the final effect of each explanatory, at first, we should put the average of the variables in the estimated function and then we should calculate the total explained sentences of the ($\hat{x}\hat{a}$) model and by putting in the above relation the resultant effect of each explanatory variable should be calculated in the logic model. If the matrix of explanatory variables contains the figurative variable too, so the final is calculated. Effects are not suitable in the average of the figurative variables because, possibly the amount of average of the figurative variables is not equal to any of the observed number of this variable (zero or one).

One of the best ways for solving this problem is the final effects of the figurative variables which should be calculated in a definite number of figurative variables (for example zero or one) as if the connected variable be fixed in the number of their averages. Therefore, the following relation calculates the final effect of the figuration variable.

$$\Delta = \Phi(\bar{x}\beta, d=1) - \Phi(\bar{x}\beta, d=0) \quad (5)$$

In most of the studies in Iran and in the world in general, for estimating the binary choice models the classical method is used from the minimum ordinary squares in the past and the maximum correction [19]. Supposing that the possibility of adoption technology follows from the logistic distribution and it is a function of the personal, social and farming farmer then logit model is used to examine the effect of different factor, on adoption of the technology as follows in this equation:

$$T_i = \beta_0 + \beta_1 EDU + \beta_2 EXP + \beta_3 AGE + \beta_4 OACT + \beta_5 PEC + \beta_6 FRS + \beta_7 PRP + \beta_8 SSAB + \beta_9 SSAN + \beta_{10} WCRP + \beta_{11} NGHT + \beta_{12} INSUR + U_i \quad (6)$$

Thus, in this relation:

Ti: The variant which represent the Combinat technology and if the farmers use from the new type of seed planting so number one, except this one, we will choose zero.

EDU: Represent he farmer level education. In most of the studies done recently it has been considered as the explanatory variable and in most of the studies its effect on adoption of the positive technology and in some of them have achieved the negative effect [3-4, 16-17, 25-26, 30, 38, 40]. The method of considering

this variable is the number of the education year and in the present study, this variable has been considered in the form of second and according to the farmer's education year.

EXP: Represents the farmer's year number experience in the field of farming. This variable too, has been done in studies of money and has been considered one effective variable in adoption the technology by the farmer [15, 24, 35, 39].

AGE: Represent farmers and this variable, in most of the studies, has been considered as an effective variable in adoption of the technology by the farmer.

OACT: Represents the figurative variable of activity out of the farm. This variable has been used in some part of the studies and has achieved 0 as an effective factor in the adoption of the technology [12, 16, 42]. In case of the farmer have job except agriculture and except this can choose zero.

PEC: The use of promotional services, which includes the farming promoter's guidance's, promotional assistance and shows the observer engineer. The promotional service in most of the recent studies as one of the most effective variables has been used in adoption the type of used technology [13, 23, 28, 33-34, 37]. This variable has been stated as a used figurative variable or unused.

FRS: Is the level under cultivation according to hectare. The level under cultivation can be used as a variable in accepting the mechanical technology. It is expected that if the level of under cultivation be higher leads to more use from mechanical technology [4, 17, 25, 38].

PRP: Shows the farmers type of passion to be the owner of the land and this variable is chosen as one value, except zero.

SSAB: The figurative variable shows the type of the soil issue in the event that the issue be light and in this condition is equal to one. If not so will be equal to zero.

NCRP: The number of the cultivated yields as an index for variation in the cultivation and controlling the risk of producing.

Table 1: Categorizing the power of anticipation the model of adoption the Combinat technology

Samples	Adoption	Non-adoption	Type of anticipation
85.51%	91.67%	71.43%	Correct
14.49%	8.33%	28.57%	In correct

NGHT: The number of pieces of land has been chosen as an index for land diffusion and it is expected that in the event that the lesser number of pieces would have accompanied the adoption of mechanical technology.

INSUR: It defines whether the cover farmer is insured. In literature, the insurance of yields production is the cover of insurance by providing a confidence for farmer for getting a safe income against the dangers which are harmful for his income and increases his tendency for accepting the new technologies [32, 41] and if the farmer is insured then the number of the variable would be one and in exceptional cases it would be zero. For testing the power of anticipating the model used it is shown that the anticipation technology out of the sample, at first the sample accidentally divided into two sub samples: one of them is the estimated sample and the other one is the anticipation sample.

These samples orderly contain 80 and 20% of general observation again all of the models have been estimated by the estimated samples and then the anticipation is done according to the anticipation sample. Anticipating out of the sample is more than the conductive anticipation estimated sample. By the use of LIMDEP software for estimating logit model the examination of the effective factors in adoption the Combinat technology by the farmers in Marvdasht in the south of Iran, was considered.

RESULTS AND DISCUSSION

The Table 1 shows the obtained results from the logit model. As you can see just the farming recording variable and none farming activities in less than 10% is meaningful from a statistical point of view. Nevertheless, it seems that the examination is necessary, because of the effect of the entire variable in the estimating model. Hence, the age variables, personal property, the number of the products for cultivation the number of pieces, the use of development services in estimating Table 1 have positive relations with the adoption of Combinat technology and the rest of the variables are negative so, the symbol of personal property variables, development services and insurance is similar to expecting. That is to say that the farmers who are the owners of the land, which is under cultivation of wheat toward rental revenue, are more attached though in adoption of Combinat technology.

Services could be useful by giving the necessary information to the farmers to guide them in using this technology. Insurance, which in related literature, is the factor of prevalence over the risk of production is able to motivate the farmers to accept the new technologies and the positive effects in adoption of Combinat technology have been shown. Regardless of decreasing the number of pieces as an index of being a land more integrated and decreasing the variety of yields as an index of the farms being more specialized should lead to adoption of the mechanical technology such as Combinat. However, the direct result of this effect has been unexpected otherwise, by increasing the level under cultivation there is expectation of adoption of mechanical technology and the result from estimating the model of this study shows the offensive side of it. The light and heavy issue of soil towards the average type has negative effects in the adoption of Combinat technology, since the common issue of the area is light. It seems that the farmers who were deprived of those types of issue which have more tendencies toward the use of this technology for decreasing the cost of their production. Table 2 show that the record of farming activity has a negative and meaning full effect in adoption Combinat technology. Meaning that by increasing the record of farming activity tendency toward the use of this mechanical is decreased from technology – otherwise by increasing the increased tendency toward this technology.

The offensive sign of these two variable shows that among the farmers the older population sample is not area son for more record and more record leads to became less. The use of deviation of the common technology with this respect that the farmers avoid the risk and avoid using the old technologies which they have experienced for planting the wheat, otherwise for developing this technology we can be hopeful of the farmers' cause and this point is also true about the farmers' literacy. As the information contained in Table 2 states that, more farmers who have less literacy have more tendency toward the Combinat technology of seed planting. In addition, the farmers who are busy farming full time had fuller tendency toward the use of Combinat technology.

In general, we can say that the farm characteristics and farmers' personal characteristics could not put the expected effect on adoption of the Combinat technology in the record of farming activity has a meaningful effect in preventing the acceptance of technology and none deviation from the old methods and instead such factors as promotional services and insurances encourage the farmers to accept Combinat mechanical technology [39-47].

Table 2: Effect of variables in possible adoption of mechanical technology Combinat.

Variable	Description of variable	Coefficients	Standard Error	t-ratio	P-Value	Final effect
Constant	Variable title	1.95476	3.30656	0.591176	0.554402	0.000478
AGE	Constant coefficient	0.0490994	0.0711819	0.689774	0.490337	0.000012
EXP	Age	0.138303-	0.0688669	-2.00826	0.0446157	-0.000034
EDU	Experience	-0.0633688	0.15113	-0.419299	0.674998	-0.000015
OACT	Education	-1.74386	0.987985	-1.76507	0.0775523	-0.000645
PRP	Work out of farm	1.05046	1.29081	0.813798	0.415761	0.000415
FRS	Type of possession	-0.103	0.121357	-0.853849	0.393189	-0.000025
NCRP	The level under cultivation	0.369701	0.620714	0.595605	0.551439	0.000090
NGHT	The number of production under cultivation	0.0547328	0.392475	0.139456	0.88909	0.000013
SSAB	The number of pieces	-0.29421	1.46093	-0.201385	0.840397	-0.000079
SSAN	The tissue of light soil	-0.610598	1.57244	-0.388313	0.697784	-0.000190
PEC	The tissue of heave soil	0.318462	0.567649	0.56102	0.574784	0.000078
INSUR	The use of promotional services	0.289255	1.35272	0.213833	0.830678	0.000076
The number of observation	McFadden	0.50397				
	Ben-Leman	0.80744				
	Cramer	0.54524				
	Chi-squared	42.73737				
	Log likelihood	-42.4007				
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For determining the effect of variables in possible adoption of mechanical technology Combinat, the final effect has been calculated in the Table 2, so by one-year increment in the farmers record the possible of adoption technology decreases up to 0.000034%. Furthermore, the farmers who do some other work except farming, the possibility of adoption of technology by them decreases up to 0.000645. With respect to these coefficients, other variables are not measuring fully statistically and so the interpretation of final effect result is not possible for them.

Table 1 shows the result of anticipated categorizing of adoption technology and it is observed that 71.43% of non-adoption anticipation and 91.67% of anticipation adoption of Combinat mechanical technology is correct. According to Table 2, the power of anticipating in the whole of the sample is equal to 85.51% and so it is suitable power anticipation.

According to the obtained information, we can get to this result that in the case of giving promotional services to the farmer about informing them of the advantages of using mechanical technology in planting seeds by the Combinat method we can increase the adoption of mechanical technology in the area. Therefore, the following suggestions are given:

- Since farmers personal and farming factor had unexpected and meaning less affect in adoption this technology by farmer, Therefore, it is suggested that

the required investing be done for increasing the promotional services as the motivating factor for developing the use of the Combinat method.

- By more activity, the insurance box of the yields provides the required field for encouraging the farmers in the adoption the new mechanical technology for planting seed by the Combinat method.
- By encouraging the farmers to work full time in the farm and by informing farmers about the advantages of incrementing the use of planting seeds by the Combinat method provides sufficient field for increasing the income via adoption of this technology.

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