A STUDY OF ECONOMIC, SOCIAL, AND INSTITUTIONAL FACTORS AFFECTING THE ADOPTION OF THE HIGH-RANK WHEAT SEEDS

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ABSTRACT
The aim of this research is to investigate the effect of economic, social and institutional factors on adoption within the national program for the propagation of high-rank seeds of wheat crop. 170 questionnaires were collected, 50% of them were participants in the program from Wasit and Babil governorates. Probabilistic regression models were used to know this effect, and the possibility of adopting Farmers of improved seeds produced from the national program for the multiplication of seeds of higher grades using the (ADOPT) program. The adoption rate was 0.12%, and the total number of adopters were 12 farmers, at a rate of 14.2%. Tobit model was estimated to find out the impact of the profitability of the dunum, capital, farm size, education, type of tenure, and the number of adoption cycles expressed by 1 in the case of adoption and 0 otherwise. It was found that the increase in the size of the farm and the profitability of the dunum by one unit, the probability of adoption will increase by 5.6 and 2.3, respectively. The results of the ADOPT analysis showed that after the first (5) passes after the launch of the program's seeds and the farmers' knowledge of its existence, the adoption rate is expected to reach about (90.9%) of farmers, and reaching the top of adoption, which reaches about (95%) of farmers, requires a period up to about (7.4) years. The size of the initial cost of the investment in relation to the potential annual returns from the use of the technology: The size of the initial investment is (low) cost, the seeds produced from the program had a lower cost than the imported seeds and are competitive with them in quality, purity, and desirable genetic characteristics , so the cost the initial investment for these seeds is small compared to the expected return from the seed output.

Keywords: tobit model , seed multiplication, tenure, comparative advantage of technology.
*Part of M.Sc.Thesis of the 2[ed] author.

دراسة العوامل الاقتصادية والاجتماعية والمؤسساتية المؤثرة في تبني الرتب العليا من بذور القمح

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المستخلص

هدف البحث الى معرفة تأثير العوامل الاقتصادية والاجتماعية والمؤسساتية في التبني ضمن برنامج أكثار بذور الرتب العليا لمحصول القمح، تم جمع 170 استمارة , 50 % منها من المشتركين في البرنامج من محافظتي واسط وبابل، استخدمت نماذج الانحدار الاحتمالية لمعرفة هذا التأثير، وتم التنبؤ بإمكانية تبني المزارعين للبذور المحسنة المنتجة من البرنامج الوطني لإكثار بذور الرتب العليا باستعمال برنامج (ADOPT)، بلغ معدل التبني 0.12 %، وان عدد المتبنين كليا بلغ 12 مزارع بنسبة 14.2%. قدر انموذج Tobit لمعرفة تأثير ربحية الدونم وراس المال وحجم المزرعة والتعليم ونوع الحيازة وعدد الدورات في التبني الذي عبر عنه 1 في حال التبني و 0 خلاف ذلك. تبين منه ان زيادة حجم المزرعة وربحية الدونم بوحدة واحدة فان احتمالية التبني ستزداد بمقدار 5.6 و2.3 على الترتيب، اظهرت نتائج تحليل ADOPT انه بعد مرور (5) الاولى بعد اطلاق بذور البرنامج ومعرفة المزارعين بوجودها فانه يتوقع ان تصل نسبة التبني الى نحو (90.9%) من المزارعين، ويتطلب الوصول الى قمة التبني والذي يصل الى نحو (95%) من المزارعين مدة زمنية تصل الى نحو (7.4) سنة. حجم التكلفة الأولية للاستثمار بالنسبة الى العوائد السنوية المحتملة من استعمال التقنية: يكون حجم الاستثمار الأولي (قليل) الكلفة،ان البذور المنتجة من البرنامج تكون كلفتها اقل من البذور المستوردة وتكون منافسة لها بالجودة والنقاوة والصفات الوراثية المرغوبة، لذا فان كلفة الاستثمار الاولي لهذه البذور تكون قليلة مقارنة بالعائد المتوقع الحصول عليه من ناتج البذور .

الكلمات المفتاحية: انموذج تويت. اكثار البذور، الحيازة، الميزة النسبية للتقنية.

*البحث مستل من رسالة ماجستير للباحث الثاني.

INTRODUCTION

The acceleration of adoption technologies is a major requirement to enhance food security, increases the agricultural productivity and reduce poverty, especially in economically poor societies . The widespread reliance on improved agricultural technology, especially in developing countries, is seen as important pathways to increase productivity, and this in turn enhances sustainable production, food security and economic development. The adoption of these technologies must be compatible with the objectives of the agricultural administration to maximize the farmer's profit and increase his income and be framed in the strategy of directing resources to produce strategic crops, and based on the foregoing, the Ministry of Agriculture noted that seeds and their development depend on food security greatly and that they are one of the important elements in the livelihoods of communities In addition, the development of the seed sector is a necessity to support the development of agriculture (11). So it adopted a program increase to multiply the seeds of the higher ranks of the wheat crop in 2017, to produce seeds of the higher ranks (the kernel, And the basis) of the high quality of the distinguished varieties of wheat, by controlling the quality of the production of the seeds of the highest ranks in the research stations of the government sector through their production and increasing and making them accessible to farmers (4), and this is done through the multiplication of the seeds under the standards of maintaining the purity of the genetic variety and free from diseases, bush seeds and seeds of other crops, as well as ensuring the germination of seeds at a high rate, as it was propagated through 35 research stations affiliated to both the agricultural research department and the ministry of agriculture, The seed technology, the wheat development program, the seed inspection and certification department, and the extension schools of the Agricultural Extension Department and the Department of Desertification included 18 varieties, knowing that they are the genetic assets of seeds and cannot be valued at a price. Then they were marketed to farmers through the Mesopotamian Company and the Iraqi Seed Company. Despite the application of the program, however, the assimilation of these techniques is still different from the results of scientific research, and the reasons for not fully adopting these techniques have not been determined because economic and social factors play a role in adopting this technology, therefore our research and aims to study the impact of these factors . The importance of the study comes from two main points: First: that seeds are a national treasure that cannot be valued at a price and must be preserved. Cornerstone and its prominent role in sustainable rural development, investment in and adoption of these technologies can help improve productivity by producing appropriate technologies that reduce production constraints. Also, investments in these technologies are usually costly and subject to risk (17), and require long time until the desired returns are achieved. The second: that wheat cultivation and production take priority from the attention of the leadership and planners of the agricultural sector, and that achieving self-sufficiency in this crop (which reached 61.9% in 2018) represents a strategic goal that agricultural policies in Iraq seek to achieve, as it is linked to the nutrition of the population, as the annual consumption rate for Iraq is approximately (4.5) million tons, and its importance for the local product on the other hand, as the wheat crop is planted in large areas, reaching approximately 43% of the annually cultivated area in Iraq and 50% of the area of grain, as the cultivated area of it in 2019 amounted to about 6331 thousand dunums, and it is one of the cash crops = that constitutes a major part of the net farm income (4) .The problem of the study is a decrease in wheat productivity in 2019 by (-0.6) compared to 2018, despite the increase in the cultivated area by 100%, this productivity was 686.1 kg/dunum , which is low when compared with other productions, This decline made Iraq import 1.37 million tons, and with the high costs of production, it represented a challenge for farmers, especially smallholders, and it reflects the lack of quality of production elements, including seeds, as their productivity deteriorated, and if they were available, their prices were high, which prompted the farmer to rely on traditional varieties, and it can be said that Failure to adopt an effective seed

system and the absence of investment programs in assets, the wheat crop did not contribute to a significant increase in income. The study aims to determine the economic and social factors that affect the adoption and intensity of adoption of higher ranks, to analyze the determinants of the adoption behavior of farmers. And predicting the rates of adoption of the studied techniques using the ADOPT program

MATERIALS AND METHODS
To meet the requirements of the research and achieve the objectives of the research, the national program for the multiplication of higher rank of wheat seeds applied by the Ministry of Agriculture was targeted. Data were collected from 85 farmers who participated in the program, 28 farmers representing 50% of the program participants in Babil Governorate, and 57 farmers in Wasit Governorate, representing a percentage of 22% of those who deal with the program are in the governorate. To find out the effect of economic, social, and institutional factors affecting adoption, probabilistic regression models were used, while predicting the possibility of farmers adopting improved seeds produced from the national program for the multiplication of higher-rank seeds using the ADOPT program (15).

RESULTS AND DISCUSSIONS
First: The level of adoption in the research sample will be found and the extent to which the seeds of higher ranks are adopted, and the most important factors affecting the level of adoption (the research sample) will be analyzed using the qualitative response model (Tobit (5,1)☐ as long as the dependent variable (the adoption level) A qualitative (descriptive) variable, because the regression analysis using the OLS method gives estimates of the model parameters that are not efficient and will not be useful in analysis, prediction or prediction of results because this type of regression and due to the nature of the qualitative dependent variable will lead to the emergence of the problem of instability of homogeneity variation and the problem of linear correlation between explanatory variables, and as it is known about the adoption process(9), it is a behavior or a decision-making process to reject or accept a

new adoption of a new technology by individuals, groups or organizations since hearing the idea until making a final decision ,and since there are several indicators of adoption, and these indicators are:
1 -Adoption rate: the percentage of farmers who use the technology
2 -Degree of adoption: the percentage of land used for the technology
3- Adoption intensity: It is measured by multiplying the adoption rate by the degree of adoption
Before conducting any analysis and estimating the model of factors affecting adoption, it is necessary to review some indicators (18). Through which adoption can be evaluated, including the adoption rate, which is the percentage of farmers who adopt the national program for the multiplication of seeds of higher ranks in a community The sample, as indicated in Table 1., indicates that the adoption rate has reached (0.272), which is the result of the number of farmers who adopted the program divided by the total number of farmers. It came with this value, and it is weak because the number of farmers is more compared to the number of adopted farmers. As for the degree of adoption, it was, Its value was (0.559), which is the result of dividing the area planted with the program's seeds by the total area in the sample. The adoption density was calculated because of the product of multiplying the adoption rate by the degree of adoption and its value was (0.152). As well as to the low incomes of some farmers and the small holdings, and it requires an intensive effort by a specialized advisory body in the program to spread the idea of adoption and crystallize it among qualified farmers. (12).

Table 1.Adoptionindicators.

Pointer	Value
Adoption rate	0.272
Degree of adoption	0.559
Adoption density	0.152

Source: Researchers work with E-Views 9

It is necessary to know the degree of adoption of farmers in the same national program to multiply seeds of higher ranks, as farmers did not adopt the program within their total holdings and adopted it in part of their holdings . On this basis, the degree of adoption was calculated, which was found by dividing the program area by the total area of the farms,

as shown in Table 2. The number of farmers who made simple adoption amounted to 20%, in the same context, the percentage of partially adopters reached 65.8% of the sample size of the study, 56 farmers in the sample, while the total adopters reached 12 farmers, or 14.2%, who are the farmers who fully adopt the program and this it is clear from Table 2. the discrepancy in percentages is attributed to their failure to obtain seeds from one season to another, or the rejection of the agricultural field by the farmer due to his non-compliance with the conditions that must be met in the field within the program's controls, including the percentage of bushes in the field or failure to germinate to other reasons (19).

Table2. adoption rate

Adoption type	Number of farmers	%
Simple adoption	17	20
Partial adoption	56	65.8
Full adoption	12	14.2
Total	85	100

Source: The work of the researcher based on the survey form

Before going to the qualitative response model, and to know the factors affecting adoption, the variables must be described

Description of variables

Table 3 shows a description of the variables included in the qualitative response models, which were the most important factors affecting the qualitative dependent variable (the level of adoption), which is supposed to have an expected effect on it. The model included six illustrative independent variables (capital, profitability of a dunum, farm size, education, type of tenure, number of Courses) including qualitative (ordinal) and quantitative (3) variables, noting that there are other variables that have been tested and then excluded because they affected the statistical indicators of the model, including family size, seed price, age and distance to agricultural extension departments.

Table 3. Description of variables

Variable	Variable type	Description
Adoption	qualitative	Qualitative variable the variable shows the level of adoption at the level of the study sample or non-adoption.
Economic variables		
Capital	Quantitative	Quantitative variable, the amount of capital available to the farmer
Donum profit	Quantitative	A quantitative variable is the amount of profit realized from one dunam. It was calculated by the revenue subtracted from the cost per dunam and estimated in dinars
Farm size	Quantitative variable	It is a quantitative variable measured in dunams and it expresses the farmer's holding
Social variables		
Education	Ordinal	It is an ordinal variable that took the following values below the elementary level (illiterate) took a value (1), while farmers who are at an elementary level took values (2) as well as farmers whose academic achievement took an average level (3), while those with a preparatory school level took a value (4) While the farmers who are at the diploma level took a value of (5) and in the same context the farmers who are at the university level took a value of (6) and as in the lower (1) Illiterate (2) Elementary (3) Medium (4) Preparatory (5) Diploma (6) college
Type of tenure	Ordinal variable	It is an ordinal variable that took the following values: rent took its value (1), while the possession formula for the pattern took a value (2), and at the same time, the possession formula took a value contract (3), which is as follows (1) rent (2) Property (3) contract
Institutional Variables		
Number of courses	Quantitative variable	It is a quantitative variable that shows the number of courses attended by the farm manager

Source: The researcher's work based on the survey form

Statistical description of the model variables: Table 4 shows the statistical description of the model variables, as the average profitability of a dunum was (401413), and the average level of capital was (67,306.917, with an arithmetic average for the size of the farm, which amounted to 409) dunums, and for the level of education it reached (3). The maximum profitability of a dunum is (984531) dinars per acre, while the minimum amounted to (-135600 per acre. In the same context, the maximum capital amounted to (765,000,000) dinars, while the minimum capital reached (744,000) dinars, while the kurtosis of the profitability of one acre was (2.62089) per acre, and the kurtosis

of the capital amounted to (14.46) dinars. 2.009), as for the test of the normal distribution (Jarque-Bera), its value reached (3,593478) for the profitability of one acre, in addition, the value of the test reached (1209.236) for the capital, while its value was in relation to the size of the farm) 944,448) and for the level of education, the value was taken (12.84471), and the value was taken (10.28536) for the tenure pattern, as well as for the number of courses, its value was (217,87766). As for the probability, it was (0.165839) for the level of education (0.001625) and for the type of tenure (0.005842), which means that most of the variables are distributed normally.

Table 4. Statistical description of the model variables

	Donum profit	Capital	Farm size	Education	Type of tenure	Number of courses
Mean	401413	67306917	409	3	2	1
Median	397421	18360000	100	3	2	0
Maximum	984531	765000000	4000	6	3	10
Minimum	-135600	744000	5	1	1	0
Std. Dev.	210127.1	121000000.00	728.19	1.601	0.724	1.972
Skewness	0.302736	3.18	3.02	0.459	-0.301	1.897
Kurtosis	2.620896	14.46	12.88	2.009	1.952	7.067
Jarque-Bera	3.593478	1209.236	944.448	12.84471	10.28536	217.8766
Probability	0.165839	0.0000	0.000	0.001625	0.005842	0.000

Source: Researcher's work using EViews 9

Application of hypotheses using qualitative response models: To use qualitative response models (Tobit model) to analyze the most important factors affecting adoption at the level of the research sample, it is necessary to apply the hypotheses of using these models (9), and among what these hypotheses include is that no there is a complete correlation between the explanatory variables with each other, as the variables that have a complete correlation between them must be deleted, and after the correlation test between the six explanatory variables included in the

qualitative response models. (Capital, dunum profitability, farm size, education, type of holding, number of courses) in addition to the hypothesis that there is no correlation between random error and explanatory variables, as well as the extent of the relationship between them and random error using Eviews9 program Results As shown in Table 5, there is no correlation between the explanatory variables with each other and between them and random error, knowing that all other hypotheses showed their conformity to the use of these models.

Table 4. Matrix of correlations between explanatory variables

	Profit_D	K	Farmsize	Education	Land_ Ten..	T_C_
Profit_D	1.000000	0.301295	0.285096	0.035834	0.256725	-0.018650
K	0.301295	1.000000	0.847117	0.135829	0.183887	0.111771
Farmsize	0.285096	0.847117	1.000000	0.159901	0.187495	0.063999
Education	0.035834	0.135829	0.159901	1.000000	-0.047142	0.336362
Land_ Ten..	0.256725	0.183887	0.187495	-0.047142	1.000000	-0.103218
T_C_	-0.018650	0.111711	0.063999	0.336362	-0.103218	1.000000

Source: Researcher's work using EViews 9

Estimating the analysis of factors affecting adoption using the Tobit model

Tobit model: This model is an expansion of the Probity model, which is used when the

dependent variable is qualitative, contains zero and continuous values, and has more than one formula taken by the logarithmic probability function depending on the nature of the dependent variable, and based on the results of

Table 5 which was made by determining the observations of the qualitative dependent variable that takes the value of (1) In the case of adoption, amounting to (85) observations by adopters and taking the value of (0) and of (85) observations by non-adopters, as for the independent variables affecting the qualitative dependent variable, some of them were quantitative and the other qualitative (ordinal) and included the variable (capital Dunum profitability, farm size, education, type of tenure, number of courses). The model was estimated using EViews 9 program and the method of greatest possibility as shown in Table 5.

Table 5. Tobit Model.

Variables	Parameters	Z	Pro.
Capital	1.82	2.58	**
The profitability of the dunum	2.34	8.21	**
Farm size	5.66	0.48	
Education	0.05	1.51	*
Type of tenure	0.03	0.53	
Number of courses	0.07	2.38	**
C	-1.04	-5.51	**
Mean dependent var	0.49	Log likelihood	-115.32
NO Adopit, n=85	Akaike info	Hannan-Quinn	Schwarz
Adopit, n=85	criterion=1.459.	criter.=1.519.	criterion=1.607

Source: Researcher's work using EViews 9

Estimation and interpretation of the parameters of the Tobit model: Capital: an independent quantitative variable, and the sign of its positive parameter is identical to the economic logic, so the relationship is direct between the capital variable and the level of adoption (the descriptive dependent variable). Thus, an increase in capital by one unit leads to an increase in the probability of the adoption level by 1.82 With the stability of the rest of the other factors included in the model. The profitability of the dunam: an independent quantitative variable, and its positive parameter appeared in conformity with the economic logic, that is, the direct relationship between it and the qualitative dependent variable (adoption level). 2.34 With the stability of the rest of the other factors included in the model, and this explains the role of the profitability of the dunum in enabling the project owner to use modern scientific methods to manage the project of producing higher grade seeds (16). The size of the farm: an independent quantitative variable, and the sign of its positive parameter appeared in conformity with the economic logic, so there is a direct relationship between the variable of the size of the farm and the level of adoption (the descriptive dependent variable). 5.66 with the stability of the rest of the other factors included in the model (14). Education level: an independent ordinal variable, and its positive parameter appeared in conformity with the economic logic, that is, the direct relationship between it and the qualitative dependent variable (adoption level). 0.05 with the stability of the rest of the other factors included in the model, and this explains the role of the level of education in enabling the project owner to use modern technical methods to manage the project of producing seeds of higher ranks and his preference for new ideas (10). Tenure type: an independent ordinal variable, and the sign of its positive parameter appeared in conformity with the economic logic, so the relationship is direct between the variable of tenure type and the level of adoption (the descriptive dependent variable). This leads to an increase in the probability of the adoption level by 0.03 and this qualifies the farmer to adopt the seed production activity within the national seed multiplication program, because the type of tenure creates a kind of tenure security so that when the farmer has a type of ownership, he is more likely to adopt. The number of courses: an independent quantitative variable, and the sign of its positive parameter appeared in conformity with the economic logic, so the relationship is direct between the variable number of cycles and the level of adoption (the descriptive dependent variable). 0.07 by farmers for the activity of seed production and the use of modern technologies, with the

stability of the rest of the other factors included in the model.

Statistical tests

1 -Wald. Test

Table 6 is explained. The results of the Wald statistic test that follow the distribution of $x2$ at the degree of freedom (6) df and showed the regression parameters of the Probity model with significance (0.000> (0.05). The model included in the model has a significant effect on the probability of the dependent variable (adoption).

2 .Test the accuracy of axial shape (ellipse) Confidence Ellipse

The Ellipse oval accuracy test at a confidence score of 1.95 was used to measure the ability of the Tobit model to distinguish between the probabilities that have the adoption trait and the probabilities that do not have that trait. Chance Diagonal indicates that the Tobit model has a discriminatory ability to distinguish between the probabilities of the qualitative dependent variable for the probability of adoption or not, and this means accepting the alternative hypothesis H1, and thus the model can predict the probabilities of the qualitative dependent variable.

Table 6. Wald Statistical Test for T Model Parameters

Probability	Value	Test St.
0.0000	18.848	F-Sta.
0.0000	113.09	Chi- Square

Source: Researcher's work using EViews 9

Second: Predicting the possibility of farmers adopting the improved seeds produced from the national program to multiply the seeds of higher grades using the ADOPT program: To assess the rate of farmers' adoption of the program's seeds, and to determine the time required to reach the top of adoption and the highest percentage that the number of farmers who adopt the program's seeds can reach, and to identify the main obstacles that limit the adoption process, the ADOPT program was used for this purpose (3). The program represents a tool for predicting the results of adoption and disseminating the results of adoption, and this program predicts the percentage of targeted farmers who may adopt this activity over time. The methodology of Focus Group Discussion (FGD) was used and information about the program was obtained (ADOPT) through the

participation of a group of seed producers and specialized technical researchers to answer a set of focused questions of (22) questions. (7).

Analysis of farmers' responses to ADOPT questions: The method of ADOPT in obtaining data and answers to the questions included in the program came with a new approach that differs from what we have learned from the methods of obtaining data in an individual way for farmers, as it is based on the principle of participatory opinion and giving answers to the questions raised. The farmers, in the presence of specialists in the field of seed production, were asked to express their opinions and beliefs about the answer that expresses their reality and their goals in the production process, so that the program, through those answers, can identify the trends of the targeted farmers and how their reaction to any modern technology is different from what Get used to it from traditional methods. The farmers' acceptance and speed of response to adopting this technology may be directly without hesitation, or they may face some difficulties in accepting it, or it may not be accepted at all. The program depends on analyzing the behavior of the society to reach a general conclusion about the extent to which society accepts this technology and how much time it takes for this technology to spread in that society and whether it will be popular with them or not. In our study, the targeted technology is represented by the improved seeds produced by the national program for the multiplication of the seeds of the higher ranks of the wheat crop in Iraq through its research and production activities that have reached to sustaining and improving the quality and quality of local seeds and producing improved seeds that compete with imported seeds in terms of quality and the stability of productivity rates over time. A representative sample of the study community was selected from farmers who adopted those seeds and a group of farmers who did not adopt them to find out the extent to which the community accepts the adoption and use of the program's seeds in the production process, and how long it takes for those seeds to reach the top of adoption in society□) (6). The results of the ADOPT analysis showed that after the first (5) lapses after releasing the program's seeds and

the farmers' knowledge of their existence, it is expected that the adoption percentage will reach about (90.9%) of the farmers, and reaching the top of the adoption, which reaches about (95%) of the farmers, requires a period of time It reaches about (7.4) years, and these percentages are very acceptable in adoption studies and that the adoption of this technology is fast if compared with other techniques, but with this achieved result, the logic dictates that the time period to reach the top of adoption is less than this The duration, especially since the seeds produced by the program are already known to the farmers, but improvements were made to them and re-perpetuated to restore the original qualities of those seeds after they were worn out over time and mixed with other varieties and bush seeds that contributed to reducing their productivity rates. The reason behind the delay in its adoption can be attributed to the presence of imported seed varieties, which give high productivity rates in the first years of their cultivation, and which do not exceed more than two productive seasons, but the Iraqi farmer seeks quick profit regardless of the costs and the high purchase price of those seeds and the lack of awareness among The farmer said that the program's seeds are characterized by their stability, purity and low price compared to the imported ones. All of this can stand in the way of the speedy adoption of the program's seeds, which requires a period of time until farmers are convinced of its economic feasibility compared to the seeds they use, which can be achieved through field observation and the experiences of nearby farmers And other means of guidance and awareness. Table (64) shows the expected adoption levels according to the analysis of the ADOPT program.

Table 7. Expected Adoption Levels

Adoption levels	Expected results
Expected years to peak adoption	7.4
Expected Peak Level of Adoption	95%
Expected adoption level after the first 5 years	%90.9
Expected adoption level after the first 10 years	95%

Source: ADOPT analysis results

A detailed discussion of the main indicators for adopting the activity of the national program for the multiplication of seeds of higher ranks will be addressed, after analyzing the answers of the 85 farmers who were targeted by the questions of the ADOPT program, as shown in Table:(8)

First: The comparative advantage of farmers: The program has (six) questions that review the following. The comparative advantage of farmers attempts to determine whether the advantage that farmers can benefit from the activity of the national program for the multiplication of seeds of higher ranks is sufficient to encourage farmers to technology adoption or not, the extent to which farmers' decisions are responsive to maximizing profits, the level of society's desire to reduce risks and short-term financial constraints, and knowledge of farmers' decisions and whether they were motivated by environmental protection (8).

•Proportion of targeted farmers who have a strong desire and motivation to maximize profit: the majority have a strong incentive to maximize profit. The target sample are farmers who produce seeds, whose goal in the agricultural production process is often to trade, achieve profits and cover expenses in the following areas: Employment of hands employment, developing agriculture, improving income, improving living conditions. The percentage of targeted farmers who have a strong desire and motivation to protect the surrounding environment: the majority have a strong incentive to protect the environment in which they live. It was found through the questionnaire that all members of the sample have a strong motivation and motivation to protect the environment using environmentally friendly pesticides and reduce pollution, and that because of its direct impact on the agricultural sector.

•Proportion of farmers who have a strong desire and incentive to reduce risks: the majority have a strong incentive to reduce risks, the majority of sample farmers aim to reduce risk and uncertainty, especially wheat farmers, because the cultivation of this crop is mostly based on inherited methods of cultivation this crop, therefore, a change in the

methods of cultivating this crop is considered a risk by farmers according to their perception, and only a small group of farmers will offer it (12,21).

•Proportion of farmers' families who benefited from the activity of the national program for the multiplication of seeds of higher grades used in their main income: Half of the targeted families benefited from the activity of seed production in their main income, the improved seeds produced from the national program for the multiplication of seeds of higher grades have a role A significant increase in productivity rates, but seeds alone cannot achieve high levels unless the appropriate conditions are available such as fertile soil, water suitable for irrigation and the correct use of fertilizers and pesticides.

•Percentage of targeted farmers who have long experience (more than 10 years) in managing their farms: Half of the farmers have long experience in managing their farms. The target sample of seed producers is characterized by the nature of their commercial activity, as well as the administrative and institutional organization of these farms, which are often newly established. So, the answer was that half of the farmers had more than 10 years of experience.

•Percentage of targeted farmers who suffer from severe financial hardship in the short term: The minority of targeted farmers suffer from severe financial distress in the short term, as most seed producers rely in marketing their production on government agencies, and the state's delay in paying farmers' dues affects negatively on the ability of some producers to fulfill the production requirements and expenses in the following season. Which affects the possibility of introducing any improvement or development in their field of work.

Second: The ability to learn technology: It was found that the characteristics of the technology itself determine the ability of farmers to identify it, and three factors (questions) are used to determine this aspect of the adoption process, namely: the possibility of conducting small experiments with the technology, whether the technology requires complex changes in the technology. Agricultural land for implementation and control level or not.

Ease of testing the technology (or its components) on a limited scale before deciding to adopt it on a larger scale: it can be easily trialed (applied) and results can be obtained in one season, improved program seeds can be planted and tested on a small scale, and the farmer can determined on this scale whether or not those seeds used are compatible with his aspirations and goals from the production process, and whether or not adopting the use of seeds requires high costs that are not compatible with the expected return from them.. Therefore, the seeds can be tested in a small area of the land and the lowest costs.

•The complexity of the technology allows the evaluation of its effects easily when used: It is not difficult to evaluate the effects of the technology because it is an uncomplicated technology, it is not difficult to evaluate the effects resulting from the cultivation of improved seeds and the differences between them and the use of traditional seeds under the same conditions and management (13).

•The extent to which the technology can be observed (observable) by farmers who have not yet adopted the technology in their area: The activity of the National Program for the Propagation of Seeds of Higher Orders was (easy) to observe. It was easy to observe the effect of planting improved seeds in the field and even before harvest, from Through the homogeneity and consistency of plants in addition to other technical indicators such as the length and weight of the spike, the number of branches and other indicators that help in observing and recognizing the difference between the cultivation of improved seeds and traditional seeds (14).

Third: The learnability of farmers: There are four questions related to this aspect of adoption, which focus on the participation of the group in the community related to technology. The learnability relates to the characteristics of farmers that affect their ability to identify that technology and the extent Their access to information through guidance, as well as farmers' awareness of technology, which are as follows:

Percentage of targeted farmers who use agricultural extension for advice related to the technology used: The majority of farmers seek

advice from specialists, and that seed producers are distinguished farmers in their field of work, and this distinction is the result of their follow-up to technical and technical development in the agricultural sector, and that is from During their continuous contact with sources of knowledge, research and extension to gain experience and knowledge (20).

•Proportion of farmers who participate in working groups discussing agricultural processes related to the technology used: The majority of the targeted farmers participate in sessions to discuss agricultural processes related to the activity of multiplication of higher grade seeds, the majority of seed producers depend on acquiring knowledge about recent developments and everything related to the production process as a second source from the experiences of other producers and the information available to them, through gatherings and sessions that are held from time to time (12).

•Percentage of farmers who need to develop new skills and knowledge to use technology: The production of wheat seeds does not require a lot of skills and knowledge because wheat production is an inherited profession in Iraq since time immemorial, so the production of seeds requires little knowledge about the type and varieties of seeds used (cream cream)

• Percentage of farmers who have awareness and awareness to use or experience technology in their area: Half of the surveyed farmers had the improved seeds produced from the program, so they became aware and aware of applying the seed production activity in their area, due to the novelty of the program and the limited production quantities of seeds that It started with its production, as it cannot cover the local demand for seeds in Iraq, but over time it can reach this stage. as this activity is considered a technical innovation and it is usual for farmers not to trust the technology until its positive results appear for adoption by them. (2).

Fourth: The comparative advantage of technology: attaches the importance of the relative advantage of technology to the objective advantages of technology without considering the society's perception of technology, and its comparative advantage is evaluated through eight questions, which deal

with the following: the initial cost of implementation, the extent of technology reflexivity, and global change The profit for the farmer from technology, the time period required to change the profit, and whether the technology affects the reduction of risks to farmers during difficult conditions in different seasons, and what are the advantages and disadvantages of technology for the environment, what is the time required for environmental impacts to occur Note and what are the non-cash returns of the technology achieved for the farms.

•The size of the initial cost of the investment in relation to the potential annual returns from the use of the technology: The size of the initial investment is (low) in cost, since the seeds produced from the program have a lower cost than imported seeds and are competitive with them in quality, purity and desirable genetic traits, so the cost the initial investment for these seeds is small compared to the expected return from the seed output

•The extent of the reflectivity of this technology after its adoption easily: the technique is (medium) application and reflection, through the productivity rates achieved from planting the seeds of the program, as well as the high purity of the seeds produced from it, it is easy to reflect the effects of this technology on the income of the farmer and this improvement in the income of the farmer It pushes other farmers to search for the reasons for this improvement and to adopt those reasons. (3)

•The impact of the use of technology on the profitability of agricultural business in the years in which it is used: There is a profit advantage (average) in the years of using technology, due to the increase in costs, especially fertilizers and pesticides, either because of their quality or the increase in their price, these reasons affect in determining the rate of profitability verified by farmers.

•The extent of additional effects on the future profitability of the farm business as a result of the use of technology: There is a (large) profitability advantage in the future. The farmers' adoption of the program's improved, high-purity seeds over time contributes to the development of the seed production industry as well as to the improvement of wheat

production in Iraq, which leads to achieve self-sufficiency, export the surplus, and achieve profitable profits for farmers in the long run

•The period of time required for the first adoption of the technology in order to affect the achievement of future profitability: It requires a period of (1-2) years, that the trial of seeds for the first time by one of the farmers in the area is sufficient to be adopted by the rest of the farmers in the area or it may be delayed Some farmers are hesitant about the second season, but it does not take long to be adopted.

•To what extent will the use of technology have net environmental benefits or costs: Its use will have moderate environmental positives. The use of high-purity improved seeds reduces the use of pesticides and chemical control materials, which will have a positive impact on the environment and reduce pollution

•The period of time required for the expected environmental benefits (or costs) after the first adoption of the technology: it requires a period of (3-5) years, environmental improvements and their effects require a longer time to identify their effects, so the sample of farmers agreed that 3-5 years sufficient to determine the environmental impact of the use of improved seeds

•The impact of the use of technology on the exposure of agricultural businesses to risk: there is a (significant) decrease in risks, the improved qualities of seeds represented in their resistance to pests and diseases, drought resistance and the expected increase in productivity rates all lead to a reduction in the proportion of risk and uncertainty in adopting the use of technology. These seeds□ Therefore, farmers expect that there will be a significant reduction in the proportion of risk when using these seeds on a large scale.

• The impact of the use of technology on the availability of ease and comfort in managing the farm in the years in which it was used: The adoption of the activity of seed multiplication led to a significant increase in the ease of management. weeding and bush removal, as well as the homogeneity of the field contributes to reducing the percentage of loss, as well as the ease of carrying out the harvest process, and all this results in reducing the associated costs, as well as ease of control and management of the field. As a result, and for many other benefits, the use of improved seeds will contribute to achieving ease and convenience in farm Management

Table 8-a. Farmers' answers to ADOPT. Questions

First, the comparative advantage of farmers		
No.	The question	The answer
1	Percentage of targeted farmers with a strong desire and motivation to maximize profit	The majority have a strong incentive to maximize profit
2	Percentage of targeted farmers who have a strong desire and motivation to protect the surrounding environment	The majority have a strong incentive to protect the environment in which they live
3	Percentage of farmers with a strong desire and incentive to reduce risk	The majority have a strong incentive to reduce risk
4	Percentage of farming families who benefited from the technology used in their main income	Half of the targeted families benefited from the seed production activity as their main income
5	Percentage of targeted farmers who have long experience (more than 10 years) in managing their farms	Half of the farmers have long experience in managing their farms
6	Percentage of targeted farmers experiencing severe short-term financial distress	The minority of the targeted farmers are suffering from severe financial distress in the short term

Source: ADOPT survey form

Table 8-b. Farmers' answers to ADOPT. Questions

Second, the ability to learn technology		
No.	The question	The answer
7	Ease of testing a technology (or its components) on a limited scale before deciding to adopt it on a larger scale	It can be tried (applied) easily and results can be obtained in one season
8	The complexity of the technology allows its effects to be easily evaluated when used	It is not difficult to assess the effects of technology because it is an uncomplicated technology
9	The extent to which the technology can be observed (observable) by farmers who have not yet adopted the technology in their area	The activity of the national program for the multiplication of seeds of higher ranks was (easy) observation)

Source: ADOPT survey form

## Table 8-c. Farmers' answers to ADOPT questions

Third: the ability to learn among farmers		
No.	The question	The answer
10	Percentage of targeted farmers who use agricultural extension for advice on the technology used	Most farmers seek professional advice
11	Percentage of farmers who participate in working groups discussing agricultural processes related to the technology used	The majority of the targeted farmers participate in sessions to discuss the agricultural processes that are related to the activity of multiplication of seeds of higher ranks.
12	Percentage of farmers who need to develop new skills and knowledge to use technology	Wheat seed production does not require a lot of skills and knowledge because wheat production is a profession inherited in Iraq since time immemorial
13	Percentage of farmers who have the awareness and understanding of using or experiencing technology in their area	Half of the farmers surveyed had the improved seeds produced from the program, so they became aware and aware of implementing the seed production activity in their area.

Ref: ADOPT survey form

Table 8-D. Farmers' answers to ADOPT. Questions

Fourth: the comparative advantage of technology		
No.	The question	The answer
14	The size of the initial cost of the investment in relation to the potential annual returns from the use of the technology	The initial investment is (low) cost
15	How reflective is this technique after it is easily adopted	The technique is (medium) application and reflection
16	The extent to which the use of technology affects the profitability of agricultural businesses in the years in which it is used	There is a (medium) profit advantage in years of using the technology
17	Additional effects on the future profitability of the farm business as a result of the use of technology	There is a (big) profitability advantage in the future
18	The time required for the first technology adoption to affect future profitability	It takes 1-2 years
19	To what extent will the use of technology have net environmental benefits or costs?	Its use will have moderate environmental benefits
20	The time required for the expected environmental benefits (or costs) after first adoption of the technology	It takes a period of 3-5 years
21	The impact of the use of technology on the exposure of agricultural businesses to risk	There is a (significant) reduction in risk
22	The impact of the use of technology on the availability of ease and comfort in managing the farm in the years in which it was used	The adoption of seed multiplication activity led to a significant increase in ease of management

Source: ADOPT survey form
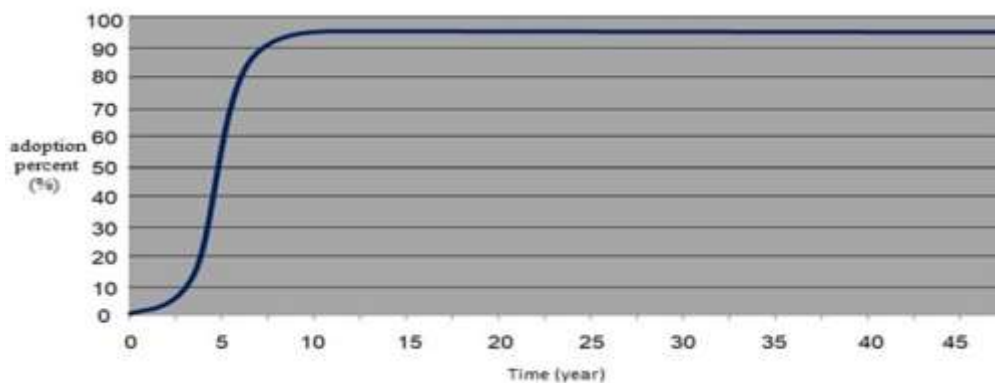
Figure 1. Level curve of seed adoption of the national program for multiplication of seeds of higher ranks

Source: ADOPT survey form

Sensitivity analysis: The sensitivity analysis expresses the extent to which each of the variables included in the program affects the adoption process, and the sensitivity analysis shows the most important variables that must be taken care of and provide the appropriate conditions to achieve the positive effects of these variables on the adoption process and how neglecting them and inappropriate conditions to achieve them will increase the duration ,the time required to reach the top of adoption, and the accuracy of the program in sensitivity analysis is to determine the time period in which each variable will affect the time required to reach the top of adoption,

negatively or positively. The sensitivity analysis for adopting the improved seed technique showed that the most important and most influential variables were as shown in Table 9:

Table 9. Factors affecting the level of adoption and the duration of reaching the top of adoption

Variable	Expected duration of impact/year
Short term financial constraints	1±
Limited ability to test	1.5 ±
The degree of complexity of the technology	1.5+
Technical Observability	0.5±
Develop technology-related skills and knowledge	0.6±

Ref: ADOPT program, based on the data of the survey

Looking at Table 9. We find that the variables vary in duration of influence among themselves on the time needed to reach the top of adoption. We find that the largest duration of influence was for the two variables (short-term financial constraints, ease of experimenting with technology on a limited scale, degree of technology complexity) by (1.5-1) years, so there is a need to pay attention to these two variables and make them a priority when planning to disseminate improved seed technology, by reducing the time period for impact by following a set of procedures, including the delivery of financial dues at the appropriate times to be able to cover the costs of production operations as well as Providing soft loans and other financing procedures. The second variable can be achieved by conducting field experiments in front of the farmers and in the fields near their farms to consolidate the farmers' belief in the feasibility of using these seeds and that the costs of planting and servicing them are appropriate to the capabilities of the Iraqi farmer and that if he wishes to test those seeds on a specific area of his land, he can do so at the lowest costs. As for the degree of complexity of the technology, it appeared with a positive effect that the improved seed technology is not complicated, and this variable can be taken care of by providing sufficient information to farmers about the improved seeds produced from the program and how it will reduce effort and costs in farm management. This can be achieved through training farmers and intensifying educational courses, and although wheat seed production does not require a lot of skills and knowledge because wheat production is a profession inherited in Iraq from time immemorial, it is necessary to keep pace with developments within this activity and to introduce technologies modern development. While the factors that were less influential to reach the top of adoption were the two variables (observability of technology, developing skills and knowledge of farmers), it is necessary to keep the period short or reduce it as much as possible for these variables through intensification of programs and plans that contribute to shortening the period required to reach the peak of adoption, which amounted to (0.6-0.5) years. Together, these variables are considered necessary and important for the successful dissemination and adoption of improved seed technology among farmers.

Figure 2. Sensitivity analysis of the response of variables to reach the top of the adoption
Source: ADOPT program, based on survey data

The research concluded that the national program for the multiplication of higher grades of wheat seeds is an important step to provide farmers with high productivity grades that contribute to increasing productivity and farmers' profits, and that seeds are a national wealth that cannot be valued at a price and must be preserved, and it has a major direct and indirect role in increasing productivity and profits and contributes to food security. The impact of economic, social and institutional factors on adoption, but the economic factors were more influential in adopting higher ranks within the program, and it was also found that the largest period of influence was for the two variables (short-term financial restrictions, ease of experimenting with technology on a limited scale, the degree of technology complexity) by (1.5-1) year, that the Iraqi farmer seeks quick profit regardless of the costs and the high purchase price of those seeds and the lack of awareness among the farmer that the seeds of the program are characterized by their stability, purity and low price compared to the imported ones, all of which can stand in the way of the speedy adoption of the seeds of the program, which it takes a period of time for farmers to be convinced of its economic viability compared to the seeds they use. Accordingly, the research recommends the need to continue the program by multiplying seeds and contracting with farmers while applying another package with seeds from crop service and pesticides so that the farmer can maintain the ability to produce pure seeds within the terms of the program. Paying attention to the variables that had a clear impact on adoption, especially economic factors, and paying attention to factors related to technology. Training farmers and intensifying training courses, and that agricultural departments have a role in communicating with program dealers and not leave the follow-up task to the Agricultural Research Department in the Ministry of Agriculture.

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