MEASURING EFFECT OF MODERM TECHNOLOGICAL PACKAGES ON THE PROFIT EFFICENCY OF WHEAT FARMERS IN IRAQ USING STOCHASTIC PROFIT FRONTIER FUNCTION.

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ABSTRACT

Using modern technology is one of the most important means that affect the productivity of wheat, the achievement of profits, the increase of agricultural production, and the progress towards self-sufficiency and food serenity. Therefore, the research aims to study the effects of the use of modern technological packages on the profits efficiency of wheat farms in Iraq for the season 2016-2017 in the provinces of (Wasit, Babylon and Diwaniyah), through estimation a stochastic profit frontier function and inefficiency function. The results showed that the values of the parameters were significant and positive for the durum income and were significant and negative for the parameters of the production costs (mechanization, seeds, dab fertilizer, urea fertilizer and human working hours) .The parameters of the model of the inefficiency of profit were all negative and significant and this means the inverse effect of the use of modern technology has reduced the inefficiency of profit . Farmers recorded average efficiency in profit (77- 91)% depending on the type of technological package . This means that farmers can improve their efficiency by improving productivity and allocative efficiency. The research recommended the need to provide technology in quantities and numbers that cover the actual need to increase the efficiency of profit.

keywords: - Modern technology on wheat, Profit inefficiency.optimal profit .
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قياس تأثير الحزم التكنولوجية الحديثة على كفاءة الربح لمزارعي القمح في العراق باستخدام دالة الربح الحدودية العشوائية.

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المستخلص :

يعد استخدام التكنولوجيا الحديثة من أهم الوسائل التي تؤثر على إنتاجية القمح وتحقيق الأرباح وزيادة الإنتاج الزراعي والتقدم نحو الاكتفاء الذاتي وصولاً لتحقيق الأمن الغذائي. لذلك يهدف البحث إلى دراسة تأثير استخدام الحزم التكنولوجية الحديثة على كفاءة الأرباح لمزارعي القمح في العراق للموسم 2016–2017 في محافظات واسط وبابل والديوانية من خلال تقدير دالة الربح الحدودي العشوائي. أظهرت النتائج أن قيم المعاملات كانت معنوية وإيجابية فيما يخص إيراد الدونم ومعنوية وسلبية لمعاملات تكاليف الإنتاج (المكننة والبذور وسماد الداب، وسماد اليوريا وساعات العمل البشري) وكانت معاملات نموذج عدم كفاءة الربح كلها سلبية ومعنوية، وهذا يعني أن التأثير العكسي لاستخدام التكنولوجيا الحديثة قد قلل من عدم كفاءة الربح، وسجلت المزارع متوسط كفاءة في الربح مقدارها (77 – 91)٪ اعتمادا على نوع الحزمة التكنولوجية ، وهذا يعني أن المزارعين يمكن تحسين كفاءتهم من خلال تحسين الكفاءة الإنتاجية والكفاءة التخصيصية لزيادة الربح. وأوصى البحث بالحاجة إلى توفير التكنولوجيا بكميات وأعداد تغطي الحاجة الفعلية لزيادة كفاءة الربح .

كلمات مفتاحية: التكنولوجيا الحديثة على القمح، عدم كفاءة الربح، دالة الربح.
***جزء من أطروحة دكتوراه للباحث الاول .**

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INTRODUCTION

Wheat is at the forefront of the world's strategic crops because its nutritional importance, which is a food source for more than 35% of the world's population. the most important grain crops, and covers the largest area planted on the surface of the earth,and it is the first crop in Iraq in terms of area and production and farm income. The use of agricultural technology at the global level has made significant strides especially in the field of producing important strategic crops such as wheat. The government has given special and increasing attention to the issue of the use of modern technology in the field of wheat production, which aims to improve productivity and some characteristics compared to traditional methods and inputs. The problem of low productivity of the wheat crop is one of the most important challenges faced by agricultural sector supervisors. Despite the progress in productivity of the unit area in recent years, it has not reached levels similar to those in other agricultural countries. Use of micronutrients [1] , micronutrients with showing machine , micronutrients with laser modification ,micronutrients with potassium sulphate , micronutrients with showing machine with potassium sulphate fertilizer ,micronutrients with herbicides (Plus) , micronutrients with herbicides (Atlantis) and micronutrients with crop rotation) on the efficiency of profits for wheat farms in Iraq for the season 2016-2017 (ProvincesWasit , Babylon and Diwaniyah as acase study) A number of studies and research have been carried out in which the stochastic profit frontier Function was used to estimate the profit function and the inefficiency and efficiency function, which provide indicators that contribute to the identification of the facts, methods and standards used, and the results that could be reached to be an extension to the previous studies and researches, such as,Abdulla and Huffman 1998study"An Examination of Profit Inefficiency of Rice farmers in Northern Ghana" (1) , And the Study ofOgundari , 2006"Determination of Profit Efficiency Determinants among Smallscale Rice Farmers in Nigeria : A profit function approach."(20) .And the Study of Galawat and Yabe 2012 "Profit Efficiency In Rice Production In Brunei Darussalam A StochasticFrontier Approach"(17).And the study of Trongw and Napasintuwong, 2015, "Profit Inefficiency among Hybrid Rice Farmers in Central Vietnam" Agriculture and Agricultural Science Procedia"(25).And the study of Sadiq and Singh 2015, "Application of stochastic frontier function in measuring profit efficiency of small-scale maize farmers in Niger State" (23).And the study of Dang 2017 "Determinants of Profit Efficiency among Rice Farmers in Kien Giang Province" (15).A number of researchers studied both technical competence and economic efficiency (2 , 4 ,5 ,6 ,7 ,8 ,10, 19, 22 ,24).

MATERIALS AND METHODS

Estimation of the stochastic profit frontier function and measuring the profit efficiency of the farmer using the FRONTIER Program.

The theoretical framework of the study:

The maximum production and profit margin function are based on Farrell's methodology, which are to achieve high levels of output with the available levels of inputs, which is the basis of all modern definitions(16). The stochastic approach. is based on the fact that the total error limit (ei) : stochastic error limit (vi), reflects measurement errors that may be positive and may be negative. The second is inefficiency limit (ui), which is a one-sided error, which reflects the differences in efficiency between farms; it comes from the negative deviation from the frontier efficiency curve (13). Stochastic frontier analysis is a teaching method that takes into account the random error and requires a predefining of the model used (18). Essentially, this model has been applied to cross-sectional data where this model can be used to obtain efficiency for each farm or institution independently. Showing the variance in the efficiency of the farm or institution and relying mainly on traditional regression analysis. The Cobb-Douglas function is the fundamental function in determining the Stochastic Frontier Profit Function(SFPF) model. This method has the ability to form a model that explains relationships and measures efficiency (11). Analysis is a very helpful way of comparing

. [1]A group of elements needed by the plant in small amounts (Cu, Mg, Mn, Fe, Zn) is used by spraying the leaves..

the efficiency of similar farms in their productive activity(12).This method provides results on the reasons why 100% profit efficiency is not achieved in resource management or inputs and helps to make proposals for efficiency enhancement, reduction wasting in inputs, thus increasing production (9). The basic rules of efficiency theory show that the method of random boundary analysis represents the most efficient points where the distance between each point and curve represents the degree of inefficiency. So that the concept of efficiency involves the use of homogeneous production inputs to obtain a homogenous output, but in agriculture, production inputs are used for different farms, which in practice if we find homogeneity in the elements of production does not achieve optimum production of optimal inputs, actual outputs despite input optimization. The producer usually selects the optimal combinations and quantities of the production in put that give the optimum profits and the efficiency of the establishment, which takes the following formula:

$\prod^{*}_{i} = \beta_i X_i k + v_i$.....(1).

Π^{*}_{i}: Planned earnings or optimal profits. Xik: Vector of input earnings.

β_i: Vector of parameters to be estimated.v_i: Random error, which represents uncontrollable and uncontrolled variables such as weather conditions, errors in measurement, random errors, independent distribution and identical distribution (iid) with an average of zero and constant variance $N(0, \sigma 2_V)$. Thus, v_i ($-\infty < v_i < \infty$) , represents the amount of inefficiency, meaning that actual profits are lower than optimal border profit and therefore the difference arises (3)

$\prod_i = (\beta_i X_i k + v_i) - u_i$.....(2).

$\prod_i = \beta_i X_i k + e_i$.....(3).

$v_i - u_i = e_i$.....(4).

Ui: The non-negative random variable that represents the inefficiency in the profit is assumed to be distributed as an independent distribution and an average or semi-normal symmetry, and an average equal to a non zero $N(> 0, \delta 2_u)$ or the normal normalized distribution of Ui and $\delta 2_u$. If the value is zero, it means that the unit of production is on the boundary curve and achieved 100% efficiency, if it is greater than zero, it means that the unit of production is not on the boundary curve and is not effective. solutionequation 4 withequation 3 we get the Stochastic Frontier Profit Function (SFPF), which takes the following formula:

$\prod i = f(x_i;\ \beta_i) + \exp(v_i - u_i)$.....(5)

Profit efficiency (TE_i), is defined as the ratio between actual and optimal profits that takes values between zero and one (3) As in equation 6.

$TE_i = \frac{\prod \ i}{\prod \ i^*}$ .....(6).

$TE_i = \frac{f(x_i;\beta_i) \ + \exp(v_i - u_i)}{f(x_i;\beta_i) \ + \exp(v_i)}$ .....(7). $TE_i = \exp(-u_i)$.....(8).

An efficient farm, is a profit whose actual profit is equal to its optimum profit

Characterization of the sample :

The sample of the study consisted of a pilot experimental sample of farms that implemented modern technology. Each farm includes the first part (traditional agriculture) and the other part or the other parts (planting using technological packages).Each technological package has equal space ؛data were collected through farmer interviews andduring harvest, a metric harvest [2]was conducted ,as shown in the table 1 .Marginal profit function variables have shown a significant difference in profit and income from one package to another. This difference is the result of the difference in the productivity of dunum of wheat. The production cost variables are not statistically significant differences depending on the technological packages. As shown in table 2

Table 1. Sample of the study

Package number	Type of technology[3] used	Number Of samples
0	Micronutrients Only	79
1	Micronutrient with sowing machine	44
2	Micronutrients with laser modification	8
3	Micronutrients with Potassium Sulphate fertilizer	52
4	Micronutrients with potassium sulphate fertilizer and sowing machine	32
5	Micronutrients with Herbicides (Plas)	35
6	Micronutrients with Herbicides (Atlantis)	30
7	Micronutrients with Agriculture after Crop rotation (Wheat - Mung bean – Wheat(.	10

Source: Preparation of the researchers based on the sample data

[2] **Method approved by the Ministry of Agriculture to estimate the productivity of dunums.**

[3] **The technology is applied according to its due date.**

Table 2. Summary statistics of variables for the estimation of stochastic frontier.

Package number	Π	Y1	C1	C2	C3	C4	C5
0	193	449	103	34	31	28	30
1	218	491	112	31	35	30	34
2	373	608	89	29	30	35	22
3	334	602	115	35	30	27	28
4	346	618	112	30	35	30	32
5	265	534	112	34	34	29	27
6	243	508	118	34	31	27	25
7	287	529	89	33	32	28	27
Average	261	525	109	33	32	29	29

Source: Preparation of the researchers has been based on the sample data

Characterization of profit [4] model using (SFPF) :

$$ln\prod i = \beta_0 + \beta_1 ln\, y_1 + \beta_2 ln\, c_1 + \beta_3 ln\, c_2 + \beta_4 ln\, c_3 + \beta_5 ln\, c_4 + \beta_6 ln\, c_5 + v_i - u_i \quad (9)$$

Where : Π : profit in thousand dinars.

y : Revenue in (thousand dinars / dunum). c_1 : cost of mechanization in (thousand dinars / dunum) .C_2: Cost of seeds in (thousand dinars / dunum). C_3: Cost of fertilizer (thousand dinars / dunum). C_4 : cost of fertilizer Urea in (thousand dinars / dunum). C_5: cost of human work in (thousand dinars / dunum). In order to estimate the effect of technological packages on efficiency as these variables are an effective source of inefficiency, the inefficiency function can be described as follows:

$$ui = \sigma_0 + \sigma_1 S_1 + \sigma_2 S_2 + \sigma_3 S_3 + \sigma_4 S_4 + \sigma_5 S_5 + \sigma_6 S_6 + \sigma_7 S_7 \quad (10)$$

Where $\sigma_1, \sigma_2, \sigma_3, \ldots\ldots\ldots \ldots \sigma_7$ are unknown parameters to be estimated. (S_1 ..... S_7) represent technological packages (micronutrients with sowing machine and micronutrients with laser modification and micronutrients with Potassium Sulphate and micronutrients with sowing machine with Potassium Sulphate fertilizer and micronutrients with Herbicides (Plus) and micronutrients with Herbicides (Atlantis) and micronutrients with crop rotation respectively), which are the dummy variables that take 1 if they are used and 0 if not. Estimation of profit function, efficiency following steps (7):

RESULTS AND DISCUSSION

A: Using the Ordinary Least Squares (OLS) method to obtain the best unbiased linear estimate of the parameters of the output function except for the discontinuous part of the B_O which is biased.

B: Depending on the Corrected LeastOrdinary Squares method (COLS) to obtain an unbiased linear parameter including the discontinuous part of the Y axis.

C: Obtaining the maximum probability estimates for the parameters of the random boundary production function using the Maximum Likelihood(ML) method according to the logarithmic production function. The value of the parameters of the output function in OLS method and after the correction to its value in the form of (ML), which is dependent on the interpretation of the relationship between the independent variables in the function and the dependent variable (profit).

The value of thesigma-squared σ^2 (0.55) is significant at a significant level (0.05 , 0.01) and indicates the quality and validity of the assumed distribution of the compound error

1- the value of gamma(γ) is 0.99 the highest deviation of marginal profit values (difference in values) is due to inefficiency of the profit and not due to random error, indicating that 0.99 of (14) and only 0.01 due to uncontrolled factors, this is consistent with the results

2- Value of the test of the one-sided error(Log-likelihood (LR)) 364 was significant at a significant level (0.05, 0.01), which was greater than the square of Cai (19.68 and 76).

[4]**The price of wheat purchase is 560 thousand dinars. In calculating revenue, the farm gate price is estimated at 500 thousand dinars.**

The alternative hypothesis confirms that there is a significant relationship between technological packages (14).And rejects the null hypothesis, which states that there is no significant relationship between technological packages and the inefficiency of wheat farms in marginal profit

3-Parameters of profit function:Significant and negative for each of the costs (labor, seed, Phosphate fertilizer (DAP), Nitrogen fertilizer (Urea) and human labor) This means increased costs(mechanization, seeds, Phosphate fertilizer, Nitrogen manure and human labor)by 1%Leading to lower profitspercent (0.42, 0.09, 0.13, 0.14 and 0.05)%consecutive, While the revenue parameter was positive, meaning the increase in revenue by1%leading to increase in profitsby (1.8) %

4-Parameters of the model of the inefficiency of the profit: all the qualitative variables (technological packages) were negative and significant,this means the reverse effect of the use of technological packages led to the reduction of inefficiency of profit, ie the use of technological packages led to increased efficiency of profit.

Table 3. Results of estimation of stochastic profit frontier

Parameter	OLS	T-Ratio	COLS	ML	T-Ratio
B0	-3.98	-6.5	-3.52	-2.43	-13.8***
B1	2.55	2.55	2.55	1.83	47.4***
B2	-0.97	-0.97	-0.97	-0.42	-12.1***
B3	-0.17	-0.17	-0.17	-0.09	-5.8***
B4	-0.08	-0.08	-0.08	-0.13	-4.91***
B5	-0.23	-0.23	-0.23	-0.15	-8.1***
B6	-0.15	-0.15	-0.15	-0.05	-3.8***
d1	#	#	#	-0.94	-4.8***
d2	#	#	#	-6.13	-5.16***
d3	#	#	#	-2.39	-6.04***
d4	#	#	#	-4.3	-5.7***
d5	#	#	#	-2.15	-6.15****
d6	#	#	#	-0.87	-17.4***
d7	#	#	#	-3.36	-4.07***
σ	0.14	#	0.34	0.56	10
γ	#	#	0.95	1	2780
Log likelihood	-121.91	#	#	63.08	#
LR	#	#	#	369.97	#

Source: prepared by the researcher based on the results of analysis.

The results of the efficiency of profit anda analysis of wheat farms applied to modern technology: The study farms achieved profit efficiency averaged(77 , 80 , 91 , 85 , 91 , 83 ,88)% respectively according to technology used (using micronutrients and micronutrients with sowing machine, micronutrients with laser modification, micronutrients with Potassium Sulphate, micronutrients with sowing machine with potassium sulphate fertilizer, micronutrients with Herbicides (Plus), micronutrients with Herbicides (Atlantis), and micronutrients with crop rotation) respectively, this means that the wheat farms have a lack of efficiency by(23 ,20 ,9 , 15 , 9 , 17 , 12) % according to technology used respectively, to increase profit by improving productivity and distribution efficiency and increasing profit To achieve the best profit efficiency study farmsThe distribution of farms according to the limits of efficiency and technology used was according to the following. Distribution of farms according to the limits of efficiency and technology used was according to the following :

a-The results of profit efficiency in wheat farms using micronutrients showed that the percentage of farms that achieve efficiency of less than 50% was 17% of farms, while farms that achieved a profit efficiency (51-60%) were 6%. The other farms representing 77% achieved a profit efficiency of 61-100%.

b-Results of the efficiency of profit in wheat farms used in micronutrients with sowing

machine showed that the percentage of farms that achieved a profit efficiency of less than 50% was 11% of farms, while farms that achieved efficiency of (51-60%) and (61-70)% was 7% of the farms using sowing machines with micronutrients, while the remaining 75% achieved a profit efficiency (between 81-100) %.

c-Results of the estimation of the profitability efficiency of wheat farms used for laser settlement with micronutrients showed that the percentage of farms that achieved a profit efficiency of less than (80-90)% was 50% of the farms while the farms that achieved efficiency from (91-100) % of farms that used micronutrients with laser leveling.

d- Results of profit efficiency in wheat farms used in Potassium Sulphate fertilizer with micronutrients showed that the percentage of farms that achieved a profit efficiency of less than 50% was 6%, while the farms that achieved efficiency were (51-70)% representing 11% .The other farms (83%) achieved a profit efficiency of over 70%.

e- Results of the estimation of the profitability of wheat farms using sowing machine with Potassium Sulphate with micronutrients showed that 97% of the farms achieved a profit efficiency (71-99)%. The other farms, which make up 3% of the farms, have achieved profit efficiency BY (61-70)%.

f-Results of profit efficiency in wheat farms that fight the harmful bushes pesticide plus with micronutrients showed that farms with a profit efficiency of less than 50% represented 8%. While farms that achieved a profit efficiency (51-60)% represent (3%). The other farms, which represent 89% of the efficiency of profit between (71-97)%.

g- Results of the profit efficiency of the wheat plantations, which the harmful jungles of the Atlantis pesticide struggled with the use of micronutrients that achieved efficiency less than 50%, accounted for 7%. While the farms that achieved the efficiency of profit (61-70)% accounted for the proportion of (10)%, while the other farms, which accounted for 83% achieved a profit efficiency between (71-97)

h- The results of the profit efficiency of the wheat farms that followed the crop rotation in addition to the use of micronutrients showed that the farms that achieved efficiency less than 50% were 10% of the farms that applied the Crop rotation, while the farms that achieved a profit efficiency (81-97) % ware (90%).

Table 4. Distribution of farms according to the limits of efficiency and type of technological package

Technological package	Profit efficiency and Percentage of farms						
	0 - 50 %	(51-60)%	(61-70)%	(71-80)%	(81-90)%	(91-100)%	Average %
0	17	6	4	11	20	42	77
1	11	7	7	0	25	50	80
2	0	0	0	0	50	50	91
3	6	4	7	4	31	48	85
4	0	0	3	12	19	66	91
5	8	3	0	6	20	63	85
6	7	10	0	10	30	43	83
7	10	0	0	0	10	80	88

Source: prepared by the researcher based on the results of analysis

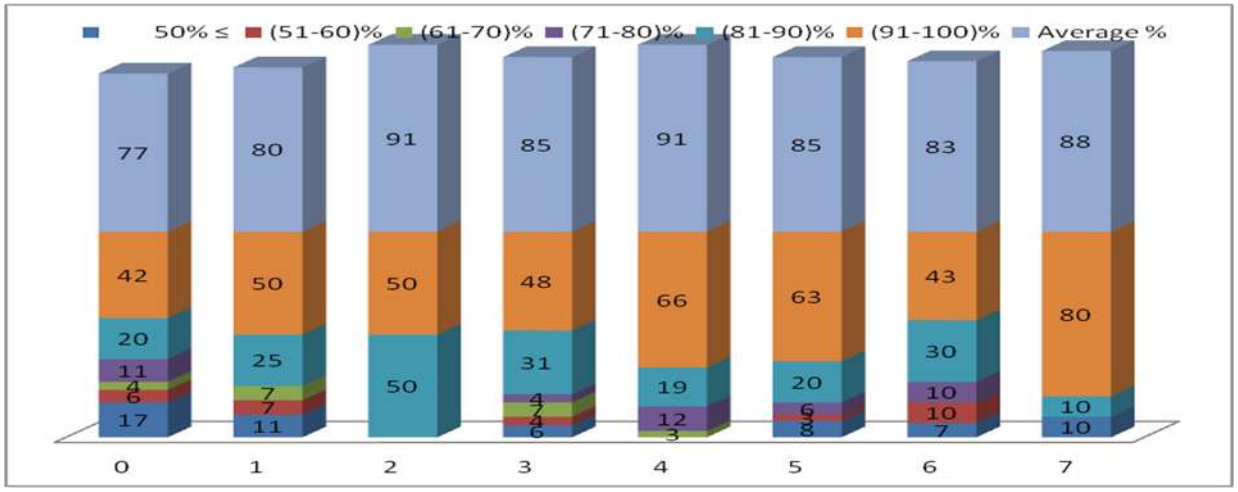

Figure 1. Profit efficiency according to the technology used and percentage distribution of farms

Source: prepared by the researcher based on the results of analysis. The research concluded The random profit function was used and the results revealed that the use of technological packages mentioned in the study have a negative and moral impact on the inefficiency of profit. In addition the farms which used (micronutrients with laser leveling), micronutrients, showing machine and Potassium Sulphate fertilizer achieved the highest profit efficiency among other farms. The research recomnonday Providing technological packages in quantities and numbers that cover the actual need for increased efficiency of profit. Al so Intensifying the work of the guidance and awareness of technological packages.

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