Economic analysis for the cost and production function for the impact of using the technology package of the national program for developing wheat cultivating in Diyala province for the season 2017-2018

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ABSTRACT

The research is concerned about studying and estimating the total cost function of the wheat crop for the farms in which the Package of National Program Technologies for wheat development was implemented to cultivating wheat in Diyala province based on a sample from crop farmers. This package included the use of improved seeds, the fertilized seeder technology, the use of micro-nutrients and effective pesticides. The optimal production was achieved through the derivation of the average total costs function for the long term and the optimal production capacity (1620 kg.dunum^{-1}). The optimum area amounted to (117.39 dunum). It was also observed that the cultivated areas were less than the obtained optimum area. Therefore, it was recommended to adhere to the optimal area with continuing the vertical expansion for the wheat crop. The production function was studied in order to determine the effect of inputs on the quantity of production, where it included seeds quantity, the amount of urea fertilizer and the amount of compost fertilizer, the costs of mechanical work, the manual labor costs, and the amount of micronutrients. The analysis showed the positive effect for inputs on the quantity of production, except for the amount of the compost, which had a negative effect. It is recommended that these technologies be applied on the achieved optimum area in order to achieve the optimal product in dunums and achieve development and expansion by the production of this important crop to meet the requirements of the consumer.

Keywords: national program, development, wheat crop, optimum area.

تحليل اقتصادي لدالة التكاليف والإنتاج لأثر استخدام حزمة تقانات البرنامج الوطني لتنمية زراعة الحنطة في محافظة ديالى للموسم 2017 – 2018 م

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الخلاصـــــة :

اهتم البحث بدراسة و تقدير دالة التكاليف الكلية لمحصول الحنطة للمزارع التي نفذت فيها حزمة تقانات البرنامج الوطني لتنمية زراعة الحنطة في محافظة ديالى إعتماداً على عينة من مزارعي المحصول وشملت هذه الحزمة استخدام البذور المحسنة و تقانة الباذرة المسمدة و استخدام العناصر الصغرى و المبيدات الفعالة, و تم التوصل الى كمية الإنتاج الأمثل من خلال إشتقاق دالة متوسط الكلفة الكلية للاجل الطويل وقدر الإنتاج الأمثل بـ (1620 كغم/ دونم) كما تم التوصل الى المساحة المثلى و بلغت (117.39 دونم) كما لوحظ ان المساحات المزروعة اقل من المساحة المثلى المتوصل اليها لذا تمت التوصية الإلتزام بالمساحة المثلى مع استمرار التوسع العمودي لمحصول الحنطة. وتم دراسة دالة الإنتاج بهدف معرفة تأثير المدخلات على كمية الإنتاج حيث شملت كمية البذور وكمية سماد اليوريا و السماد المركب و تكاليف العمل الآلي و تكاليف العمل الثابت (العمل اليدوي) و كمية العناصر الصغرى وقد اوضح التحليل التأثير الايجابي للمدخلات على كمية الانتاج ماعدا مورد كمية السماد المركب حيث جاءت بتأثير سلبي. و تمت التوصية بتطبيق هذه التقانات على المساحة المثلى المتوصل اليها بهدف تحقيق الناتج الامثل بالدونم و تحقيق التنمية و التوسع بإنتاج هذا المحصول المهم لغرض سد احتياجات المستهلك.

كلمات مفتاحية: البرنامج الوطني, تنمية , محصول الحنطة , المساحة المثلى.

1. INTRODUCTION

Wheat crop (*Triticum estirum* L.) is considered a strategic crop, which occupies the first order of agricultural production in the world and because of the increasing demand for it as a major crop it was necessary to study this crop and the new techniques used in its production in order to know the achieved optimum sizes from the applying the technologies in its cultivation. The use of technology in developing countries is considered lagging behind the developed countries in the field of wheat cultivating and the importation and application of technology in developing countries in inappropriate conditions, which makes them more expensive and less productive (Al-fahdawy and Al-jumaily, 2017). In spite of adopting a number of aimed policies to increase the level of productivity, the productivity of dunums is still low compared to the developed countries. This is due to several reasons, including the inability of the farmer to mix the elements of production with high efficiency, This has prevented the achievement of good productivity and inefficiency in productivity of the dunums. The state of production expansion is either horizontal through the exploitation and reclamation of more areas or through vertical expansion, such as the insertion of technological variables in the same unit area such as the improved seeds, plowing, regular seeders, identifying the quantities of fertilizers, highly efficient pesticides and irrigation with high efficient (Al-Summary et al., 2017). The national program for developing the wheat cultivating is a package of technologies Targeting the vertical expansion for wheat crop through applying a set of these technologies and follow-up in the cultivated areas. The package that is the topic of the research included the use of seeds resistant to the salinity of irrigation water. The fertilized seeder, the pesticide sprayer with 1000 L capacity, and the sprayer for foliar fertilizer with modern specifications were also used. As well as determining the quantities of seeds and the compound and nitrogen fertilizers with rates that differ from the patterns of cultivation that did not apply this package in one dunum. In addition, micronutrients were sprayed and highly effective chemicals were used. Therefore, it was necessary to study applying this program to identify its results and the extent of achieving its objectives. The Cubic function was used to estimate the results of this program.

The problem of research:

The decrease in the productivity of the dunums in wheat farms despite the increase in the demand for it, which encouraged the concerned authorities to exploit all technological resources available to increase the productivity of the crop and applying the wheat crop development program, which is one of these technologies, It was necessary to study the effect of applying the package of Technologies program in order to benefit from the results of research in the agricultural sector in the future.

The aim of the research:

The study of the optimal production and the optimal area after applying the national program technology, by studying the cost function and knowing the quantity of products which maximize profit and reduce costs and studying the effect of production inputs on the quantity of production through studying the production function.

Research importance:

The introduction of modern technologies in order to increase the production of the strategic wheat crop for the producer and consumer in Iraq in general and Diyala in particular, it is imperative to study the results of the experiment to make the most beneficial from the resources available to applying the results of future research in the agricultural sector.

2. MATERIALS AND METHODS

1- Data related to the applying national program technologies were obtained in the covered areas such as the Directorate of Agriculture in Diyala province, Department of Plant Production. The study included the areas

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of Baldrouz, Kanaan, Hibhib, Al-Muqdadiya, Bani Saad and Buhriz.

2- In November 2017 - 2018, a questionnaire was conducted for a group of farmers who applied the program technology to their area. The number of studied samples amounted to (47 farmers) from a total of (297) farmers on their holdings so what constitutes a percentage (15.8%). The total area of the surveyed sample amounted to (2579). The first part of the data was obtained and the places from which it was taken, were designated for completion.

3- The second part of the data was obtained in mid-February and it included actually used quantities from urea fertilizer, compost fertilizer, micronutrients, pesticide spraying costs, and the costs of crop service operations.

4- At the end of May, the last part of the data was obtained, which is for productivity and it represents the final part of the questionnaire and for the sample farmers themselves.

5- The contents of the questionnaire were placed in the tables and data were tabulated and analyzed using the programs (Excel and Evieos) to obtain the results.

Table 1: Characteristics of the research sample.

Characteristics of the studied farms			
Number of farmers concerned with the implementation of the program			297 Farms
Number of the surveyed sample farmers			48 farms
Type of agricultural land for the surveyed sample farms			44 Farms (contract)
			3 farmers (Freehold)
Number of farmers concerned with the implementation of the program			46 Farms: Flood irrigation
			2 farms: irrigation by methods
Characteristics of the farmers			
Academic achievement	Percentage (%)	Years of Experience	Percentage (%)
Illiterate	4.15	10 – 6 years	%13.37
primary	28.56	15 – 7 years	%31.32
preparatory	29.26	20 – 16 years	%55.31
secondary	21.35	-----	----
Undergraduate	16.68	------	----

Reference: The researcher worked based on the questionnaire

Table 2: the vocabulary of the national program for the developing the wheat cultivating in Diyala province for the season (2017-2018).

No.	The vocabulary of the program	The details
1	Soil Service	The use of modern tractors in plowing, settling, smoothing and dividing the land into plots, seeding, fertilization, and control.
2	Seed cultivar	IPA 99 - Abu Ghraib - Barcelona - Bora - Adana - Rashid - Bengal
	Quantities of seeds and fertilizers	1- Seed quantities (35 - 50 kg.dunum^{-1}) 2- Urea fertilizer (35 - 60 kg.dunum^{-1}) 3- compost fertilizer (35 - 50 kg.dunum^{-1}) 4- quantities of foliar fertilizer (0.25 kg per 400 L of water) / dunum
3	Services	1- Field visits to farms and seminars to train farmers 2- The integrated irrigation and fertilization programs and determining the date of cultivation. 3- Control program with Pallas and Atlantis pesticide.

Reference: Directorate of Agriculture Diyala province, Directorate of Plant Production. Annual plan for wheat crop for the period 2017-2018.

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3. RESULTS AND DISCUSSION

The Total Cost Curve in Long Run is the Envelope curve for the Cost Curve in short Run (with U-shaped) showing the minimum limit from the production cost for the unit produced from a particular commodity (Al-Summary, 2008, p. 102). The appropriate function for this curve takes the Cubism form (Al-Summary, 2009):

$Tc = b_0 + b_1 Y - b_2 Y^2 + b_3 Y^3 + Ui$

By excluding the constant limit (b0), the long-run total cost function became as follows:

$LRTC = b_1 Y - b_2 Y^2 + b_3 Y^3 - b_4 AY + b_5 A^2 + ui$ .. . .. (1)

Long-run cost function.

Where each of the following:

A = farm area / dunum

TC = Total Cost / JD

bi = Regression coefficients

Y = quantity of production / kg

Ui = random variable

and by writing the equation in its Implicit form where Tc is an implicit function for A, Y

$V = TC - b_1 Y + b_2 Y^2 - b_3 Y^3 + b_4 AY - b_5 A^2 - ui = 0$ ..... (2)

and by conducting the partial derivative relative to A and equating it to zero, we get:

$b_4 Y - 2b_5 A = 0$ .....(3)

$A = 1\backslash 2\ b_4 Y \backslash b_5$ .....(4)

where A is obtained by Y.

$LRTC = b_1 Y - b_2 Y^2 + b_3 Y^3 - b_4 (b_4 Y / 2b_5) .Y + b_5 (b_4 Y / 2b_5)^2$ ui

$= b_1 Y - b_2 Y^2 + b_3 Y_3 - b_4^2 Y^2 / 2b_5 + b_5 b_4 y^2 / 4b_5$

$= b_1 Y - b_2 Y^2 + b_3 Y^3 - b4^2 Y^2 / 2b_5 + b_4 Y^2 / 4b_5$

$= b_1 Y - b_2\ Y_2 + b_3 Y^3 - (1/2) b_4^2\ Y^2 / b_5 + (1/4) b4^2\ Y_2 / b_5$

$= b_1 Y - b_2 Y^2 + b_3 Y^3 - (1/4)\ (b4^2 / b_5)$

by sum the boundaries of Y2

$= b_1 Y - (\ b_2 - (1/4\ b4^2 / b_5)\ .\ Y^2 + b_3 Y^3$

The final form for the cost function be:

$LRTC = b_1 Y - b_2 Y^2 + b_3 Y^3$ the long-run total cost function

Total Production Costs:

The total cost items included fixed costs and variable costs. Fixed costs included the depreciation value for the agricultural tractors, the smoother machine, the fertilized seeders, the plow for the farmers who own these machines, the cost of the land rent and the fixed labor costs. The variable costs included the costs of tillage, smoothing, leveling, the dividing the land into the plots, cost of seed purchase, purchase cost of urea fertilizer and compost fertilizer, cost of control and seeding process, seed, fertilization, and irrigation.

First: Estimating and analysis of the cost function:

In order to find the optimum amount of production, the optimum area, the short-run total cost for wheat was estimated, It was found to be identical to the economic logic. This function has passed the statistical and standard tests and after introducing the area variable (A), it was as follows:

1- The short-run cost function for the wheat crop:

$SRTC = 648.506114572\ Y - 0.291293400186\ Y^2 - 1.62113098287\ Y^3 + 0.222848535279\ AY + 0.0003075294145\ A^2$

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Table 3: The estimated parameters for the total short-run cost function for the wheat crop

Independent variables	The estimated parameters
Y (t)*	648.506114572 (7.672502)
Y^2 (t)*	0.291293400186 (-7.185255)
Y^3 (t)*	1.62113098287 (-2.481132)
AY (t)*	0.2228485352 (4.522363)
A^2 (t)	0.0003075294145 (0.017833)
Coefficient of determination R^2 Adjusted R^2	(0.872759) (0.856446)
test D.W	(1.968158)
test ** F	(53.50118)

* Significant at (0.01) ** Significant at (0.05)

2- Write the function in its implicitly form:

$V=TC-648.506114572Y+0.291293400186Y^2+ 1.62113098287Y^3- 0.222848535279 AY- 0.0003075294145A^2 = 0$

and by conducting the first partial derivative to it related to A:

□□V \□□□□□□□0.222848535279 AY- 0.0003075294145A = 0

A = 0.222848535279 AY \ 0.0003075294145

A= 724.64136687972 Y ..... (5)

By offsetting the value of A by the equivalent in the original function, we obtain the long-run cost function as follows:

LRTC= 648.506114572 Y- 0.291293400186 Y^2- 1.62113098287 Y^3+ 0.222848535279 (724.64136687972 Y) Y+ 0.0003075294145(724.64136687972 Y)^2

= 648.506114572Y- 0.291293400186Y^2 - 1.62113098287Y^3 +161.485267211718Y^2 + 525105.110593309 Y^2

by Combining the boundaries of Y2, we get:

LRTC =648.506114572Y + 525266.304567121Y^2 - 1.62113098287Y^3

The total long-run cost function for the wheat crop.

Statistical analysis:

The T-Test showed the significance of the estimated parameters for the wheat crop. except the variable square area (A2), It was not significant because the area where the program was implemented is small so its effect is insignificant in the short run especially since the implementation of the technology package is limited to vertical expansion more than horizontally, The significance of the function as a whole was determined by the (F) test at a significant level (0.05). The R^2 has shown that 87% of the occurred changes in costs are caused by the change in the total output per dunum. This proves that there is a positive effect on the used technologies and the 13 remaining due to other factors that have not been measured by the function.

Standard Analysis:

The model showed that there was no autocorrelation problem by means of the Durbin-Watson Test (DW), which amounted to

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(1.968) at the significant level of (0.05) and degrees of freedom (K = 2) and greater than the value of (du and dL) amounted to (1.63 and 1.46) respectively, and from this we can infer that there is no autocorrelation problem between residues, as demonstrated by the Park test, which included estimating the regression equation of the error square as a dependent variable and the result Y as an independent variable. The absence of Heteroscedasticity, The function was as follows:

$Log(ei)^2$ = -84.309658309 + 12.0660937562log(Y)

(0.501337) t(-0.495566)

F (0.251339) R^2 (0.009223)

It was found that the parameters of the estimated function are not significant at the acceptable levels. This indicates that there is no problem with Heteroscedasticity, which usually appears in the cross-section data.

Economic Analysis:

1- Determining the optimum amount for wheat production:

To determine the optimal amount for the product that reduces costs and maximizes profit, the LRATC should be derived by dividing it by (Y) and then applying the requirement to minimize costs (The derive of LATC divided on the derive of y): (Al-Summary, 2008).

LRTC =648.506114572Y + $525266.304567121Y^2$ - $1.62113098287Y^3$

By dividing the product (Y) we obtain the cost function in the following long-run:

LRATC= LRTC/ Y =648.5061145 + 525266.304567 Y - $1.621130982\ Y^2$

It is a function of the average long-run total cost. The necessary condition for cost minimization is as follows:

□□**LATC/** □□**Y** = 525266.304567121 / 3.2422Y

Y= 525266.304567121 / 3.2422

Y= 1620.09 Kg /don

Y = 1.620 TON / DON

The optimal production quantity reduces the costs and maximizes the profit for the wheat crop.

2- Determining the optimum area for wheat production farms:

The optimal area from offsetting the value of the output that was reached in the long run in the equation of area (5) and as follows:

A= 724.64136687972 Y

A = 724.6413668 (1.620)

A= 117.39 DON

The optimum area that achieves optimal production.

Second: Measuring the impact of inputs on the quantity of production:

Production function: A mathematical relationship that describes to us the average at which the elements of production are used to convert it into a product. The simplest forms of Production Function that link variable factors of production with an output which as the following: (Abu Shawr et al., 2011).

Y = f (X1,X2,X3 .... Xn)

Production (Y) was selected as a dependent variant which included the total quantity for the farm ($kg.dunum^{-1}$), The dependent variables are included (X1) Seed quantities ($kg.dunum^{-1}$), (x2) Urea fertilizer ($kg.dunum^{-1}$), (x3) compost fertilizer ($kg.dunum^{-1}$), (X4) the costs of mechanical work, including the costs of tillage, smoothing and settling, diving the land to the plots and seeding, fertilization, spraying of micronutrients and pest control, as for the

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variable (X5) included the costs of manual labor, which is irrigating the farm and managing it (the farmer and his family members), where the mixing of production resources, The variable (X6) included the amount of micronutrients that were sprayed to the farm, this material was allocated by the agricultural departments as a vocabulary of the national program for developing the wheat cultivation, which is a fertilizer in the form of a powder consisting of (iron, copper, magnesium, manganese, and zinc) used as a solution for foliar fertilization. The function was analyzed in linear and semi-logarithmic, double logarithmic, logarithm inverse by taking the natural logarithm for production as a dependent factor and the natural logarithm for each production resource as independent factors. The linear model was chosen as the best model, the function passed the statistical and standard tests and the results were given in Table (4).

Y = the amount of total production (kg.dunum^{-1})

X1 = seed quantity (kg.dunum^{-1})

X2 = the amount of urea fertilizer (kg.dunum^{-1})

X3 = the amount of compost fertilizer (kg.dunum^{-1})

X4 = the costs of mechanical work (tillage, smoothing and settling, diving the land into the plots and seeding, fertilization, spraying of micronutrients and pest control) thousand dinars/dunum

X5 = manual labor costs (irrigating and farm management) / thousand dinars

(The amount of employee's wage is 10000 dinars per 6 hours)

X6 = the amount of micronutrients (zinc, iron, manganese, magnesium, copper) (kg.dunum^{-1})

Table 4: The estimated Production Function for Wheat Farms Implementing the National Program Package for the Season 2017 - 2018 / Diyala province.

Functional formulas / The estimated parameters	Linear function Y = F (X)	Semi-logarithmic function Ln (Y) = F (X)	Double logarithmic function Ln (Y) = F Ln (X)	Inverse logarithmic function Y = F Ln (X)
Constant	5.817465	1.9316	2.210781	8.9808
t	(8.061675)	(29.61838)	(100.0366)	(37.5116)
X1 = seed quantity	1.59531	0.1424422	0.0092052	0.102522
t	(2.849550)	(2.815146)	(1.535528)	(1.57862) *
X2 = the amount of urea fertilizer	1.54392	0.12651934	- 0.000612	0.01395
t	(2.933295)	(2.659605)	(-0.114524)	(0.240657)
X3 = the amount of compost fertilizer	- 1.30680	- 0.119934	- 0.010565	- 0.1157905
t	(-2.208562)	(-2.242721)	(-1.807020)	(-1.82807)*
X4 = the costs of mechanical work	0.001958	0.012490284	0.0126413	0.1140099
t	(0.004281)	(0.302128)	(2.867494)	(2.3872) **
X5 = manual labor costs	0.786309	0.07449607	0.01079765	0.110659
t	(2.207795)	(2.314355)	(2.899724)	(2.7431) **
X6 = the amount of micronutrients	0.112625	0.010781607	0.02135460	0.245881
t	(0.73323)	(0.776647)	(3.574893)	(3.7995) **
R^2	0.983007	0.983385	0.990245	0.9904
Adjusted R	0.980520	0.980954	0.988817	0.9890
F	395.2935	404.4452	693.6330	707.58 **
D.W K =3 (dl =1.42) (du=1.67)	1.920881	1.877195	1.934562	1.494 **

* Significant level 0.10% ** Significant level 0.05%

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Linear Model for Wheat Production Function:

Y = 8.98081 + 0.102522 X1 + 0.0139546 X2 - 0.115790 X3 + 0.1140099 X4 + 0.1106592 X5 + 0.2458812 X6

Statistical and standard analysis for the productive function:

The T-test proved the significance of the estimated parameters, Where the significance of the variable X1: seed quantity and X3: the amount of compost fertilizer at a significant level of 0.10%. It was proved the significance of X4: the costs of mechanical work, X5: the manual labor costs and X6: the amount of micronutrients at a significant level of 0.05%. As for the variable X2, it proved to be insignificant at acceptable levels. This may be due to the overlap of the function factors with each other in the linear model, where this resource proved it's significant at the level of 0.05 when estimating the simple regression equation for the variable (X2: the quantity urea fertilizer), with the produced quantity of the crop. It proved its significance at the 0.05% level, which indicates its importance for the production process and as shown by the following function:

Y = 7.96940870 + 0.40996758 X2

t (94.0375) (36.68341)

R^2 (0.966946) F (1345.673)

The (F) test also proved the significance of the function as a whole where their value amounted to (707.58). The R^2 coefficient indicated that 99% of the changes in production were caused by the productive resources entering the function, as for the remaining 1% is due to other factors not measured by function. The DW test also proved that there was no autocorrelation problem, Where their value amounted to (1.494) at the significant level of (0.05%), degrees of freedom (k=3) and its value is limited between (dl = 1.42> D.W = 1.494> du = 1.67) and From this we conclude that there is no autocorrelation problem between residues.

It is cleared from the Park test, which included estimating the regression equation of the error square as a dependent variable and the result (Y) as an independent variable, there is no Heteroscedasticity phenomenon and the function was as follows:

$Log(ei)^2$ = 6.644313889 - 1.57417553521e-05 Y

T (2.733266) (-0.450730)

R^2 (0.004397) F (0.203158)

It was found that the parameters of the estimated function are not significant at the acceptable levels. This indicates that there is no problem with Heteroscedasticity, which usually appears in the cross-section data.

Economic analysis for the estimated productive function:

The values of parameters for the estimated function refer to the elasticity of productive resources. Through the value of elasticity, it is possible to know the impact of these resources on the quantity of production, where the analysis shows that the elasticities of productive resources (seed quantity, amount of urea fertilizer, the costs of mechanical work, manual labor costs and the amount of micronutrients) were positive signs, which indicates that the production of these resources occurred in the second stage from the law of diminishing returns, which is the stage of increasing total production. In the second stage of diminishing returns, production increases at a decreasing rate until it reaches the third stage of the law. This decrease is due to the unhelpful factors created by the increase of one of the production elements (Al-Maksousi. 2007. pp. 42--41). As for the amount of compost fertilizer, its elasticity was with a negative signal. This means that the production of this resource occurred in the third stage of the law of diminishing returns, which is the stage of decreasing the total production. This may be due to non-compliance with the fertilization program in terms of quantity and date. Al-

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Shebini (2009, p. 269) mentioned that the use of compost phosphate fertilizer at a rate of (40 kg per 4200 m^2) increases the number of branches and spikes, thus increasing the amount of produced grain in spike and increase the amount of straw with taking into account the soils need to this. While it was shown from the data of the national program and the questionnaire that the used quantity in wheat farms ranging from (35 - 50 kg.dunum^{-1}). The researchers (G.W.Rehm, A.Lims, J.A.Lamp. 2003) also concluded in the study of estimating the phosphate fertilization rate at different tillage levels for wheat growth and harvest in the USA, The use of (20 - 40 kg.dunum^{-1}) once, and (20 - 60 kg.dunum^{-1}) again has a positive impact on the growth, branching, and elongation of the plant, where It was used at appropriate times with the recommended amounts of this fertilizer.

4. CONCLUSIONS

1- The study concluded that the implementation of the national program package did not achieve the optimum area due to the use of small areas to implement the technologies of the national program where the optimum area amounted to (117.6) dunums, and the study also concluded to the optimum production amount which amounted to (1620 kg.dunum^{-1}) which is the productivity that should be achieved when using these technologies.

2- The productive inputs (seed quantity, the amount of urea fertilizer, the costs of mechanical work, manual labor costs and the amount of micronutrients) positively affected the quantity of production through the elasticity for the estimated parameters in the production function while the effect of the compost fertilizer was negative and the reason may be to adding it without date or not to adhere to the recommended amounts from this fertilizer.

5. RECOMMENDATIONS

1- Applying the optimum area that reached in the research (117.39 dunums) which achieve optimum productivity, and The optimal amount of product that maximizes profit and lower costs that reached by the research (1620 kg.dunum^{-1}) should be reached by increasing the cultivated areas up to or near the optimum area reached while continuing the vertical expansion.

2- Preparation of fertilization programs based on the results of scientific research and analysis of soil before cultivating to determine their need for fertilizers and elements in order to rationalize the use of resources and achieve productive efficiency at low cost in order to vertical development for the wheat crop.

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