The aim of this research was to estimate the production function to measure returns to scale and distribution efficiency of resources used in the production of wheat. Cross sectional data used of a random sample of 130 farmers in Dhi Qar Province. The results of the quantitative analysis of estimating production function showed that the double logarithmic form was the best estimated model based on economic and statistical indicators. However, that form suffered from heteroscedasticity and autocorrelation, so the robust regression technique was chosen. Value of returns to scale was 0.89 and this indicates decreasing returns to scale. This means that production function is in the second stage of the function. The results of the distributional efficiency study showed that the resources used in the production of the crop were not optimized as they amounted to 1.28 for the human labor resource and 20.6 for the capital. There was a shortage in the use of labor resource and capital for the optimal use that achieves economic efficiency and this caused low efficiency of crop production. Therefore, the research recommends the need to increase the amount of human labor in the wheat crop farms in Dhi Qar province, which would move the production function curve to a higher level in order to achieve the economic efficiency of the crop cultivation in the province on the one hand and return the farmers to production in the rational stage. Also, it is important to have the proper allocation of resources available by farmers, which has the effect of increasing the economic efficiency of those resources, which will in turn reflects on the efficiency of crop production.

Keywords: robust least squares method, cobb-douglas function, economic efficiency.
INTRODUCTION
Production in general means the process of converting inputs such as land, labor and capital into goods and services called outputs, and achieving optimal level of production with the least amount of resources possible is the primary goal targeted by communities around the world to reduce poverty and achieve high productivity. In order to achieve self-sufficiency, especially in developing countries, efficiency in the use of economic resources is an issue that is of big concern to economists recently as a precondition for achieving comprehensive economic development in society. This is obtained by minimizing the cost of production with a certain level of production or maximizing production with a certain level of cost. This requires proper allocation or redistribution of available resources to maximize production for many agricultural crops (10). Thus, one of the objectives of development is the fighting poverty and the optimal use of production resources, and agricultural projects are the basis for agricultural development in the economies of many countries (11). Agricultural production plays an important role in the economies of a country because it is linked to the lives of its people first and from the sources of economic activity, especially grain crops, which constitute 80% of the total plant foods (1). Although China has only 15% of arable land, it produces food for about 20% of the world's population and is the world's largest wheat producer (18). In 2014, China's wheat production reached 126.2 million tons (13). Because Iraq is famous for the cultivation of wheat since ancient times, this crop occupies an important economic position in the Iraqi agriculture, both in terms of its contribution to farm income or to cultivated areas, where the cultivated areas of the crop 43% of the average cultivated land and about 50% of the cultivated areas of grain (7). Agricultural growth can be achieved through horizontal expansion by introducing new land into crop cultivation, or by vertical expansion by achieving higher rates of unit productivity (9). Achieving this depends to a large extent on how to deal with agricultural lands, with good management and scientific method that enables this efficiency (12). Therefore, studies on the economics of agricultural production need to be addressed through the optimal use of economic resources and achieving high rates of agricultural production and productivity because these studies illustrate the nature of the relationship between economic variables in agriculture (2). Therefore, the aim of this research was to identify the distribution efficiency of wheat cultivation in Dhi Qar governorate, as the cultivation of wheat crop in Dhi Qar governorate faces productivity and profitability problems, such as farmers’ move away from the concept of optimization in the resources used, which reflected on the low economic efficiency in crop production. Farmers usually continue to grow wheat despite declining productivity and declining net farm income (6). This study assists farmers in the governorate and enables them to know the optimal use of resources that will in turn be reflected in production and thus increase the profits from crop production. The hypothesis of research is based on the existence of deviations in the use of resources from the best use of them, which reflected negatively on the economic efficiency of those resources, which in turn affected the low efficiency of production and profits from the production of the crop. The objective of this research is to estimate production function of wheat crop, to measure economies to scale in wheat production, as well as to measure the distribution efficiency of the resources used to produce the crop.

MATERIALS AND METHODS
This study was based on a questionnaire for a sample of wheat farmers in the province of Dhi Qar for the season 2017-2018 130 questionnaires were distributed to a random sample of the farmers of the crop. Cultivated areas were emptied and analyzed using the computer program of the statistical program Eviews11. For quantitative analysis, the ordinary least squares and robust regression methods were used.

Theoretical framework
First: economic production function of wheat crop: The economic production function generally means the relationship between the value of the gross product achieved on the one hand and the factors influencing the values of resources (costs) on the other hand (19).
By estimating the parameters, it was found that Cabb-Douglas function is the most suitable model in the study because of its compatibility with the logic of economic theory and statistical and standard tests (4).

\[ Y = b_0 K^{b_1} L^{b_2} \]

The economic production function can be converted from the exponential model to the linear logarithmic model as follows:

\[ \ln Y = \ln b_0 + b_1 \ln K + b_2 \ln L + \sum u_i \]

So: \( Y \): quantity of wheat crop production (tons), \( K \): capital (IQD), \( L \): number of hours worked (hours), \( b_i \): constant limit, \( b_i \): regression coefficients, \( u_i \): random variable.

Measurement of wheat production function.

Second: Return to scale (RTS) is the measure of the organization's success in producing the maximum output from the available input range (17). Productivity elasticity is defined as the amount of relative change in output due to the relative change in the resource used (16). Productivity elasticity is calculated according to the following formula: Where: \( EP \): Elasticity of Production .MP: Marginal Product .AP: Average Product. Return to scale takes the following values:

\[ \sum EP = 1, \sum EP > 1, \sum EP < 1 \]

If \( \sum EP = 1 \), returns to scale are constant.
If \( \sum EP > 1 \), returns to scale are increasing.
If \( \sum EP < 1 \), returns to scale are decreasing.

Third: Measuring the distribution efficiency of the resources used in the production of wheat: Allocative Efficiency (AE) means choosing a combination of inputs to achieve a certain level of output with minimal expenditure and reflecting the farm's ability to optimize inputs taking into account the prices of these inputs and available production techniques (8). According to the following formula (3):

\[ AE = \frac{MVP}{MFC} \]

\[ MVP = MP \times Py \]

\[ MP = Bi \times AP \]

\[ AP = G(Y)/G(X) \]

\[ MP = Bi \times G(Y)/G(X) \]

\[ MFC = Px \]

AE: Allocative efficiency, MVP: marginal value of product, MFC: marginal cost of the resource representing the resource price (Px), Py: output price of the unit produced, MP: marginal output, AP: Average output of the resource, G (Y): Geometric mean of total return, G(X): Geometric mean of value resource.

Distributional efficiency takes values according to the following formula:

\[ AE = \frac{MVP}{MFC} = 1 \text{ Efficient Used} \]

\[ AE = \frac{MVP}{MFC} > 1 \text{ Over Used} \]

\[ AE = \frac{MVP}{MFC} < 1 \text{ Under Used} \]

If the value of \( AE = 1 \) this means that quantities of the resource are used to achieve complete efficiency, then if the value of \( AE > 1 \) this means using less of the resource, then if the value of \( AE < 1 \) this means using more quantities than the supplier.

In order to know the amount of surplus or deficit in the use of the resource from the optimum level that achieves the distributional efficiency:

\[ D = [1 - (MFC/MVP)] \times 100 \]

D: The absolute value of the relative change in the value of the marginal product of the resource.

**RESULTS AND DISCUSSION**

Descriptive analysis of the structure of the costs of wheat production.

Production costs are an important and fundamental issue in economic studies, because production decisions depend largely on the level of production costs, as the volume of production is always linked to production costs, because the importance of studying production costs is a key factor in determining the net income (5). Therefore, this aspect of importance is highlighted in the study. Table 1 shows that variable costs constitute 66% of total production costs, whereas fixed costs represent 27% of total production costs. As for variable cost items, chemical fertilizers costs came first with 24%. Fixed cost items came in first place with 14%. Descriptive analysis of revenue and gross profit from wheat production. Table 2 shows that the total revenues amounted to 4,137,040,000 dinar, an average of about 31,823,385 dinar at the farm level, while the total profit amounted to 2,000,888,143 dinar, with an average of about 16,431,937 dinar. The area cultivated in the research sample reached about 8562 dunums. Economic, statistical and econometric analysis of the economic production function of wheat crop: The parameters of the model variables were estimated using a econometric model in
several formulas (linear, semi logarithmic, inverse semi logarithmic and finally double logarithmic) to select the best by using statistical and standard tests with the economic logic and representation of the above productive relationship, especially passing the statistical and econometric tests and according to the tests of the first and second degree.

Table 1. Costs structure of wheat crop production.

| Items            | Cost per project (IQD) | Total cost in the research sample (IQD) | Relative importance |
|------------------|------------------------|----------------------------------------|---------------------|
| Seeds            | 1686484.177            | 219242943                              | 11%                 |
| Fertilizers      | 3730174.615            | 484922700                              | 24%                 |
| Pesticides       | 76769.23077            | 9980000                                | 0%                  |
| Fuel             | 734230.7692            | 95450000                               | 5%                  |
| Maintenance      | 275269.2308            | 35785000                               | 2%                  |
| Mechanical Labor | 3597038.462            | 467615000                              | 23%                 |
| Variable Costs   | 10099966.48            | 1312995643                             | 66%                 |
| Marketing Costs  | 1108461.538            | 144100000                              | 7%                  |
| Land Rent        | 228200.7692            | 296661000                              | 1%                  |
| Depreciation     | 2163815.385            | 281296000                              | 14%                 |
| Interest on Capital | 1143464.615       | 148650400                              | 7%                  |
| Humen Labor      | 647538.4615            | 84180000                               | 4%                  |
| Fixed Costs      | 4183019.231            | 543792500                              | 27%                 |
| Total Costs      | 15391447.25            | 200088143                              | 100%                |

Source: Prepared by the researcher based on the questionnaire data.

Table 2. Total revenue and profit from wheat production.

| Items                | The Average In Sample Level | Total     | Relative Importance |
|----------------------|----------------------------|-----------|---------------------|
| Production (Tons)    | 55.5                       | 7219.05   |                     |
| Main Revenue (IQD)   | 29,870.577                 | 3,883,175,000 | 94%                |
| Secondary Revenue (IQD) | 1,952,808                 | 253,865,000 | 6%                 |
| Total Revenue (IQD)  | 31,823,385                 | 4,137,040,000 |                  |
| Total cost (IQD)     | 15,391,447                 | 2,000,888,143 |                  |
| Profit (IQD)         | 16,431,937                 | 2,136,151,857 |                  |

Source: Prepared by the researcher based on the questionnaire data.

All coefficients of the estimated productive function were positive and consistent with what was expected according to the logic of economic theory. It may be noted through the analysis that the capital variable is more specific to the production of wheat crop, because the crop responds to the requirements of production of seeds and fertilizers and does not require a large amount of labour as wheat crop is one of the least need crops for agricultural labour. The f test showed that the overall model was significant at significant levels above 1%. The determination coefficient $R^2$ indicates that 91% of the variation in wheat production in Dhi Qar province was caused by independent variables (labor and capital), while 9% of these changes were due to other variables such as soil quality, climate and management, water source, not included in the model. Its estimated effect has been absorbed by the random variable (Ui). Econometric tests of the estimated model were carried out. The results indicate that the estimated model suffers from autocorrelation, according to the Breusch-Godfrey Serial Correlation LM Test. Multicolinearity has been solved because the estimated model is the logarithmic model is free from the problem of linear correlation. To detect heteroskedasticity, Breusch-Pagan-Godfrey test was used (14). It was found that the model estimated by the method of ordinary least-squares OLS suffers from heteroskedasticity. This requires appropriate
treatment to get rid of this problem of autocorrelation and heteroscedasticity. Therefore, the model was estimated using the robust regression method to treat the two problems. This method (Robust Least Squares) is one of the efficient methods to treat these two problems with it. The robust regression method was used, as showed in table 6. All the coefficients of the new production function, estimated by the robust regression, came with a positive and consistent signal with what was expected according to the logic of economic theory. The estimated function parameters were significant at the 1% level according to the t test and f test as a whole at significant levels above 1%. The Jargue-Bera test showed that the remainder of the estimated function is normally distributed. It proved that increasing the number of working hours by one unit when the amount of capital is stable at the average will lead to an increase in production by 14%, while the impact of capital on the amount of production is greater, as production will increase by 75% when the capital increase by one unit. Wheat yields are not highly dependent on labor, while production responds significantly to increased spending on seed and fertilizer inputs. Since the parameter value of the variable in the double logarithmic function represents the productive elasticity of that variable. The estimated function reflects that the production elasticity of the capital resource is 0.75, a positive value which is higher in value than the labor resource, indicating that wheat production depends mainly on the use of technology from improved seeds and the use of modern fertilizers, pesticides and agricultural mechanization. This is consistent with the economic reality of the sample farms as shown in the field survey, while the elasticity of the labor resource was about 0.14, which indicates that the crop weak response to the number of working hours if the crop does not require long hours of work. It reached 0.89, which is less than the correct one, indicating a decrease in the return on scale, meaning that the increase in production resources by 100% is accompanied by a decline in total output by 11%. This means that production function is in the second stage of the function and. The determination coefficient R² indicates that 70% of the variation in wheat production in Dhi Qar province was caused by independent variables (labor and capital).

| Variable | Coefficient | Std. Error | t-Statistic | Prob.  |
|----------|-------------|------------|-------------|-------|
|          |             |            |             |       |
| C        | -9.346258   | 0.647448   | -14.43553   | 0.0000|
| LOG(L)   | 0.142983    | 0.025860   | 5.529086    | 0.0000|
| LOG(K)   | 0.752065    | 0.050132   | 15.00175    | 0.0000|

Source: Prepared by the researcher based on the results of the statistical program eviews 11.
Table 4. LM test

Breusch-Godfrey Serial Correlation LM Test:

| F-statistic     | 8.874872 | Prob. F(2,125) | 0.0002 |
|-----------------|----------|----------------|--------|
| Obs*R-squared   | 16.16442 | Prob. Chi-Square(2) | 0.0003 |

Test Equation:
Dependent Variable: RESID
Method: Least Squares
Date: 10/11/19  Time: 20:05
Sample: 1 130
Included observations: 130
Presample missing value lagged residuals set to zero.

| Variable  | Coefficient | Std. Error | t-Statistic | Prob. |
|-----------|-------------|------------|-------------|-------|
| C         | 0.103671    | 0.627638   | 0.165177    | 0.8691|
| LOG(L)    | 0.013674    | 0.025036   | 0.546176    | 0.5859|
| LOG(K)    | -0.012682   | 0.048654   | -0.260663   | 0.7948|
| RESID(-1) | 0.311252    | 0.090706   | 3.431431    | 0.0008|
| RESID(-2) | 0.099539    | 0.093381   | 1.065941    | 0.2885|

R-squared    | 0.124342    | Mean dependent var | 3.30E-16 |
Adjusted R-squared | 0.096321    | S.D. dependent var  | 0.216058 |
S.E. of regression | 0.205389    | Akaike info criterion | -0.290116 |
Sum squared resid  | 5.273098    | Schwarz criterion   | -0.179827 |
Log likelihood    | 23.85756    | Hannan-Quinn criter. | -0.245302 |
F-statistic       | 4.437436    | Durbin-Watson stat  | 1.970895 |
Prob(F-statistic) | 0.002183    |                        |         |

Source: Prepared by the researcher based on the results of the statistical program eviews 11.

Table 5. Breusch-pagan-godfrey test

Heteroskedasticity Test: Breusch-Pagan-Godfrey

| F-statistic     | 6.976877 | Prob. F(2,127) | 0.0013 |
|-----------------|----------|----------------|--------|
| Obs*R-squared   | 12.86938 | Prob. Chi-Square(2) | 0.0016 |
| Scaled explained SS | 15.29498 | Prob. Chi-Square(2) | 0.0005 |

Test Equation:
Dependent Variable: RESID^2
Method: Least Squares
Date: 10/11/19  Time: 20:15
Sample: 1 130
Included observations: 130

| Variable  | Coefficient | Std. Error | t-Statistic | Prob. |
|-----------|-------------|------------|-------------|-------|
| C         | -0.732498   | 0.208743   | -3.509084   | 0.0006|
| LOG(L)    | -0.024277   | 0.008338   | -2.911774   | 0.0042|
| LOG(K)    | 0.059989    | 0.016163   | 3.711503    | 0.0003|

R-squared    | 0.098995    | Mean dependent var | 0.046322 |
Adjusted R-squared | 0.084806    | S.D. dependent var  | 0.073386 |
S.E. of regression | 0.070206    | Akaike info criterion | -2.451973 |
Sum squared resid  | 0.625960    | Schwarz criterion   | -2.385799 |
Log likelihood    | 162.3782    | Hannan-Quinn criter. | -2.425084 |
F-statistic       | 6.976877    | Durbin-Watson stat  | 1.693581 |
Prob(F-statistic) | 0.001334    |                        |         |

Source: Prepared by the researcher based on the results of the statistical program eviews 11.
Table 6. The new production function of wheat by using Robust Least Squares method

| Variable | Coefficient | Std. Error | z-Statistic | Prob. |
|----------|-------------|------------|-------------|-------|
| C        | -9.401507   | 0.637911   | -14.73796   | 0.0000|
| LOG(L)   | 0.140183    | 0.025479   | 5.501890    | 0.0000|
| LOG(K)   | 0.757099    | 0.049393   | 15.32796    | 0.0000|

Robust Statistics

R-squared          0.701290  Adjusted R-squared 0.696586
Rw-squared         0.930244  Adjust Rw-squared 0.930244
Akaike info criterion  121.7047  Schwarz criterion 131.6984
Deviance           5.089641  Scale                 0.208484
Rn-squared statistic 1428.854  Prob(Rn-squared stat.) 0.000000

Non-robust Statistics

Mean dependent var 3.599699  S.D. dependent var 0.745994
S.E. of regression 0.217815  Sum squared resid 6.025292

Source: Prepared by the researcher based on the results of the statistical program eviews 11.

Table 7. Jatque-bera test

| Source: Prepared by the researcher based on the results of the statistical program eviews 11. |
|-------------------------------------------------------------|
| Measuring yield returns in wheat production: This shows that the yield value of the wheat yield was 0.89, smaller than the correct one, which indicates that there are decreasing capacity yields, this indicate that the yield of the crop is subject to decreasing yields based on economic theory. Production is done in the third stage of the production function. 100% of the resources considered will result in an 11% decrease in production. Measuring the distribution efficiency of resources used in wheat production: The results of the distributional efficiency of the labor and capital resource are shown in table 8. It reached 1.28 for the labor resource and about 20.6 for the capital. The allocative efficiency of the human labor resource is low compared to the capital allocative efficiency, which is greater than the correct one. This means that the marginal cost of one working hour by was 1.8 thousand will increase the value of the marginal output of the supplier by IQD 2.41 thousand. Wheat depends on mechanical labor. The human labor resource has not achieved the optimum level, the number of working hours used below the required level that |
achieves price efficiency. The decrease in the quantities of human labor is due to the high marginal cost, which means that the use of human labor should be increased with a decrease in its cost because This resource contributes to the increase in the marginal production value of the resource as it increased by about 22%. As for the capital resource, it has been shown that the distributional efficiency is high, reaching 20.6, which is also greater than the correct one. This means an increase in the cost of capital by 10%, which will lead to an increase of IQD 2.06 thousand in relation to the value of the marginal output of the resource, shown by the value of the capital efficiency, and the amount of change in the value of marginal product as a result of the use of capital amounted to 95%. It achieves an increase and therefore the use of capital must be increased in such a way that the resource achieves the price efficiency. It is evident from the distribution efficiency study that resources used in the production of wheat crop in the province of Dhi Qar achieve the optimal use of capital, and there was a surplus in the use of the resource capital, and therefore reflected on the profits from the production of wheat crop.

Table 8. Results of the distribution efficiency of the resources used in wheat production.

| Variables    | GM*    | MVP   | MFC   | AE     | D%   |
|--------------|--------|-------|-------|--------|------|
| Total Revenue| 21086.65 | -     | -     | -      | -    |
| Human Labor  | 1228.34 | 2.406 | 1.88  | 1.283  | 22.08|
| Capital      | 7736.61 | 2.064 | 0.10  | 20.635 | 95.15|

Source: Work of the researcher based on the questionnaire.

* GM: Geometric mean (1000 dinars).

Recommendations

In light of the results, the research found that by measuring the yield value of the capacity of 0.89, the production of wheat crop in Dhi Qar province yields decreasing returns to scale. The distribution efficiency study also showed that the resources used in the production of the crop were not optimized, as there is a shortage in the use of the labor resource for optimal use that achieves economic efficiency and this affects the low efficiency of crop production. Therefore, the research recommends the need to increase the amount of human labour in wheat production in the province of Dhi Qar. This would achieve economic efficiency of crop production in the province, as well as the need to allocate properly available resources by farmers because of its impact in increasing the economic efficiency of those resources which in turn will be reflected in increasing crop production efficiency.

REFERENCES

1. Ahmad, M., M. Afzal, A. Ahmad, A.U.H. Ahmad and M.I. Azem.2013.Role of organic and inorganic nutrient sources in improving wheat crop production Secretary Agronomic in Moldova vol. XLVI. 153 (1): 15-21.
2. Ahmed, A. S. 2006. Economic Study of Factors Affecting Poultry Production in Giza Governorate. Department of Agricultural Economics, college of Agriculture. University of Al-Azhar, Arab Republic of Egypt. pp:167.
3. Ahmed,M.T., S. C. Nath, S. S. R. M. Sorwar, and M. H .Rashid. 2015. Cost effectiveness and resource use efficiency of sweet potato in bangladesh .Journal of Agricultural Economics and Rural Development (JAERD). 2(2): 26-31.
4. Ajewole,O.C.2015.Income and factor analysis of watermelon productionin ekiti state, Nigeria.Journal of Economics and Sustainable Development .6(2):67-72.
5. Alabi, O. F., B. Owonibi, S. Olafemi and S. Olagunju. 2013. Production analysis of groundnut in birnin gwari local government area of kaduna state.PAT December. 9(2):102-113.
6. Al-Azzi, J. M. 2002. The possibility of achieving economic objectives in small farms. Journal of Agricultural Sciences. 33 (3): 245-250.
7. Al-Bahadli, F. H. 2012. Effect of Fragmentation of Farm Holdings on the Costs and Productivity of Wheat Crop. MSc. Thesis . Agric. Economics Department. Coll. of Agric. University of Baghdad.pp:128
8. Ali, I. H. 2014. Measuring the Economic Efficiency and Determining the Economic Size of the Farms of Diyala Province. Ph.D. Dissertation, Department of Agricultural Economics. college of Agric. University of Baghdad.pp:210.
9. Al-Omairi, S. A. 2011. An economic Study of the Response of the Wheat and
Barley Crop in Iraq for the Period (1980-2009). MSc. Thesis. Agricultural Economics Department. college of Agric. University of Baghdad.pp:148.

10. Alufohai G. O. ,and O. B. Izekor. 2014. Production elasticities, return to Scale and allocative efficiency in yam production in Edostate, Nigeria. Agrosearch.14(2):179-190.

11. Barbaz, D. S. 2014. The economic evaluation of producing wheat at al-abaichi farm. The Iraqi Journal of Agricultural Sciences. 24 (2): 165-173.

12. Barbaz, Dh. and S. Izzaldin. 2019. Role of tenure in the feasibility of wheat production projects in Dhi-Qar governorate. The Iraqi Journal of Agricultural Sciences . 50(6).

13. FAOSTAT.

14. Gujararti, D. 2004. Basic Econometrics. Mc Graw. Hill. Book Co. New york .pp:1002.

15. http://coagri.uobaghdad.edu.iq

16. Madaki, M. J., I. Y. Abba, G. Auwalu, and A. Mary. 2015. Resource use efficiency of groundnut production in biu local government of Borno State, Nigeria. Researchjournali’s Journal of Agriculture. 2 (6):1-8.

17. Sanusi, S. M., A. O. Ogunbile, M. T. Yakasal, M. M. Ahmad, and M. I. Daneji. 2015. Optimization of Resource use efficiency in small scale maize production in Niger State, Nigeria. Asian Journal of Science and Technology. 6:1070-1075.

18. www.aragaam.com/ar/article/articledetail/id/468104.

19. Zidane, A. G. 2015. An analytical study of the economics of wheat production in Muqdadiya district. Euphrates Journal of Agricultural Sciences. 3: 268-281.
