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# DETERMINANTES OF THE ECONOMIC EFFICIENCY OF WHITE ONION PRODUCTION (CRYSTAL) IN NINEVEH GOVERNORATE FOR THE PRODUCTION SEASON 2022 (A FIELD STUDY IN SHEKHAN DISTRICT)

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**ABSTRACT**

The research aimed to study the determinants of economic efficiency and the amount of surplus the deficit in the quantities used in the production of dry onions (crystal) in Nineveh Governorate and for the 2022 production season. The study included 52 farms that produce onions in the Sheikhan district. Data on the study were obtained through a questionnaire form dedicated to this purpose and through interviews with farmers. The variables studied included the quantity of production in Each farm as a dependent variable, and each of the (cultivated area, seeds, no fertilizers, labor, mechanical work, pesticides, and irrigation hours) as independent variables, using the data envelopment analysis DEA) method and the statistical program Deap). Economic efficiency results and components have the results of economic efficiency and, as well as determining the amount of surplus or deficit in each farm. Both economic, allocative, and economic efficiency in Palm reached an average of about (86%, 68%, 60%) in the research sample farms, respectively, while All farms included in the study achieved a surplus in the use of the quantity of resources, with the exception of the resource of irrigation hours, where the deficit rate reached an average of about 27% for the sample, while the rate of waste in the quantities of other resources ranged between 4.5% to 36%. The researcher recommends that farmers take care of price relationships and not purchase supplies. Production in instalments or on deferred payments, as well as the need to know the standard quantities of resources needed by crops and follow scientific instructions in this regard.



## INTRODUCTION

Determining the size of the resources available in the agricultural sector and the efficiency of their exploitation is an important necessity in order to reveal the existing possibilities for developing these resources. Despite the importance of vegetables and their role in promoting health, some of their species offer significant benefits, including onions of all kinds, known for their value. Nutrition and therapeutic capacity (Al- Habar, 2018) and its suitability for food flavors and its role Economic, health, and social, especially in enhancing food security, generating income for many farmers, and reducing poverty by creating job opportunities, as well as the medicinal properties that distinguish it. It has been proven that both garlic and

onions have applications as antimicrobials, anticoagulants, and antitumor. It lowers blood lipids, anti-arthritis, and lowers blood sugar. In recent years, extensive research has focused on the useful and medical properties of garlic and onions. In particular, the use of these agents in the treatment and prevention of heart disease is due to their OH content It is rich in vitamins, minerals, and plant compounds that enhance human health (Thomson and Afzal, 2000)., onions are consumed in large quantities in Iraq and vary in size, shape, color, and flavor. Red, yellow, and white onions are among the most common and consumed species worldwide (onions, ww) grow onions in all countries of the world, including Iraq, where they are grown in most governorates of Iraq in varying area. Nineveh governorate is characterized by the production of all types of onions, especially red and white, and consumed by the entire population in large quantities. However, the population's need is not met by local production, so they resort to Importing the crop from some countries, especially neighboring countries, and the production of onions of all kinds is afflicted with many economic and environmental problems and obstacles, which are among the primary determinants of onion production, especially with regard to the efficient use of quantitative inputs identified for economic efficiency, and thus reduced crop production .

**Research problem**

The research problem summarizes that despite the availability of all production capabilities and requirements, there is no production of dry onion crops. There is a decrease and fluctuation in the cultivated areas below the required level, as well as a decrease in actual production and its distance from optimal production as a result of the lack of optimal use of the productive resources used and thus the failure to achieve economic efficiency. in a way that maximizes production at the lowest cost, and therefore the product does not receive profitable profits as a result of the above, as well as ignorance Some farmers in managing and cultivating the crop. All this has led to many farmers' reluctance to grow the crop, which requires studying the determinants of production efficiency to identify the deviation of the use of resources from the optimal use and the extent to which economic efficiency is achieved in the research sample farms.

**Importance of the research**

The importance of the research comes from importance of the onion crop as it is one of the important food sources for which there are no alternatives at all, in addition to its high nutritional value and health benefits, its use as a treatment for many diseases, and its consumption by all members of society, in addition to its role in enhancing food security and providing opportunities. It is work and a source of income for many families. Identifying the factors that influence and determine economic efficiency and explaining their optimal use to avoid waste and misuse is of great importance to decision makers and farm owners when drawing up their farm plans and formulating agricultural policy. In addition, the issue of resource size and efficiency is an important need to clarify the possibility of improving crop production.

**The research hypothesis**

It is based on the hypothesis that there are many production determinants used in the production of the white onion crop in the research sample farms, which are

used in different quantities and result in varying production that reflects the difference in the use of productive resources and thus a difference in economic efficiency in the research sample farms.

**The research aims**

The aim of the research was to estimate the economic determinants of the production efficiency of white (crystal) onions in Nineveh Governorate and for the 2022 agricultural season and determine the optimal quantities achieved for economic efficiency, including diagnosing the deviation rates in the quantities of resources used in producing the crop for a sample of onion farmers in the Sheikhan region.

**Research method**

The research was adopted to achieve the goal of combining the descriptive analysis method, which is based on economic theories that studied economic efficiency and its components, and previous studies to identify some study variables and the results achieved from these studies in order to make a comparison between the results of our study and the results of other studies to identify the differences and similarities. The quantitative analysis method is to assess the applicable aspect, drawing on some economic, normative and statistical indicators to interpret and test relationships between variables, using data development analysis and using the statistical programmed platform.

## MATERIALS AND METHODS

The crop has been grown on large areas in recent years in the Sheikhan district of Nineveh Governorate as a result of many factors, the most important of which is the availability of irrigation water sources represented by wells and modern irrigation networks, as well as the quality of agricultural land, the availability of labor, and remunerative selling prices for the crop, as the cultivated areas amounted to about 8,62 dunum. Growing in Al- Sheikha district during the productive season 20-22 , and due to the small size of the community (52 farmers), the entire research community was selected , and the cultivated areas in the research sample ranged between 4-33 without m With a total capacity of (862) dunums, and an average of (16.56) dunums/farm The sample's production reached (7533) tons , with an average of (144,865) tons/farm, and the average dunum productivity in the research sample farms was (8738) kg/dunum..

In order to achieve the goal of the research, we relied on data from its original sources and for every farmer, the crop in the Sheikhan district in Nineveh Governorate reached (52) farms and collected crops. The data was obtained through a structured questionnaire form in which the research requirements were specified, and through direct interrogation with the farmers of the research sample. The focus was on the economic determinants of white onion production, which included (cultivated areas, quantity of seeds and fertilizers of all kinds, manpower, mechanical work, pesticides, and number of irrigation hours. In addition to the quantities of the crop produced on each farm, the research also relied on published and unpublished secondary data from official institutions and ministries such as FAO, the Arab Organization for Agricultural Development, statistics of the Ministry of Agriculture and the Iraqi Ministry of Planning. To achieve its objectives, the research relied on the use of descriptive economic analysis and standard economic analysis, and on the

use of some statistical methods and mathematical models Using the restricted frontier methodology or what is called data envelopment analysis ( DEA), the values of economic efficiency and its components in onion production farms were obtained, the optimal use of the productive resources used was determined, and the degree or percentage of excess or deficiency of the resources used was determined using the statistical program (Deap).

Economic efficiency and its components, technical efficiency and allocative efficiency, are the most important indicators of use and are an effective tool that contributes to achieving the sustainability of limited resources by ensuring their optimal use (Kehlude and Awoyemi,2009) It refers to the relationship between inputs and outputs and represents the proportion of actual production corresponding to the limits of production with the use of a certain level of inputs (AL- Nuaimy , and Abd ,2013), and means the use of economic resources in a way that aims to maximize these resources by maximizing the level of production, (Nahm, and Sutummakid, 2003 ) Productive efficiency or so-called technical efficiency means optimal use of available resources, ( Dawoud and Abd, 2013). Technical efficiency reflects the producer's ability to achieve the maximum possible production using the same quantities of productive resources used or to achieve a certain amount of production with the least quantities of resources (Mohammed, and Ali, (2018). To be economically effective, the farm must be technically effective (Sa'il *et al*, 2020), and it represents the operational state of the production unit compared to the maximum limits of the unit that produces at the level of the maximum limits, as it is technically efficient (Emrouznejad and Thanassoulis, 2010). It achieves full technical efficiency, and the efficiency value is equal to the right value. The second source of economic efficiency is allocative efficiency, which means the ability of the production unit to use the optimal combination of productive resources that can be used to produce a certain amount of production at the lowest cost, taking into account the prices of these resources and available production technologies (Coelli, 1995), and is measured in terms of a curve. Iso - quite costs and by finding the tangency point between the iso -quite output curve and the cost line (Iso-Cost This point is considered to achieve both technical and efficiency allocative and therefore economic efficiency, (Hussain and Chaudhary, 1995).

There are two methods for estimating economic efficiency, one is called the random method and the maximum likelihood method is used to estimate Parameters of the random frontier production function (Tsionas. 2012). The other method is a non-parametric method that is used to estimate efficiency in the case of multiple inputs and outputs and for each farm separately. It is known as the (data envelopment analysis method (DEA) (Data Envelopment Analysis) (Mhasin. 2021) which is an indicator for producers about the proportions and quantities used of productive resources and determining the volume of resources achieving economic efficiency at the lowest cost (Sa'il *et al*, 2020). There are several models for measuring the efficiency index using the data envelopment method (DEA), the most important of which are the constant returns to scale model (CRS) and the returns to scale model. Variable (VRS) (Podinovski, 2004). Through them, efficiency can be measured from the input side and it is called the (Input Orientated Measures) Or from the output side, which is called the (Output Orientated Measures model (Cooper and To. 2007) to

measure economic efficiency and its components and determine the size of the optimal resources from the independent production elements that achieve economic efficiency, using data envelopment analysis and the input-oriented model for product control. For inputs more than outputs and resource quantities affecting dry onion production in research sample farms and their prices in light of changing volume returns (VRS). Using a linear programming problem, the economic efficiency model can be depicted as follows (Parikh and Shah, 1995):

$Min_{xi\Lambda}Wi^{1}X^{*}$
Subject to:
$-yi + Y\ \Lambda \geq 0$
$\Theta xi\ ^{*}\_\ x\Lambda \geq 0$
$N,\Lambda = 1$
$\Lambda \geq 0$
X = Vector for minimizing farm costs
W = vector of input prices
YI = output vector

Economic efficiency is calculated EE Depending on both technical competence (TE) Allocative efficiency (AE, (EE=TE × AE, (Al-Guindy and Hanna, 2020) The volume of surplus or insufficient resources to achieve economic efficiency was calculated by comparing the actual volume of resources used in the production process for each farm with the volume of resources achieved for economic efficiency, from which the percentage of waste or deficit in the volume of resources was calculated through the following equations:

Amount Surplus or deficit = the amount of productive resources actually used in each field - the amount of resources achieved for economic efficiency at the lowest cost (Saleh and Jbara, 2022).

Either the percentage of surplus or deficit It = the amount of increase or decrease in productive resources / the amount of actual use of productive resources. (Mohammad and Zuweid, 2022).

Many researchers have conducted studies on the determinants of the economic efficiency of productive resources for agricultural crops during the past decades, including a study (Haile, 2015) of the determinants of the technical, employment and economic efficiency of some onion farms in Ethiopia for a random sample of 200 farmers. The required data was collected using the questionnaire form and using the production function. Random borders. The study revealed that the most important economic determinants of economic efficiency are land fertility and irrigation water, and the most important social determinants are age, experience, and farm income, as well as extension visits. The study recommended improving institutional services This has been done (Manerehu and Libeli, 2020) to assess the economic efficiency of input groups for onion farmers in Rwanda, based on a random sample of 94 farmers, using the random frontier function method derived from the Cobb-Douglas function. The function parameters were estimated using the maximum likelihood method (ML). The results of the analysis showed that seeds and organic fertilizers are the most influential determinants. It was found that the sum of the input parameters was

1.03, which is greater than one. It indicates that onion production in the farms of the research sample was in the stage of increasing returns. The results indicated the significance of education and family size. The study suggested strengthening vocational training for farmers and reintroducing Intensifying agricultural extension to achieve optimal use of inputs.

Target (Al- sanosy, 2020) Study also productive and economic indicators as well as the most important cost items and determine the factors affecting the production of the winter onion crop in Sohag Governorate, using the standard estimate of the functions for producing the crop and a sample of onion farmers for the 2019 agricultural season. The results showed that the optimal size of production and maximum profits for an acre is 23.8 tons, and the volume achieved for the lowest production cost averaged 19.5 tons. Cost elasticity reached 96%, and production takes place in the first stage of production.

(Yahya Abdullahi,2021) studied the economic efficiency of onion production in Kebbi State, for a rando sample of 210 producers, using a questionnaire form, descriptive statistical analysis method, trend analysis, randomization, and the frontier cost function. The study showed that the average cultivated area was 0.8 hectares , and the estimated coefficients for labor cost were 0.345 , seeds were 0.167 , and organic fertilizer was 0.263 , Accordingly, the total cost of onion production was found to have increased, and the economic efficiency of producers ranged from 20% to 91%, averaging 70.30% ,The researcher recommends linking onion production with financial affairs, soft loan institutions, and insurance to increase cost effectiveness and improve suitable varieties.

(AL- Haboobi, 2020) began a to analyse income items and costs and identifying the economic feasibility of onion production and calculating efficiency and its components. The sample was from onion farmers in Diyala Governorate and Khanaqin District for the 2014-2015 production season. The research sample included 12 farms; the area ranged from one to ten square feet. The results of the research showed that the average net cash income reached (672.97) dinars / dunum, and the average economic profit reached (468.65) dinars / dunum. While the average efficiency reached (0.91, 0.45, 0.41) technical, allocative, and economic, respectively, it was found that there were positive returns and most of the financial indicators. The study recommended ending the fragmentation of ownership and adopting support policies for onion farmers.

Onion crops of all kinds are grown in most countries of the world, and the continent of Asia occupies first place, contributing to the production of about 67% of global production. India, China and Egypt are among the largest onion producing countries, with the production of these countries estimated at (23,641,008, 24,163,008, 3,312,469) tons annually, respectively. The crop is grown in large areas, and India occupies the largest area (16,181,500) Hectare (World Food and Agriculture Organization) (FAO). Crop productivity per hectare varies according to varieties, production conditions, planting season, and farm efficiency, and ranges between 15 to 40 tons. The Arab world contributes 5.51% of the cultivated area in the world, as the cultivated area reached 302.04 thousand hectares, while it was The Arab world's contribution to global production is 7.71%, and the Arab world's productivity was greater than the world's productivity, as the Arab world's

productivity reached 6674 kg/dunum, while the world's productivity reached 4771 kg/dunum.

Table (1): The reality of the area, productivity and production of dry onions in Iraq and the Arab world for the period 2001-2020.

| Percentage of Iraq's contribution to the Arab world | | The Arab world | | | Iraq | | | year |
|---|---|---|---|---|---|---|---|---|
| Production | Space | Production (thousand tons) | Productivity (kg/acre) | Area (thousand hectares) | Production (thousand tons) | Productivity (kg/acre) | Area (thousand hectares) | |
| 9.165 | 14.05 | 4211320 | 4553 | 231250 | 386000 | 2969.23 | 32500 | 2001 |
| 3.771 | 7.230 | 4136560 | 4824 | 214380 | 156000 | 2516.12 | 15500 | 2002 |
| 2.819 | 8.101 | 4113560 | 5207 | 197490 | 116000 | 1812.5 | 16000 | 2003 |
| 2.287 | 5.788 | 5026740 | 5708 | 220250 | 115000 | 2254.90 | 12750 | 2004 |
| 3.044 | 8.150 | 5321540 | 5490 | 242310 | 162000 | 2050.63 | 19750 | 2005 |
| 1.744 | 5.176 | 5616950 | 5486 | 255970 | 98000 | 1849.05 | 13250 | 2006 |
| 2.159 | 5.243 | 5822730 | 6073 | 293710 | 125734 | 2041.13 | 15400 | 2007 |
| 1.995 | 5.161 | 5854000 | 5454 | 268310 | 116807 | 2108.42 | 13850 | 2008 |
| 0.760 | 2.315 | 6011130 | 5571 | 269740 | 45735 | 1830.86 | 6245 | 2009 |
| 0.705 | 2.294 | 6323700 | 6182 | 255770 | 44596 | 1899.64 | 5869 | 2010 |
| 1.421 | 4.594 | 6348230 | 6183 | 256700 | 90247 | 1913.14 | 11793 | 2011 |
| 1.981 | 5.002 | 6294230 | 5956 | 264190 | 124693 | 2358.92 | 13215 | 2012 |
| 1.995 | 5.759 | 6464440 | 6207 | 260380 | 129003 | 2150.48 | 14997 | 2013 |
| 0.981 | 3.381 | 7646560 | 6193 | 275700 | 75085 | 2013.65 | 9322 | 2014 |
| 0.291 | 0 .84 | 6366790 | 5212 | 305360 | 18583 | 1794.41 | 2589 | 2015 |
| 0.187 | 0.652 | 7252270 | 6333 | 286260 | 13592 | 1820.03 | 1867 | 2016 |
| 0.168 | 0.722 | 7613630 | 6459 | 294660 | 12842 | 1507.27 | 2130 | 2017 |
| 0.165 | 0.574 | 7875030 | 6219 | 316680 | 13024 | 1789.01 | 1820 | 2018 |
| 0.356 | 1.258 | 8261706 | 6818 | 302949 | 29471 | 1932.27 | 3813 | 2019 |
| 0.816 | 2.718 | 8063920 | 6674 | 302040 | 65829 | 2004.53 | 8210 | 2020 |

Source: Arab Organization for Agricultural Development, Arab Agricultural Statistics Yearbook, various issues.

Iraq contributes 2.71% in terms of the cultivated area in the Arab world and came in seventh place among the total Arab countries. Egypt and Sudan ranked first in terms of area, as each of them contributed (27.36%, 24.46%) respectively. In terms of production, Algeria ranked first, contributing 20.65% of the Arab world's production. Sudan came in second place, contributing 17.46% of the Arab world's

production. Iraq in 12th place with its contribution to Arab production reaching 81.0%. For the 2020 production season, in terms of productivity, Jordan ranked first, with the productivity of one dunum reaching 12,222 kg, Kuwait and Saudi Arabia ranked second. For Iraq's one dunum productivity, it was 1,753 kilograms during the productive season 2020, and it ranked seventeenth among the group of Arab countries and beyond. As shown in Table (1).

## RESULTS AND DISCUSSION

### First: the results of the analysis of economic efficiency and its components on the farms of the research sample

Its components Economic efficiency (EE)and, technical efficiency (TE) and allocative efficiency (AE), were estimated from the input side and using the data envelopment model (DAE) and the statistical program Deap). Depending on the quantity of inputs and their prices, economic efficiency and its components were estimated, assuming variable returns to scale VRSThe inputs included the explanatory variables (X1 area, X2 seeds, X3 fertilizers, X4 labor, X5 mechanical work, X6 pesticides, X7 irrigation hours) and the dependent variable, the quantity of production on each farm.

### Technical efficiency

By reviewing the results of Table (2), it becomes clear that the level of technical efficiency in the farms of the research sample reached between a minimum of 21.1% for the fourth farm and a maximum of 100%. The farms achieving full technical efficiency constituted 36.5% of the total farms of the research sample, and the average technical efficiency reached 85.9. % This level is considered very good and indicates experience and know-how in managing agricultural operations and choosing the most optimal combination of nutrients, despite the presence of waste in the use of resources used in the production process. Based on the average technical efficiency in the farms of the research sample, the estimated amount of waste in the amount of resources was reached. About 14.1%, in other words, the farmer can produce the same level of current production with a smaller amount of inputs used, by 14.1%. Therefore, farms seeking to achieve full technical efficiency must strive to make optimum use of the resources used, especially farms that have achieved lower than average technical efficiency.

### Allocative efficiency

Using the quantity of inputs used in the farms of the research sample and their prices, and using the data envelopment analysis (DAE) method, the allocative efficiency shown in the data in Table (2) was obtained, as it reached an average of 68.9%, which indicates the presence of a surplus in the production costs used in producing the level The current production in the research sample farms is 31.1% of the total costs spent in the research sample farms. This result entails that producers can achieve a higher level of current production using the same current costs , or that redistributing the use of inputs will save an estimated 31.1% (2) of The total costs, and by observing the data in the table , it was shown that the minimum allocative efficiency in the farms of the research sample reached 43.6%, and the maximum limit was 100%, and was achieved by only four farms, which constituted 7.69% of the

total number of farms in the research sample, and these are the only farms that achieved optimal production and use. The optimum is at the point where the production possibilities curve touches the is cost curve. The results of the analysis show that the farms that achieve the lowest allocative efficiency must reduce their costs by 56.4% in order to achieve the optimal allocative efficiency and achieve the optimal use of inputs without incurring losses. It is noted that the technically efficient projects were not This may be due to the lack of interest of some farmers in the price relations between the resources used and the lack of interest in the prices of resources, as most farmers resort to purchasing production requirements on credit (payment is made until the production season), which results in the pictorials being higher than their cash prices. Average allocative efficiency mean increase in the level of costs used in production above gravity costs, equivalent to 43.6% of total costs.

**Economic efficiency**

With regard to economic efficiency, its levels were directly affected by the levels of both technical efficiency and allocative efficiency. The results of the analysis in Table (2) indicate that it ranged between a minimum of 12.9% and a maximum of complete economic efficiency. The percentages of farms achieving complete economic efficiency constituted 7.69% of the total number of farms in the research sample, while the average economic efficiency in the farms in the research sample was 59.9%. This enables farmers to achieve the same level of output in light of reducing production costs or reducing the quantities of resources used by about 41.1%. The low average allocative efficiency indicates misuse of resources, which results in It has to increase the quantities used and thus increase production costs. Observing the results of the analysis, it turns out that the farms that were allocatively efficient have become economically efficient. Farmers' avoidance of achieving high levels of economic efficiency is due to high production costs, which led to the is cost line falling above the production possibilities curve. To achieve Economic efficiency requires reducing costs and moving the is cost line to be tangent to the production potential curve and upward to be tangent to the cost line curve. Thus, farms are technically and allocatively efficient and thus economically efficient.

**Second: Results of estimating the amount of resources achieved for economic efficiency and the quantity and percentage of surplus and deficit on the farms of the research sample**

To estimate the amount of resources that achieve economic efficiency and determine the amount of production at the lowest cost, based on the resources used in onion production and their prices, which are represented by (cultivated area, seeds, fertilizers, labor). The worker (mechanical work, pesticides, irrigation hours), and using the data envelopment analysis method and the statistical program Deap, allocative efficiency was calculated, including calculating the amount of surplus or waste by comparing the actual quantities with the quantities achieved for efficiency, as well as calculating the percentage of surplus or deficit by apportioning the amount of surplus or deficit. Actual quantities are multiplied by 100.

Table (2): The economic efficiency and its components of the dry onion crop in the research sample farms.

| The farmer | Technical efficiency | Allocative efficiency | Economic efficiency | The farmer | Technical efficiency | Allocative efficiency | Economic efficiency |
|---|---|---|---|---|---|---|---|
| 1 | 1.000 | 0.790 | 0.790 | 27 | 1.000 | 0.317 | 0.317 |
| 2 | 0.948 | 0.438 | 0.416 | 28 | .996 | 0.785 | 0.782 |
| 3 | 0.455 | 0.453 | 0.206 | 29 | 0.842 | 0.487 | 0.410 |
| 4 | 0.211 | 0.613 | 0.129 | 30 | 0.809 | 0.622 | 0.503 |
| 5 | 0.740 | 0.656 | 0.485 | 31 | 1.000 | 0.404 | 0.404 |
| 6 | 0.767 | 0.436 | 0.335 | 32 | 0.526 | 0.622 | 0.327 |
| 7 | 0.958 | 0.977 | 0.936 | 33 | 0.695 | 0.482 | 0.334 |
| 8 | 0.811 | 0.847 | 0.686 | 34 | 0.857 | 0.362 | 0.310 |
| 9 | 0.582 | 0.509 | 0.296 | 35 | 1.000 | 0.332 | 0.332 |
| 10 | 0.726 | 0.735 | 0.534 | 36 | 1.000 | 0.911 | 0.911 |
| 11 | 0.811 | 0.594 | 0.482 | 37 | 1.000 | 0.764 | 0.764 |
| 12 | 0.540 | 0.555 | 0.300 | 38 | 0.800 | 0.699 | 0.559 |
| 13 | 1.000 | 1.000 | 1.000 | 39 | 1.000 | 0.571 | 0.571 |
| 14 | 1.000 | 0.968 | 0.968 | 40 | 0.822 | 0.638 | 0.525 |
| 15 | 0.831 | 0.812 | 0.675 | 41 | 0.924 | 0.659 | 0.609 |
| 16 | 0.866 | 0.752 | 0.651 | 42 | 0.794 | 0.678 | 0.538 |
| 17 | 1.000 | 1.000 | 1.000 | 43 | 1.000 | 0.852 | 0.852 |
| 18 | 0.928 | 0.676 | 0.628 | 44 | 0.931 | 0.393 | 0.366 |
| 19 | 0.849 | 0.715 | 0.606 | 45 | 0.876 | 0.556 | 0.487 |
| 20 | 1.000 | 0.897 | 0.897 | 46 | 0.763 | 0.794 | 0.605 |
| 21 | 1.000 | 1.000 | 1.000 | 47 | 0.802 | 0.714 | 0.573 |
| 22 | 1.000 | 0.911 | 0.911 | 48 | 1.000 | 1.000 | 1.000 |
| 23 | 0.989 | 0.638 | 0.631 | 49 | 0.730 | 0.717 | 0.524 |
| 24 | 1.000 | 0.791 | 0.791 | 50 | 1.000 | 0.506 | 0.506 |
| 25 | 1.000 | 0.968 | 0.968 | 51 | 0.725 | 0.498 | 0.361 |
| 26 | 0.791 | 0.806 | 0.637 | 52 | 1.000 | 0.705 | 0.705 |
| Average | | | | | 0.859 | 0.685 | 0.599 |

Source: Outputs of the statistical program deap

**The actual and achieved quantities of economic efficiency and the quantities and percentage of surplus or deficit area resource in the farms of the research sample**

indicates data Table (3) that the quantities achieved for economic efficiency in the farms of the research sample for the area resource amounted to an average of 823 dunums, which is less than the actual area. This resulted in a surplus capacity of 39 dunums and a surplus percentage that averaged 4.5%, and the largest surplus percentage was about 28.5%. For farm (3), the largest waste rate was 32.5% for farm (5). This means that this farm must increase the actual area by 32.5% in order to achieve production at the lowest cost.

**The actual and achieved quantities of economic efficiency and the quantities and percentage of surplus or deficit seed supply on the farms of the research sample**

Indicates data Table (3) that the quantities achieved for economic efficiency in the farms of the research sample for the seed supplier amounted to an average of 1131 kg, which is less than the amount of seeds used. This resulted in a surplus

capacity of 120 kg and a surplus percentage that averaged 9.36%, and the largest surplus percentage was about 55%. For farm the largest waste rate was 52%, and the owner of this farm must increase the amount of seeds by 50% to ensure optimal production is achieved at the lowest cost.

Table (3): The actual and achieved quantities of economic efficiency and the quantities and percentage of surplus or deficit for suppliers of area and seeds on the farms of the research sample.

| Space resource | | | | | Seed supplier | | | |
|---|---|---|---|---|---|---|---|---|
| T | Actual quantities | Quantities achieving efficiency | Surplus or deficit | Surplus or deficit ratio % | Actual quantities | Quantities achieving efficiency | Surplus or deficit | Surplus or deficit ratio % |
| 1 | 25 | 23.5 | 1.5 | 6 | 36 | 32.5 | 3.5 | 9.722 |
| 2 | 7 | 6.38 | 0.61 | 8.84 | 18 | 9.787 | 8.213 | 45.628 |
| 3 | 7 | 5 | 2 | 28.57 | 18 | 8 | 10 | 55.556 |
| 4 | 4 | 5 | -1 | 25 | 38 | 18 | 12 | 40 |
| 5 | 15 | 19.87 | -4.87 | 32.5 | 29 | 27.25 | 1.75 | 6.034 |
| 6 | 17 | 16.68 | 0.31 | 1.83 | 24 | 23.125 | 0.875 | 3.645 |
| 7 | 25 | 23.8 | 1.2 | 4.8 | 40 | 33 | 7 | 17.5 |
| 8 | 20 | 22 | -2 | 10 | 42 | 30 | 12 | 28.571 |
| 9 | 6 | 6.06 | -0.0 | 1.05 | 15 | 9.375 | 5.625 | 37.5 |
| 10 | 17 | 16.68 | 0.312 | 1.83 | 30 | 23.125 | 6.875 | 22.967 |
| 11 | 18 | 17.75 | 0.25 | 1.388 | 35 | 24.5 | 10.5 | 30 |
| 12 | 4 | 5 | -1 | 25 | 20 | 8 | 12 | 60 |
| 13 | 5 | 5 | 0 | 0 | 8 | 8 | 0 | 0 |
| 14 | 6 | 5 | 1 | 16.66 | 10 | 8 | 2 | 20 |
| 15 | 17 | 15.62 | 1.37 | 8.08 | 25 | 21.75 | 3.25 | 13 |
| 16 | 17 | 16.68 | 0.31 | 1.83 | 30 | 23.125 | 6.875 | 22.967 |
| 17 | 23 | 22 | 1 | 4.34 | 30 | 30 | 0 | 0 |
| 18 | 30 | 23.8 | 6.2 | 20.66 | 35 | 33 | 2 | 5.714 |
| 19 | 20 | 22 | -2 | 10 | 40 | 30 | 10 | 25 |
| 20 | 24 | 18.81 | 5.18 | 21.61 | 20 | 25.875 | -5.875 | 29.375 |
| 21 | 30 | 25 | 5 | 16.66 | 35 | 35 | 0 | 0 |
| 22 | 25 | 23.5 | 1.5 | 6 | 38 | 32.5 | 5.5 | 14.473 |
| 23 | 15 | 12.43 | 2.56 | 17.08 | 15 | 17.625 | -2.625 | 17.5 |
| 24 | 5 | 5 | 0 | 0 | 8 | 8 | 0 | 0 |
| 25 | 5 | 5 | 0 | 0 | 10 | 8 | 2 | 20 |
| 26 | 10 | 9.78 | 0.21 | 2.19 | 18 | 14.187 | 3.813 | 21.183 |
| 27 | 6 | 6.06 | -0.06 | 1.05 | 20 | 15 | 5 | 25 |
| 28 | 28 | 23.5 | 4.5 | 16.07 | 25 | 32.5 | -7.5 | 30 |
| 29 | 15 | 16.68 | -1.68 | 11.25 | 25 | 23.125 | 1.875 | 7.5 |
| 30 | 26 | 23.5 | 2.5 | 9.61 | 35 | 32.5 | 2.5 | 7.142 |
| 31 | 5 | 5 | 0 | 0 | 8 | 8 | 0 | 0 |
| 32 | 14 | 16.688 | -2.688 | 19.2 | 30 | 23.125 | 6.875 | 22.967 |
| 33 | 8 | 8.188 | -0.188 | 2.35 | 15 | 12.125 | 2.875 | 19.167 |
| 34 | 6 | 6.063 | -0.063 | 1.05 | 18 | 9.375 | 8.625 | 47.916 |
| 35 | 4 | 5 | -1 | 25 | 10 | 8 | 2 | 20 |
| 36 | 24 | 25 | -1 | 4.166 | 33 | 35 | -2 | 6.06 |
| 37 | 24 | 25 | -1 | 4.1666 | 30 | 35 | -5 | 16.66 |
| 38 | 29 | 25 | 4 | 13.793 | 33 | 35 | -2 | 6.060 |
| 39 | 21 | 20.938 | 0.062 | 0.295 | 22 | 28.625 | -6.625 | 30.11 |
| 40 | 21 | 24.4 | -3.4 | 16.190 | 35 | 34 | 1 | 2.857 |
| 41 | 25 | 23.8 | 1.2 | 4.8 | 30 | 33 | -3 | -10 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 42 | 10 | 8.719 | 1.281 | 12.81 | 15 | 12.813 | 2.187 | 14.58 |
| 43 | 18 | 17.75 | 0.25 | 1.388 | 15 | 2 1.5 | - 6.5_ | 43.333 |
| 44 | 7 | 7.125 | -0.125 | 1.785 | 10 | 10.75 | -0.75 | 7.5 |
| 45 | 16 | 14.563 | 1.437 | 8.981 | 15 | 20.375 | -5.375 | 35.833 |
| 46 | 26 | 23.5 | 2.5 | 9.615 | 30 | 32.5 | -2.5 | 8.333 |
| 47 | 25 | 24.1 | 0.9 | 3.6 | 30 | 33.5 | -3.5 | 11.66 |
| 48 | 33 | 33 | 0 | 0 | 27 | 27 | 0 | 0 |
| 49 | 30 | 24.4 | 5.6 | 18.66 | 33 | 34 | -1 | 3.030 |
| 50 | 5 | 5 | 0 | 0 | 8 | 8 | 0 | 0 |
| 51 | 10 | 7.656 | 2.344 | 23.44 | 13 | 11.437 | 1.563 | 12.023 |
| 52 | 29 | 25 | 4 | 13.79 | 20 | 35 | -15 | 75 |
| | 862 | 823.03 | 38.97 | 4.52 | 1252 | 1131.349 | 120.651 | 9.63 |

Source: It was calculated by the researcher based on the questionnaire form and the outputs of the analysis of the statistical program deap.

## The actual and achieved quantities of economic efficiency and the quantities and percentage of surplus or deficit fertilizer supplier in the farms of the research sample

Data from Table (4) indicate that the quantities achieved for economic efficiency in the farms of the research sample for the fertilizer supplier amounted to an average of 46,581 kg, which is less than the amount of fertilizer used. This resulted in a surplus capacity of 10,358 kg and a surplus percentage that averaged 18.19%, and the largest surplus percentage was about 25 %. The largest waste rate was 48%, and the owner of this farm must increase the amount of fertilizer by 48% to ensure optimal production at the lowest cost.

Table (4): The actual and achieved quantities of economic efficiency and the quantities and percentage of surplus or deficit for fertilizer suppliers and labor on the farms of the research sample.

| T | Seed supplier | | | | Manpower supplier | | | |
|---|---|---|---|---|---|---|---|---|
| | Actual quantities | Quantities achieved for efficiency | Quantities of surplus or deficit | Surplus or deficit ratio | Actual quantities | Quantities achieved for efficiency | Quantities of surplus or deficit | Surplus or deficit ratio |
| 1 | 1700 | 1325 | 375 | 22.058 | 35 | 20 | 15 | 42.857 |
| 2 | 400 | 346.094 | 53.906 | 13.4765 | 10 | 7.138 | 2.862 | 28.62 |
| 3 | 300 | 275 | 25 | 8.333 | 4 | 6 | -2 | -50 |
| 4 | 200 | 275 | -75 | -37.5 | 4 | 6 | -2 | -50 |
| 5 | 1350 | 1040.625 | 309.375 | 22.916 | 30 | 18.25 | 11.75 | 39.166 |
| 6 | 1150 | 876.562 | 273.438 | 23.777 | 23 | 15.625 | 7.375 | 32.065 |
| 7 | 1800 | 1360 | 440 | 24.444 | 35 | 20 | 15 | 42.857 |
| 8 | 1500 | 1150 | 350 | 23.333 | 33 | 20 | 13 | 39.39 |
| 9 | 400 | 329.687 | 70.313 | 17.578 | 10 | 6.875 | 3.125 | 31.25 |
| 10 | 1125 | 876.562 | 248.438 | 22.083 | 25 | 15.625 | 9.375 | 37.5 |
| 11 | 1200 | 931.25 | 268.75 | 22.395 | 23 | 16.5 | 6.5 | 28.260 |
| 12 | 300 | 275 | 25 | 8.333 | 3 | 4 | - 1 | 33.33 |
| 13 | 300 | 275 | 25 | 8.333 | 7 | 6 | 1 | 14.285 |
| 14 | 225 | 275 | -50 | 22.222 | 5 | 6 | -1 | -20 |
| 15 | 1050 | 821.875 | 228.125 | 21.726 | 22 | 14.75 | 7.25 | 32.954 |
| 16 | 1125 | 876.562 | 248.438 | 22.083 | 23 | 15.625 | 7.375 | 32.065 |
| 17 | 1500 | 1150 | 350 | 23.333 | 30 | 20 | 10 | 33.333 |
| 18 | 1725 | 1360 | 365 | 21.159 | 35 | 20 | 15 | 42.857 |
| 19 | 1500 | 1150 | 350 | 23.333 | 30 | 20 | 10 | 33.33 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 20 | 1275 | 985.937 | 289.063 | 22.671 | 26 | 17.375 | 8.625 | 33.173 |
| 21 | 1875 | 1500 | 375 | 20 | 40 | 20 | 20 | 50 |
| 22 | 1700 | 1325 | 375 | 22.058 | 36 | 20 | 16 | 44.444 |
| 23 | 825 | 657.813 | 167.187 | 20.265 | 15 | 12.125 | 2.875 | 19.166 |
| 24 | 225 | 275 | -50 | 22.22 | 6 | 6 | 0 | 0 |
| 25 | 275 | 275 | 0 | 0 | 6 | 6 | 0 | 0 |
| 26 | 700 | 521.094 | 178.906 | 25.558 | 13 | 9.938 | 3.062 | 23.55 |
| 27 | 375 | 329.687 | 45.313 | 12.083 | 10 | 6.875 | 3.125 | 31.25 |
| 28 | 1690 | 1325 | 365 | 21.59 | 35 | 20 | 15 | 42.857 |
| 29 | 1125 | 876.562 | 248.438 | 22.083 | 26 | 15.625 | 10.375 | 39.903 |
| 30 | 1750 | 1325 | 425 | 24.285 | 36 | 20 | 16 | 44.444 |
| 31 | 300 | 275 | 25 | 8.333 | 6 | 6 | 0 | 0 |
| 32 | 1125 | 876.562 | 248.438 | 22.083 | 24 | 15.625 | 8.375 | 34.89 |
| 33 | 525 | 439.062 | 85.938 | 16.369 | 12 | 8.625 | 3.375 | 28.125 |
| 34 | 375 | 329.687 | 45.313 | 12.083 | 7 | 6.875 | 0.125 | 1.785 |
| 35 | 200 | 275 | -75 | -37.5 | 4 | 6 | -2 | -50 |
| 36 | 1900 | 1500 | 400 | 21.052 | 35 | 20 | 15 | 42.85 |
| 37 | 2000 | 1500 | 500 | 25 | 36 | 20 | 16 | 44.444 |
| 38 | 2100 | 1500 | 600 | 28.571 | 37 | 20 | 17 | 45.945 |
| 39 | 1500 | 1095.313 | 404.687 | 26.979 | 30 | 19.125 | 10.875 | 36.25 |
| 40 | 1800 | 1430 | 370 | 20.555 | 36 | 20 | 16 | 44.444 |
| 41 | 1725 | 1360 | 365 | 21.159 | 36 | 20 | 16 | 44.444 |
| 42 | 600 | 466.406 | 133.594 | 22.265 | 15 | 9.063 | 5.937 | 39.58 |
| 43 | 1200 | 931.25 | 268.75 | 22.395 | 26 | 16.5 | 9.5 | 36.538 |
| 44 | 450 | 384.375 | 65.625 | 14.583 | 9 | 7.75 | 1.25 | 13.888 |
| 45 | 975 | 767.188 | 207.812 | 21.314 | 19 | 13.875 | 5.125 | 26.973 |
| 46 | 1600 | 1325 | 275 | 17.187 | 33 | 20 | 13 | 39.393 |
| 47 | 1650 | 1395 | 255 | 15.454 | 33 | 20 | 13 | 39.393 |
| 48 | 1850 | 2750 | -900 | 48.648 | 36 | 20 | 16 | 44.444 |
| 49 | 1800 | 1430 | 370 | 20.55 | 38 | 20 | 18 | 47.368 |
| 50 | 225 | 275 | -50 | 22.22 | 6 | 6 | 0 | 0 |
| 51 | 500 | 411.719 | 88.281 | 17.656 | 10 | 8.188 | 1.812 | 18.12 |
| 52 | 1875 | 1500 | 375 | 20 | 39 | 20 | 19 | 48.717 |
| | 56940 | 46581.87 | 10358.12 | 18.19 | 1163 | 737.952 | 425.048 | 36.54 |

Source: Calculated by the researcher based on the questionnaire form and the outputs of the analysis of the statistical program deap.

**The actual and achieved quantities of economic efficiency and the quantities and percentage of surplus or deficit labor supply on the farms of the research sample**

Indicates data Table (4) indicate that the quantities achieved for economic efficiency in the farms of the research sample for the labor supply amounted to an average of 737 workers, which is less than the number of workers employed. This resulted in the presence of a surplus capacity of 425 workers and a surplus percentage that reached an average of 36.54%, and the largest surplus percentage was about 47 % for the farm (49), and the largest waste rate was 50%. The owner of this farm must increase the number of workers by 50% to ensure optimal production is achieved at the lowest cost.

**The actual and achieved quantities of economic efficiency and the quantities and percentage of surplus or deficit resource Mechanical work on farms of the research sample**

Indicates data Table (5) that the amounts achieved for economic efficiency in the farms of the research sample for the mechanical labor resource amounted to an average of 14,732 working hours, which is less than the amount of labor used. This resulted in a surplus capacity of 3,242 hours and a surplus percentage that averaged 18%, and the largest surplus percentage amounted to about 34% for farm (20), and the largest waste rate was 76%The owner of this farm must increase the amount of mechanical work hours by76% to ensure optimal production is achieved at the lowest cost

**The actual and achieved quantities of economic efficiency and the quantities and percentage of surplus or deficit pesticide supply on the farms of the research sample**

Table (5) shows that the quantities achieved to achieve economic efficiency in the pesticide supplier's research sample farms averaged 690 mm, less than the amount of pesticides used. This resulted in a surplus capacity of 82 mm and a surplus percentage that averaged 10%, and the largest surplus percentage was about 60%. For farm (2), the largest waste rate was 66%, and the owner of this farm must increase the amount of pesticides by 66% to ensure optimal production is achieved at the lowest cost.

Table (5): The actual and achieved quantities of economic efficiency and the quantities and percentage of surplus or deficit for suppliers of pesticides and mechanical work on the farms of the research sample.

| T | Mechanical work | | | | Pesticide supplier | | | |
|---|---|---|---|---|---|---|---|---|
| | Actual quantities | Quantities achieving efficiency | Surplus or deficit | Surplus or deficit ratio | Actual quantities _ | Quantities achieving efficiency | Surplus or deficit | Surplus or deficit ratio |
| 1 | 520 | 434 | 86 | 16.538 | 25 | 20 | 5 | 20 |
| 2 | 125 | 121.6 | 3.4 | 2.72 | 5 | 6.975 | -1.975 | 39.5 |
| 3 | 130 | 106 | 24 | 18.461 | 5 | 2 | 3 | 60 |
| 4 | 60 | 106 | -46 | 76.667 | 6 | 6 | 0 | 0 |
| 5 | 400 | 274 | 126 | 31.5 | 18 | 16.5 | 1.5 | 8.333 |
| 6 | 350 | 238 | 112 | 32 | 15 | 14.25 | 0.75 | 5 |
| 7 | 600 | 461.2 | 138.8 | 23.13 | 23 | 18 | 5 | 21.73 |
| 8 | 500 | 298 | 202 | 40.4 | 20 | 18 | 2 | 10 |
| 9 | 100 | 118 | -18 | 18 | 5 | 6.75 | -1.75 | 35 |
| 10 | 350 | 238 | 112 | 32 | 15 | 14.25 | 0.75 | 5 |
| 11 | 350 | 250 | 100 | 28.571 | 16 | 15 | 1 | 6.25 |
| 12 | 100 | 106 | -6 | 6 | 4 | 6 | -2 | 50 |
| 13 | 90 | 106 | -16 | 17.778 | 4 | 6 | -2 | 50 |
| 14 | 75 | 106 | -31 | 41.333 | 3 | 1 | -2 | 66.66 |
| 15 | 300 | 226 | 74 | 24.67 | 15 | 13.5 | 1.5 | 10 |
| 16 | 350 | 238 | 112 | 32 | 15 | 14.25 | 0.75 | 5 |
| 17 | 500 | 298 | 202 | 40.4 | 20 | 18 | 2 | 10 |
| 18 | 500 | 461.2 | 38.8 | 7.76 | 23 | 20.4 | 2.6 | 11.304 |
| 19 | 500 | 298 | 202 | 40.4 | 18 | 18 | 0 | 0 |
| 20 | 400 | 262 | 138 | 34.5 | 18 | 15.75 | 2.25 | 12.5 |
| 21 | 600 | 570 | 30 | 5 | 25 | 22 | 3 | 12 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 22 | 500 | 434 | 66 | 13.2 | 22 | 20 | 2 | 9.090 |
| 23 | 250 | 190 | 60 | 24 | 11 | 11.25 | -0.25 | 2.272 |
| 24 | 75 | 106 | -31 | 41.333 | 3 | 3 | 0 | 0 |
| 25 | 80 | 106 | -26 | 32.5 | 5 | 6 | -1 | 20 |
| 26 | 200 | 160 | 40 | 20 | 9 | 9.375 | -0.375 | 4.166 |
| 27 | 115 | 118 | -3 | 2.608 | 5 | 6.75 | -1.75 | 35 |
| 28 | 525 | 434 | 91 | 17.333 | 23 | 20 | 3 | 13.043 |
| 29 | 400 | 238 | 162 | 40.5 | 15 | 14.25 | 0.75 | 5 |
| 30 | 490 | 434 | 56 | 11.42 | 22 | 20 | 2 | 9.090 |
| 31 | 100 | 106 | -6 | 6 | 5 | 6 | -1 | 20 |
| 32 | 350 | 238 | 112 | 32 | 15 | 14.25 | 0.75 | 5 |
| 33 | 200 | 142 | 58 | 29 | 8 | 8.25 | -0.25 | 3.125 |
| 34 | 110 | 118 | -8 | 7.272 | 5 | 6.75 | -1.75 | 35 |
| 35 | 60 | 86 | - 26 | 30.23 | 5 | 6 | -1 | 20 |
| 36 | 600 | 570 | 30 | 5 | 25 | 22 | 3 | 12 |
| 37 | 650 | 570 | 80 | 12.307 | 25 | 22 | 3 | 12 |
| 38 | 550 | 570 | -20 | 3.636 | 25 | 22 | 3 | 12 |
| 39 | 500 | 286 | 214 | 42.8 | 20 | 17.25 | 2.75 | 13.75 |
| 40 | 600 | 515.6 | 84.4 | 14.067 | 22 | 21.2 | 0.8 | 3.636 |
| 41 | 500 | 461.2 | 38.8 | 7.76 | 20 | 20.4 | -0.4 | 2 |
| 42 | 200 | 148 | 52 | 26 | 8 | 8.625 | -0.625 | 7.815 |
| 43 | 400 | 250 | 150 | 37.5 | 18 | 15 | 3 | 16.66 |
| 44 | 200 | 130 | 70 | 35 | 6 | 7.5 | -1.5 | 25 |
| 45 | 300 | 214 | 86 | 28.667 | 15 | 12.75 | 2.25 | 15 |
| 46 | 520 | 434 | 86 | 16.554 | 25 | 20 | 5 | 20 |
| 47 | 550 | 488.4 | 61.6 | 11.2 | 25 | 20.8 | 4.2 | 16.8 |
| 48 | 600 | 522 | 78 | 13 | 25 | 17 | 8 | 32 |
| 49 | 600 | 515.6 | 84.4 | 14.067 | 25 | 21.2 | 3.8 | 15.2 |
| 50 | 100 | 106 | -6 | 6 | 5 | 6 | -1 | 20 |
| 51 | 150 | 136 | 14 | 9.333 | 8 | 7.875 | 0.125 | 1.562 |
| 52 | 600 | 570 | 30 | 5 | 25 | 22 | 3 | 12 |
| | 17975 | 14732 | 3242.2 | 18.03 | 773 | 690.5 | 82.5 | 10.67 |

Source: Calculated by the researcher based on the questionnaire form and the outputs of the analysis of the statistical program deap.

## The actual and achieved quantities of economic efficiency and the quantities and percentage of surplus or deficit resource of irrigation hours in the farms of the research sample

Table (6) indicate that the amounts achieved for economic efficiency in the farms of the research sample for the irrigation hours resource amounted to an average of 56,618 irrigation hours, which is greater than the irrigation hours used. This resulted in a deficit of 12,288 hours, and the percentage of the deficit amounted to an average of 27%, and the largest percentage of deficit reached. 62% for farm 42. The owner of this farm must increase irrigation hours by 62% to ensure optimal production at the lowest cost.

Table (6): The actual and achieved quantities of economic efficiency and the quantities and percentage of surplus or deficit for the resource of irrigation hours on the farms of the research sample.

| T | Irrigation hours supplier | | | |
|---|---|---|---|---|
| | Actual quantities | Quantities achieving efficiency | Surplus or deficit | Surplus or deficit ratio |
| 1 | 1300 | 1575 | -275 | 21.153 |

| | | | | |
|---|---|---|---|---|
| 2 | 250 | 313.437 | - 63.467 | 25.38 |
| 3 | 330 | 400 | -70 | 21.212 |
| 4 | 175 | 200 | -25 | 14.28 |
| 5 | 1000 | 1406.25 | -406.25 | 40.625 |
| 6 | 1000 | 1190.625 | -190.625 | 19.062 |
| 7 | 1300 | 1580 | -280 | 21.538 |
| 8 | 1200 | 1550 | -350 | 29.166 |
| 9 | 300 | 471.875 | -171.875 | 57.291 |
| 10 | 850 | 1190.625 | -340.625 | 40.073 |
| 11 | 850 | 1262.5 | -412.5 | 48.529 |
| 12 | 250 | 400 | -150 | 60 |
| 13 | 250 | 400 | -150 | 60 |
| 14 | 200 | 300 | -100 | 50 |
| 15 | 800 | 1118.75 | -318.75 | 39.843 |
| 16 | 800 | 1190.625 | -390.625 | 48.828 |
| 17 | 1200 | 1550 | -350 | 29.166 |
| 18 | 1400 | 1580 | -180 | 12.857 |
| 19 | 1200 | 1550 | -350 | 29.166 |
| 20 | 1000 | 1334.375 | -334.375 | 33.437 |
| 21 | 1400 | 1600 | -200 | 14.285 |
| 22 | 1350 | 1575 | -225 | 16.66 |
| 23 | 600 | 903.125 | -303.125 | 50.520 |
| 24 | 200 | 280 | -80 | 40 |
| 25 | 250 | 400 | -150 | 60 |
| 26 | 400 | 523 | - 123 | 30.75 |
| 27 | 350 | 471.875 | -121.875 | 34.821 |
| 28 | 1400 | 1575 | -175 | 12.5 |
| 29 | 1000 | 1190.625 | -190.625 | 19.062 |
| 30 | 1300 | 1575 | -275 | 21.153 |
| 31 | 225 | 350 | - 125 | 55.55 |
| 32 | 800 | 1190.625 | -390.625 | 48.828 |
| 33 | 400 | 615.625 | -215.625 | 53.906 |
| 34 | 350 | 471.875 | -121.875 | 34.821 |
| 35 | 200 | 400 | -200 | 100 |
| 36 | 1400 | 1600 | -200 | 14.285 |
| 37 | 1400 | 1600 | -200 | 14.285 |
| 38 | 1500 | 1600 | -100 | 6.666 |
| 39 | 1100 | 1478.125 | -378.125 | 34.375 |
| 40 | 1350 | 1590 | -240 | 17.777 |
| 41 | 1350 | 1580 | -230 | 17.037 |
| 42 | 400 | 651.563 | -251.563 | 62.890 |
| 43 | 1000 | 1262.5 | -262.5 | 26.25 |
| 44 | 400 | 543.75 | -143.75 | 35.937 |
| 45 | 900 | 1046.875 | -146.875 | 16.319 |
| 46 | 1200 | 1575 | -375 | 31.25 |
| 47 | 1500 | 1585 | -85 | 5.666 |
| 48 | 1500 | 1800 | -300 | 20 |
| 49 | 1300 | 1590 | -290 | 22.307 |
| 50 | 250 | 400 | -150 | 60 |
| 51 | 400 | 579.688 | -179.688 | 44.922 |
| 52 | 1500 | 1600 | -100 | 6.666 |
| | 44330 | 56618.7502 | -12288.7502 | 27.72 |

Source: Calculated by the researcher based on the questionnaire form and the outputs of the analysis of the statistical program deap.

## CONCLUSIONS

The research sample farms achieved high technical efficiency compared to the level of both allocative and economic efficiency, reaching an average of about 86%, while the research sample farms achieved an average of 68% and 60%, respectively. This means that the farmers have knowledge and experience in the technical aspect and technical relations. for productive resources. The number of technically efficient farms exceeded the number of specialized and economically efficient farms, which confirms farmers' neglect of the price relations of resources. This was reflected at the level of both allocative and economic efficiency. Redistributing the amounts of resources used in onion production in the farms of the research sample and full knowledge of prices will enable them to save production costs amounting to an average of about 40%, or farmers can obtain higher production from using the same amount of costs. There is a surplus in most of the quantities of resources used in producing onions in the farms of the research sample, with the exception of the resource of irrigation hours, as it was found that there is a shortage in their use, at a rate of 27% at the level of the research sample.

## RECOMMENDATIONS

The necessity of redistributing economic resources in a way that ensures achieving full economic efficiency and reaching the optimal size of production to avoid wasting the quantities of resources used. Farmers' interest in price relations and avoiding access to resources at future prices because they lead to higher production costs and thus lower economic efficiency. It is necessary to study and review the approved standard indicators for using quantities of resources and to follow scientific instructions and guidance in using them to avoid high rates of surplus or deficit in the quantities used for resources. It is necessary to study the water needs of the onion crop and follow modern irrigation systems to avoid losses during irrigation operations and to focus on the drip irrigation system to ensure that the crop meets the standard requirements.

## ACKNOWLEDGMENT

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## CONFLICT OF INTEREST

The researcher supports the idea that this work does not conflict with the interests of others.

## محددات الكفاءة الاقتصادية لإنتاج البصل الأبيض (الكرستال) في محافظة نينوى للموسم الإنتاجي 2022 (دراسة ميدانية في قضاء الشيخان)

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**الخلاصة**

استهدف البحث دراسة محددات الكفاءة الاقتصادية ومقدار الفائض او العجز في الكميات المستخدمة في إنتاج محصول البصل الجاف (الكريستال) في محافظة نينوى وللموسم الإنتاجي 2022 وشملت الدراسة 52 مزرعة تنتج البصل في قضاء الشيخان وتم الحصول على البيانات المتعلقة بالدراسة عن طريق استمارة استبيان مخصصة لهذا الغرض وبالمقابلات الشخصية مع المزارعين وشملت المتغيرات المدروسة كمية الإنتاج في كل مزرعة كمتغير تابع وكل من (المساحة المزروعة والبذور ولا أسمدة والأيدي العاملة والعمل الميكانيكي والمبيدات وساعات الري) كمتغيرات مستقلة وباستخدام أسلوب تحليل مغلف البيانات (DEA) والبرنامج الإحصائي Deap. تم الحصول على نتائج الكفاءة الاقتصادية ومكوناتها فضلا عن تحديد مقدار الفائض أو العجز في كل مزرعة وقد بلغت كل من الكفاءة الاقتصادية و التخصيصية والاقتصادية في بالمتوسط في مزارع عينة البحث حوالي (86%، 68%، 60%)على التوالي في حين حققت جميع المزارع المشمولة بالدراسة فائضا في استخدام كمية الموارد باستثناء مورد ساعات الري حيث بلغت نسبة عجز بلغت في المتوسط للعينة حوالي 27% بينما تراوحت نسبة الهدر في كميات الموارد الاخرى بين 4.5% إلى 36% ، ويوصي الباحث ضرورة اهتمام المزارعين بالعلاقات السعرية وعدم شراء مستلزمات الإنتاج بنظام التقسيط أو الآجل وكذلك ضرورة الاطلاع على الكميات القياسية لاحتياج المحصول من الموارد واتباع الإرشادات العلمية في هذا الشأن.

الكلمات المفتاحية: الكفاءة الاقتصادية, محصول البصل, الفائض او العجز.

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## REFERENCES

Abd, Z. F., Sultan, M. M., & Abd, S. S. (2020). Impact of herd size on the productive efficiency of sheep breeding projects at the kokjali region in nineveh governorate for the production season 2018. *The Iraqi Journal of Agricultural Science*, 51 (6), 1613-1622. : https://doi.org/10.36103/ijas.v51i6.1188

Ahmad, M. H., & Zuweid F. Abd. (2022). Optimization of economic resources in raising and fattening poultry fields for 2020 productive season (hamdaniya district: a case study). *Indian Journal of Ecology* (2022) *49* Special Issue (20), 290-297. https://www.researchgate.net/publication/372628844

Al- Gendy, Hoda Ali & Dr. Bassem Doss Hanna (2020). Estimating the economic efficiency of the faba bean crop in assiut governorate, *Egyptian Journal of Agricultural Economics*,30(*1*). https://doi.org/10.21608/meae.2020.138212

Al- Haboobi ZAM (2020). A financial and economic evaluation of the onion crop production in diyala governorate, kanakeen: (as case study). *Plant ArchivesVol.20*, (Supplement1),562-567. https://www.plantarchives.org/SPECIAL%20ISSUE%2020-1/110__562-567_.pdf

Al- Sanosy. Hatem. M (2020) An economic study of onion production in sohag governorate. *The Egyptian Journal Of Agricultural Economics – 30* (2). https://doi.org/10.21608/Meae.2020.138236

Arab Organization for Agricultural Development, *Yearbook of Arab Agricultural Statistics*. Vol *21-41*. https://www.aoad.org/priod_en.htm

Emrouznejad, A., & Thanassoulis, E. (2010). Measurement of productivity index with dynamic DEA. *International Journal of Operational Research*, *8*(2), 247-260. https://doi.org/10.1504/ijor.2010.033140

Haile, B. T. (2015). Determinants of technical, allocative and economic efficiencies among onion producing farmers in Kobo District, Amhara Region, Ethiopia. *Journal of Economics and Sustainable Development*. (Online).*6* (3). https://worldveg.tind.io/record/54405/?ln=en

Coelli. T. J. (1995). Recent developments in parametric modeling and efficiency measurement. *australian journal of agricultural economics.australian.society*. 39 (3). 219-245. https://doi.org/10.1111/j.1467-8489.1995.tb00552.x

Cooper, W. W., Seiford, L. M., & Tone, K. (2007). Data envelopment analysis: a comprehensive text with models, applications, references and DEA-solver software (*Vol. 2*, p. 489). New York: Springer. https://doi.org/10.1007/978-0-387-45283-8

Nahm, D., & Sutummakid, N. (2003). Efficiency of Agricultural production in the Central Region of Thailand (No. 0302). *Macquarie University, Department of Economics*. https://econpapers.repec.org/repec:mac:wpaper:0302

Hussain, S. S., & Chaudhary, M. A. (1995). Analysis of Allocative Efficiency in Northern Pakistan: Estimation, Causes, and Policy Implications [with Comments]. *The Pakistan Development Review*, *34*(4),1167-1180. https://file.pide.org.pk/pdf/PDR/995/Volume4/1167-1180.pdf

Kehinde, AL, & Awoyemi, T. T. (2009). Analysis Of Economic Efficiency In Sawnwood Production In Southwest Nigeria. *Journal of Human Ecology, 26* (3), 175-183. https://doi.org/10.1080/09709274.2009.11906179

Maniriho, A., Musabanganji, E., & Lebailly, P. (2020). Analysis of economic efficiency of small-scale onion production in Volcanic Highlands in Rwanda. *Montenegrin Journal of Economics*,*16*(3),185-196. https://doi.org/10.14254/1800-5845/2020.16-3.15

Mohammed, N. R., & Ali, E. H. (2018). Economic efficiency estimation of Rice crop in the Najaf Province in 2016 growing season. *Jornal of Al-Muthanna for Agricultural Sciences*, *6*(4),55-65. https://www.iasj.net/iasj/download/0c3d407bba48fa56.

Sa'il Abd, S., Abdukkadir Ahmad, M., & Fathi Abd, Z. (2020). Measuring the economic efficiency of honey production in Nineveh governorate for the Season 2018-2019. *Al-Qadisiyah Journal For Agriculture Sciences*, *10*(2), 335-342. https://doi.org/10.33794/qjas.2020.167477

World Food and Agriculture Organization (FAO). https://www.fao.org/home/en

Yahaya Kaka, & Abdullah Auwal Gindi. (2021). Economic efficiency of onion production and price trend in kebbi state, nigeria: a stochastic frontier cost function approach. Direct Research Journal Of Agriculture And Food Science. 9, 325- 333. https://directresearchpublisher.org/drjafs/files/2021/09/Yahaya-and-Abdullahi.pdf

Mhasin Mahmood Al-Jebory . (2021). The production efficiency and determinants of the chickpea crop in Nineveh governorate for the production season2019.

*Mesopotamia Journal of Agriculture*,*49*(*4*),18-34. https://doi.org/10.33899/MAGRJ.2021.132054.1146

Al - Habar, M. (2018). A comparative study for seed extraction methods: air blowering and water soaking for two onion varieties. *Mesopotamia Journal of Agriculture, 46* (1), 41-48. https://doi.org/10.33899/magrj.2018.161415

Al- Nuaimy, Salim. Y., & Abd Zawid, F. (2013). Estimating technical efficiency of buffalo breeder in nineveh province by using both styles of data envelopment analysis and stochastic frontier analysis. *Mesopotamia Journal of Agriculture*,*41*(4),36-2. https://www.iasj.net/iasj/download/5d8f51d4054ddb63

Ali, M., Thomson, M., & Afzal, M. (2000). Garlic and onions: their effect on eicosanoid metabolism and its clinical relevance. *Prostaglandins, Leukotrienes and Essential Fatty Acids (PLEFA), 62*(2), 55-73. https://doi.org/10.1054/plef.1999.0124

Tsionas, E. G. (2012). Maximum likelihood estimation of stochastic frontier models by the fourier transform. *Journal of Econometric 170* (1), 234-248. https://doi.org/10.1016/j.jeconom.2012.04.001

Podinovski, V. V. (2004). Bridging the gap between the constant and variable returns-to-scale models: selective proportionality in data development analysis. *Journal of the Operational Research Society, 55* (3), 265-276. https://doi.org/10.1057/palgrave.jors.2601691

Parikh, A., Ali, F., & Shah, M. K. (1995). Measurement of economic efficiency in pakistani agriculture. *American Journal of Agricultural Economics, 77* (*3*), 675-685. https://doi.org/10.2307/1243234

Daowd, H., & J Abd, S. (2013). Productivity determinants and their effect in the planting yield for the crops of main vegetables in telkeef district. *Mesopotamia jornul of Agriculture, 41*(1),21-31. https://doi.org/10.33899/magrj.2013.74708

Saleh, M. M., & Jbara, O. K. (2022). Measuring economic efficiency of wheat crop producers in desert areas who adopt pivot irrigation technology and who do not adopt for the season2020-2021. *Anbar Journal of Agricultural Sciences*, *20*(1),120-137. https://doi.org/10.32649/ajas.2022.175493