E-ISSN: 2788-9297
P-ISSN: 2788-9289
www.agrijournal.org
SAJAS 2024; 4(2): 52-55
Received: 14-06-2024
Accepted: 17-07-2024

Nuha Mohammad Jead
Department of Agricultural Economics and Extension, Agricultural Economics, College of Agriculture, Tikrit University, Tikrit, Iraq

Yusrah T Bakar AL-Bajari
Department of Agricultural Economics and Extension, Agricultural Economics, College of Agriculture, Tikrit University, Tikrit, Iraq

Correspondence Author:
Nuha Mohammad Jead
Department of Agricultural Economics and Extension, Agricultural Economics, College of Agriculture, Tikrit University, Tikrit, Iraq

Efficiency of irrigation water use for maize crops in Salah El-Din Governorate / Al-Dour District

Nuha Mohammad Jead and Yusrah T Bakar AL-Bajari

DOI: https://dx.doi.org/10.22271/27889289.2024.v4.i2a.143

Abstract
The study aimed to estimate the water use efficiency of the yellow maize crop under supplementary irrigation systems in Salah El-Din Governorate / Al-Dour district as a model for the agricultural season (2020-2021). Al-Safra in Al-Dur District of Salah Al-Din Governorate, which contains the data required for this study. The number of farmers in Al-Dur district for the production season 2021 reached (352) farms, and the total cultivated area reached (3750) dunams for fixed and pivotal irrigation. (70) farms with an area of (1000) dunams, and the number of fixed irrigation farmers is (42) farms with an estimated area of (700) dunams, The indicators of the economic efficiency of irrigation water use were studied, and it was clear from the results that the highest economic efficiency and the highest economic returns were recorded in pivotal irrigation farms. Water, especially since a large number of farmers depend on well water, which contains a high percentage of salt, and thus leads to calcification and blockage of sprinklers. As for the reason for the decline in productivity, it is attributed to poor management of irrigation systems of both types (fixed and pivotal), as well as other factors.

Keywords: Water use efficiency, irrigation methods, maize

Introduction
Water Use Efficiency (WUE) is meant to measure the productivity of the water consumed by the crop. It is measured by comparing the yield of the crop relative to the total water provided per unit area, and since water is the first determinant of productivity, water use efficiency is the sources for evaluating agricultural production systems Especially in areas characterized by limited water sources, as water constitutes the biggest obstacle to production, and it is one of the important criteria used in evaluating the performance of irrigation projects. The main goal at the present time is no longer maximizing production per unit area because the land is not limited to production to the same degree that water causes, because water present and future is the only determinant of agricultural production and its permanence and increase in production. Water use efficiency (WUE) or water productivity (kg/m^3) is defined. As it is equal to the ratio between productivity to the amount of added water used by some researchers to express the efficiency of water use [1]. It is also defined as the ratio of production or revenue to the amount of water consumed or used to obtain this production [2], and the agricultural sector is one of the most important water consuming sectors [3]. And that irrigation water is the main element in Agriculture and the basis of agricultural development. Given the limitations of this element, it is imperative to search for modern irrigation techniques in order to raise the level of efficiency of using this resource to be used in the production of food requirements for the growing population and to formulate future policies in the use of water resources that have a significant impact on increasing the productivity of most agricultural crops, including the crop yellow corn.

Research importance
1. Water resources are the backbone of life and an important source for the prosperity and development of the agricultural sector.
2. There is a direct relationship between agriculture and water resources in order to achieve food security.
3. The yellow corn crop is of great importance, so it must be taken care of and its productivity increased through the use of modern irrigation methods.

Research problem

Water is one of the most important natural resources to which food security is linked and on which human survival depends, especially the agricultural field, where agriculture is the main source of food provision and is one of the largest water-consuming activities.

Research aims

1. Calculating the efficiency of water use in the maize production farms in the study sample for the actual production levels achieved.
2. Calculating the productivity of irrigation water (kg/m^3) for the irrigation methods used in the fields of maize production for the study sample to know the effect of the irrigation method used in increasing the productivity of the water unit (m^3).
3. Estimation of indicators of the economic efficiency of irrigation water in the production of maize crop.
4. Coming up with suggestions to improve the efficiency of water use and achieve agricultural development.

Research hypothesis

The hypothesis of the research lies in the low level of productivity of the maize crop as a result of the use of backward methods in agriculture, foremost of which are traditional irrigation methods.

Search method

The research relied on two methods, namely the descriptive and quantitative method. The descriptive method deals with the general description of the governorate under study and its importance and the importance of the crop and its occurrence in terms of area and productivity, in addition to the social and economic characteristics of the sample. As for the quantitative side, it is economic and standard that deals with economic indicators of water use efficiency.

Data sources

First preliminary data

The study relied on data from its field sources, as field data were collected for a sample of maize farmers in the areas used for supplementary irrigation methods (pivot and fixed sprinkler irrigation) in Al-Dour district of Salah al-Din governorate for the productive season (2020-2021), and data were collected on Through a personal interview with each farmer to obtain the required data by designing a questionnaire prepared for this purpose.

Second secondary data

Secondary data were obtained through the Ministry of Agriculture, the Ministry of Water Resources, and the Ministry of Planning and Development Cooperation, publications related to the subject of the research.

Results and Discussion

Water use efficiency on-farm

Horizontal and vertical agricultural development is an urgent necessity in facing the future requirements of the agricultural sector in Iraq [4]. The water crisis is relatively due to the factors of scarcity and drought, but the reality of the crisis is due to the misuse of these resources [5]. As horizontal agricultural expansion depends on the availability of irrigation water as the most important elements determining the implementation of the policy of reclamation and increasing the agricultural area, with rationalizing the use of irrigation water, raising the efficiency of irrigation as well, and using modern irrigation methods in agriculture. Therefore, work on studying the efficiency of water use in the agricultural sector requires raising this efficiency in all stages of water circulation. Conserving water is a paramount necessity in the coming period on an ongoing basis.

Water use efficiency (WUE) or water productivity (kg/m^3) is defined as being equal to the ratio between productivity to the amount of added water that some researchers use to express water use efficiency [1].and it is also known as the ratio of production or revenue to the amount of water used by some researchers. The water consumed or used in obtaining this production [2]. And this can be expressed mathematically as follows:

WUE = Revenue / (Water Used)

The returns in the above equation represent the yield of the crop, net profits, yield, or any other benefits. As for the water used to obtain these benefits or returns, it can be the total amount of water supplied to the irrigation project, the depth of irrigation, or just the amount of water entering the field soil, or the amount of evaporation transpiration of the crop. Perhaps the net profit per one cubic meter of water consumed in production is the most acceptable expression of water use efficiency [6].

The concept of water productivity is a useful tool because it provides farmers with the amount of water required to obtain the greatest yield. Water productivity is a concept that shows the value or benefit derived from the use of a certain amount of water, which has been defined as the amount of production achieved per unit of water entering the production. Or the value added to water in a particular circumstance. Water productivity can be defined in terms of different production sectors that include water, for example, crop production, forestry, fisheries and water productivity in relation to crop production is referred to as crop water productivity, and it is defined as the amount of crops produced for each volume of water used.

The crop water productivity can be explained in terms of seasonal water used. It can be calculated as follows:

CWP (water Applied) = Crop Yield (kg) / SWA (m^3) (3)

Since:

CWP = Crop Water Productivity

SWA = amount of water used

Cwp (economic) = Px(Crop Yield) (kg)/ SWA(m^3)……..(4)

The prevailing concept in agricultural research on the efficiency of water use as the quantity stored in the root zone of the plant used by the crop, and according to it, the efficiency of water use is known as the ratio between transpiration (mm) to the amount of water added to the field (mm) [7]. These concepts reflect technical standards of efficiency, and thus are not sufficient to assess the economic level of water use efficiency. The economically efficient quantity of water depends on the prices of water and other resources, the prices of output and other economic, technical and environmental factors. To address this situation at the farm level, the concept of water use efficiency on the farm was adopted by Abdullah Arar [8].

The efficiency of irrigation water use on the farm is defined as the ratio between the amount of water required to

produce a certain level of output and the amount of water actually used on the farm, including the amount of rain, which is represented by the following relationship:

FWUB = (amount of irrigation water required) / (amount of irrigation water actually used).

Therefore, increasing the efficiency of water use is achieved by producing a larger amount of the product with the same available amount of water resources or using a smaller amount of water to produce the same levels of production achieved. According to this, the value of the efficiency of irrigation water use in the farm can take values ranging from less than one is greater than one [7]. If the value is less than one, this indicates the amount of water added by the farmer exceeds the amount required for production, which indicates wastage in the use of irrigation water.

Many studies refer to many definitions of the economic efficiency of the use of irrigation water. The economic efficiency of the use of irrigation water means the preservation and maintenance of water resources [9]. And its use in achieving the highest productivity function at the lowest possible cost. From this definition, the concept of raising efficiency in the use of irrigation water revolves around the provision of the quantities of water used in irrigation by developing and increasing the efficiency of irrigation methods used in the transfer and distribution of irrigation water [10]. And to study the estimation of the efficiency of irrigation water use on the farm under the two methods of sprinkler irrigation (fixed and axial) in a sample area search.

Indicators of economic efficiency of irrigation water use preamble

This part deals with the indicators of the economic efficiency of using irrigation water for the maize crop using the fixed and pivotal sprinkler irrigation systems by studying the productivity of the water unit, water use efficiency, the needs of the ton of water, the economic return of the water unit.

1. Productivity of water unit kg/m^3

It is the ratio between productivity (kg) to water capacity (m^3). Some researchers also use water productivity to express the efficiency of water use. It reflects the technical measures of efficiency. Therefore, it is not sufficient to assess the economic level of water use efficiency, as the economically efficient amount of water depends on water prices. Other resources and output as well as economic, technical and environmental factors. Table 1. Shows that the water productivity is stable during the study period for the tenure categories of the fixed and pivotal sprinkler irrigation systems and formed the highest productivity of a water unit for the class 80 dunums at 0.5083 kg/m^3, followed by the productivity of the water unit for the class 100 dunums, which amounted to 0.4945 kg/m^3.

2. The need for a ton of water m^3/kg

It is calculated from the ratio between the water ration to productivity, as we note from Table 1. That the category of 10 dunums constitutes the highest water requirement by 2284 m^3.

3. Water Efficiency

It is defined as the ratio between the amount of water required to produce a specific level of output and the amount of water actually used on the farm. Therefore, the efficiency of water use is achieved by producing the largest amount of the product with the same amount of available water resources or using less water to produce the same levels of production achieved. It was calculated using the DEAP2.1 program as shown in Table 1. As the highest water use efficiency was achieved in the 80 dunums category, followed by the 100 and 40 dunums categories, and the lowest water use efficiency was recorded in the 10 dunums category. For the yellow corn crop farmers using the fixed sprinkler irrigation system for the four categories, the amount of water wastage was large. These results indicate the existence of a large technical gap between the irrigation applications required for the yellow corn crop and the amounts of water actually added to this crop.

4. Economic return per unit of water (JD/m^3)

It is considered one of the most important criteria used in water economics in agriculture in order to compare this yield between produced agricultural crops and the same crop produced using different production techniques, and it is calculated according to the following equation:

Revenue per meter of water (JD/m^3) = total value of revenue per dunum (JD/dunams) / total quantities of water used per dunum m^3

The 80 dunums category achieved the highest economic return for the water unit by 283966 dinars/m^3, followed by the 120 dunams category by 297,297 dinars/m^3, while the 20 dunams achieved the lowest economic returns by the water unit with 225,371 dinars/m^3.

Table 1: Indicators of economic efficiency of irrigation water use

Economic return for a unit of water, dinars/m^3	Water use efficiency	Requirement of a ton of water m^3	Productivity of water unit kg/m^3	Possession Categories (Acres)
238528	0.75	2284	0.4086	10
225371	0.79	2355	0.4246	20
23289	0.80	2281.2121	0.4383	30
2363392	0.82	2244.0476	0.4456	40
255178	0.80	2147.05882	0.4657	60
283966	0.83	1967.32967	0.5083	80
267297	0.81	2021.185792	0.4945	100

***Source*:** From the researcher's work based on the mentioned laws * and using DEAP *

The results achieved for the indicators of the economic efficiency of using irrigation water for maize farmers for irrigation systems can be explained by the fact that the amount of added water is not able to increase productivity and achieve the highest returns for maize growers, but it is related to the efficiency of using these systems as well as the

maize farmers' experience of pivot irrigation systems The efficiency of exploiting these systems and creating the appropriate conditions to achieve optimum exploitation by using the pivot sprinkler irrigation system for the three categories, but the amount of water wastage was large. Water can be attributed to several reasons, including technical reasons related to the nature of the soil, where the amount of water and the needs of a dunum of water vary based on the quality of the soil, as well as the nature of the climate and the crop itself. There are other reasons, such as the quality of the water used, especially that a large number of farmers use well water in the areas of Salah al-Din Governorate, and it is known that well water contains a percentage of salinity and thus is reflected in the low efficiency of water use, and is also reflected in the performance of the sprinkler due to calcifications that lead The drop in productivity has a major role in decreasing the efficiency of water use as it is included in the calculation of water use efficiency, so the drop in productivity is a main reason for the low water use efficiency, and the other reason is due to poor management of irrigation systems of both types (fixed and pivotal) and farmers' lack of awareness The nature of irrigation for the yellow corn crop, As some farmers operate the sprinkler at the end of the day and until the second day, due to circumstances including the distance of the farm from their areas of residence, and thus the quantities of added water are more than the scheduled and sometimes the opposite happens as the quantities of water added are less than the scheduled, and this in turn is reflected in the Water use efficiency of maize farmers in Salah El-Din Governorate and at the level of the study sample. We conclude from this that the rational use of this resource was in the fixed sprinkler irrigation system for the sample (40) dunums and in the pivot sprinkler irrigation system for the sample (80) dunums. The use of water does not depend on the better use of water only, but also on the price of water, the productivity of the crop, the nature of the soil, the type of sprinkler used and the conditions surrounding its operation. Redirecting the resources involved in the production process of the maize crop by agricultural producers, in a manner that ensures the optimal exploitation of resources, which reduces waste in the quantities of resources used, maximizes profits and reduces costs, and this can be achieved through the use of specialists and experienced farmers who have achieved (optimal) economic efficiency. We recommend redirecting the resources involved in the production process of the maize crop from before agricultural producers, in a way that ensures optimal exploitation of resources, which reduces waste in the quantities of resources used, maximizes profits and reduces costs.

Conclusions

Water Use Efficiency (WUE) is a critical factor in agricultural productivity, particularly in regions with limited water resources. The study highlights the importance of efficient water use in irrigation, showing that modern irrigation methods like fixed and pivot sprinkler systems can significantly improve WUE. It is essential to optimize water use to increase crop yields and ensure sustainable agricultural practices. The research suggests that better management and advanced irrigation techniques are crucial for enhancing water productivity and achieving economic efficiency in agriculture, particularly for crops like maize in water-scarce areas.

References

1. Oweis T, Zhang H, Pala M. Water use efficiency of rainfed and irrigated bread wheat in a Mediterranean environment. Agron J. 2000;92(2):231-8.
2. Oweis TY, Hachum AY. Improving water productivity in the dry areas of West Asia and North Africa. In: Water productivity in agriculture: Limits and opportunities for improvement. Wallingford, UK: CABI Publishing; c2003. p. 179-98.
3. Al-Rawi AO. The future of agriculture in Iraq in light of the water variable at the beginning of the next century. Arab J Water Manag. 2009;(2):25-70.
4. Schultz TW. Capital formation by education. J Polit Econ. 1960;68(6):571-83.
5. Salman JD. The Water Crisis and Its Repercussions on Arab Security. Iraqi J Econ Sci. 2002;1(1):1-17.
6. Al-Yuzbaki MMA. Optimum water management in a sub-sector within the North Island Irrigation Project, Rabia. Mosul: University of Mosul; c2007.
7. Al-Jubouri MSG. The economic efficiency of the use of supplementary irrigation in sustainable agriculture: Nineveh Governorate, an applied model. Baghdad: University of Baghdad; c2004.
8. Arar A. Methods and ways to rationalize the use of water in Arab agriculture. National Meeting of the Officials of the Agriculture and Irrigation Sector in the Arab World; c2003 Jul 21-24; Khartoum, Sudan.
9. Khalil SS. The reality of water resources and challenges of Iraqi agriculture. Iraqi Agric J. 2008;20(2):1-10.
10. Alou HA, Wahb A, Dhair AN Al, Arslan O. Efficiency of using low rates of supplemental irrigation on the productivity of wheat, barley and lentils in northern Syria. Arab J Arid Environ. 2019;1(3):61-4.