

The Role of Cartographic Analysis in Agricultural Investments of Cereal Crops in Al-Muthanna Governorate Using GIS

¹Saeed Abdulhussein Shalaan Al-Dhalimi, ²Prof. Dr. Hamid Sfeh Ajrash Al-Rikabi

^{1,2}Dhi Qar University / College of Arts / Department of Geography and Geographic Information Systems

¹Corresponding Author E-mail: art41gsg43@utq.edu.iq

Second Author E-mail: hamidsfeh@utq.edu.iq

Abstract

Wheat is of great importance in human life and plays a major and effective role in ensuring food security and providing sustenance for the population. Undoubtedly, the Iraqi state had long relied on imports to compensate for the deficit in wheat production in order to secure food supplies. Among the most significant imported crops was wheat, sourced from various countries around the world such as Australia, Canada, and Ukraine. In recent years, following the establishment of the Investment Commission in 2006, the Iraqi government has worked to encourage investments, including agricultural investments, particularly the investment of agricultural lands for wheat cultivation, as it is considered one of the strategic crops. This policy contributed to achieving self-sufficiency in wheat production, with output exceeding six million tons in both 2024 and 2025. The study area (Al-Muthanna Governorate) is among the leading governorates in wheat production, with production surpassing 250 thousand tons in 2025. Wheat production through agricultural investments has been achieved by utilizing and investing arable lands in the desert areas of Al-Muthanna Governorate, where desert-region production exceeded 200 thousand tons. Agricultural investments in Al-Muthanna were not limited to wheat production alone; Rather, they also included several other grain crops, such as barley and maize, among others.

Keywords: production, Agricultural, barley

Introduction:

Wheat is an important crop because it is the main source of food in the production of bread and pastries. This is why it is important and there is a focus on expanding its cultivation. In order to expand its cultivation, the Iraqi government has begun to encourage agricultural investments. Among the areas that it has focused on is Al-Muthanna Governorate because of the presence of agricultural resources, especially in the desert region, due to the availability of vast agricultural lands suitable for cultivation, in addition to the presence of groundwater in these areas. Indeed, thousands of dunams have been cultivated in these areas by investors in the agricultural sector in recent years, and production in the governorate has risen to record levels compared to previous years, as production has exceeded more than (200) thousand tons of wheat, which has made the governorate self-sufficient in the production of the wheat crop.

First: The problem of the study:

The problem addressed in this study is as follows:

1. How can technology be employed? GIS in agricultural investment for wheat crops in Al-Muthanna Governorate?
2. Is it possible to prepare a geographic database for agricultural investment in wheat crops in Al-Muthanna Governorate?
3. How does the preparation of agricultural investment maps for wheat crops affect the localization of agricultural investment in Al-Muthanna Governorate?

Second: Study Hypothesis

1. Modern geographic technologies, including the program GIS has a high capacity to support and produce agricultural investment for wheat crops in Al-Muthanna Governorate.
2. By preparing a geographic database for agricultural investment in Al-Muthanna Governorate, it can contribute to the preparation and production of digital maps in a scientific and accurate manner for wheat production areas.
3. Investment maps in Al-Muthanna Governorate can contribute to drawing up agricultural investment policies between the governorate's administrative units for the wheat crop in Al-Muthanna Governorate.

Third: Study Objectives: The importance of this research can be summarized in the following points:

1. Highlighting the most important agricultural investments for the wheat crop in the governorate and their geographical distribution.
2. Using modern geographic technologies, including geographic information systems, in the analysis and digital mapping of wheat cultivation in the governorate.
3. This study contributes to supporting and assisting in future decision-making and policy-making regarding agricultural investments in the governorate's wheat production.

Fourth: The importance of the study

The importance of this study lies in demonstrating several practical and theoretical aspects and highlighting agricultural investment in wheat in Al-Muthanna Governorate. This study is the first of its kind in Al-Muthanna Governorate to address this topic scientifically using modern technologies and in the form of digital maps. The study presents a scientific model through the use of Geographic Information Systems (GIS). GIS in the agricultural field, as this study works to keep pace with developments in modern technologies and using a geographic database of agricultural activities to produce wheat in the governorate and integrate these tools to produce a digital geographic subject. This study provides a reference for many government agencies and institutions in the governorate for the purpose of planning in the field of agricultural investment to expand wheat cultivation.

Fifth: Scope of the study

1. Spatial boundaries: The study area (Al-Muthanna Governorate) is located in the southwestern part of Iraq. It is bordered to the north by Al-Qadisiyah Governorate, to the south and southwest by the international border with the Kingdom of Saudi Arabia, to the east by Dhi Qar Governorate, and to the west by Najaf Governorate (Map 1).
2. Time limits: For the time limits, data was used from 2018 to 2025.
Republic of Iraq, Ministry of Water Resources, General Survey Authority, Baghdad, Map Production Department, Administrative Map of Iraq, scale 1:1,000,000, Baghdad, 2021, using software ARC GIS 10.8

Its total area is (51,642 km²) and is (11.78%) of the total area of the Republic of Iraq, which is (438,317 km²). Al-Muthanna Governorate is the second largest governorate in terms of area after Anbar Governorate and includes (12) administrative units, nine districts, which are (Al-Samawah - Al-Rumaytha - Al-Warka - Al-Khidr - Al-Salman - Al-Majd - Al-Suwayr - Al-Najmi - Al-Hilal) and three sub-districts, which are (Al-Daraji) administratively affiliated with Al-Khidr District, and (Al-Karama) sub-district administratively affiliated with Al-Warka District, and (Basiya) sub-district administratively affiliated with Al-Salman District. As for its astronomical location, Al-Muthanna Governorate is located between longitudes (43.5-46.32) east, and between latitudes (29.05-31.42) north.

Maps showing the geographical distribution, production, and productivity of wheat crops in Al-Muthanna Governorate

Wheat is one of the most important and widely cultivated agricultural crops in the world, as it is used in many industries, most notably food industries such as bread, pasta, biscuits, and confectionery, in addition to its milled byproducts (bran), which are a major source of animal feed. Given the economic importance of wheat, the Iraqi government has encouraged farmers and investors to expand its cultivation in most Iraqi governorates and in suitable areas. Nineveh Governorate ranked first, followed by Salah al-Din Governorate in second place, and Wasit Governorate in third. In recent years, Muthanna Governorate has also been a leading

wheat producer.¹⁾Through Table (1) and the use of the quantitative method ⁽²⁾By using different statistical methods such as the arithmetic mean and standard deviation (*), as well as using the standard score (**).

Table (1) Investment areas, production quantities and productivity of wheat crop for the period from 2018-2025 in Al-Muthanna Governorate

Standard grade	Yield kg	Standard grade	Production quantity ton	Standard grade	cultivated area dunam	agricultural season
-1.51	432	-1.10	2259	-1.14	5223	2018-2019
-1.23	451	-0.87	4028	-0.84	8930	2019-2020
0.46	564	-0.70	5271	-0.72	10279	2020-2021
0.06	529	-0.30	8316	-0.37	15716	2021-2022
0.52	568	0.49	14375	0.52	25278	2022-2023
0.82	588	1.06	18735	1.07	31823	2023-2024
1.00	600	1.42	21454	1.39	35713	2024-2025
	533.1		10634		18994.5	arithmetic mean
	66.6		7578.5		11980.6	standard deviation

Source: Researcher's work based on

1. Data from the Directorate of Agriculture of Al-Muthanna Governorate, Agricultural Production Division for the year 2025
2. Investment Authority in Muthanna Governorate, 2025 data

We note that the highest area cultivated with wheat through agricultural investment in Al-Muthanna Governorate reached (35,713) dunams in the 2024-2025 agricultural season, with a standard value of (1.39). In contrast, the lowest cultivated area reached (5,223) dunams in the 2018-2019 agricultural season, with a standard value of (-1.14). As for the quantity of production, the 2024-2025 agricultural season was the highest in the governorate, reaching (21,454) tons, with a standard value of (1.42). The lowest agricultural season in the governorate was the 2018-2019 season, with a production of (2,259) tons, with a standard value of (-1.10). As for productivity*, the highest productivity for the agricultural season at the governorate level was in the 2024-2025 season, reaching (600) kg, with a standard value of (1.00). The lowest productivity was (432) kg - tons for the 2018-2019 agricultural season.³⁾

We will now explain the geographical distribution and production of agricultural investment in wheat crops, specifically in the Al-Muthanna Governorate, as follows:

A. Samawah District:

Table (2) and Map (2) show that the largest area planted with wheat in the Samawah district, in terms of agricultural investment, was in the 2024-2025 agricultural season, reaching (4350) dunams, with a standard score of (1.20), while the smallest area planted with wheat was in the 2018-2019 season, reaching (600) dunams, with a standard score of (-1.28), while the highest production rate was in the 2024-2025 agricultural season, with a production of (1761) tons, and a standard grade of (1.56), while the lowest

Table (2) Investment areas, production quantities and productivity of wheat crop for the period 2018–2025

In the district of Samawah

Standard grade	Yield kg	Standard grade	Production quantity ton	Standard grade	cultivated area dunam	agricultural season
-0.30	318	-1.16	190	-1.28	600	2018-2019
-0.33	317	-1.09	231	-1.20	730	2019-2020
0.24	338	-0.26	709	-0.29	2100	2020-2021
-0.04	290	-0.13	783	0.10	2700	2021-2022
-0.71	303	0.13	939	0.37	3100	2022-2023
0.18	336	0.95	1411	1.10	4200	2023-2024
2.02	405	1.56	1761	1.20	4350	2024-2025
	329.5		860.5		2540	arithmetic mean
	37.3		576.6		1505.7	standard deviation

Source: Researcher's work based on

1. Data from the Directorate of Agriculture of Al-Muthanna Governorate, Agricultural Production Division for the year 2025
2. Investment Authority in Al-Muthanna Governorate, 2025 data

The production rate in Samawah district was in the 2018-2019 agricultural season, as the production amount reached (190) tons, with a standard grade that reached (-1.16). The highest productivity rate was in the 2024-2025 agricultural season, where the productivity reached (305) kg and a standard degree reached (2.02), while the lowest productivity rate was in the 2021-2022 agricultural season, where it reached (290) kg and a standard degree (-0.04).

B. Al-Rumaytha District:

Table (3) and Map (3) of cultivated areas, production, and productivity of wheat show that the largest cultivated areas for wheat in Al-Rumaytha district were in the 2024-2025 agricultural season, reaching a maximum of (614) dunams, with a standard value of (1.37). The lowest cultivated area for wheat was in the 2018-2019 agricultural season, reaching (200) dunams, with a standard value of (The highest production quantity was in the 2024-2025 agricultural season, as the production for this season amounted to (233) tons, with a standard degree of (1.53). The lowest production quantity was (62) tons for the 2018-2019 agricultural season, with a standard degree of (-1.81). The highest production quantity was in the 2024-2025 agricultural season, as it amounted to (381) kg, with a standard degree of (1.70). The lowest production quantity in Al-Rumaytha district was in the 2018-2019 agricultural season, as it was (312) kg, with a standard degree of (-1.19).

(1Ministry of Agriculture, Directorate of Agricultural Statistics, Statistics Authority, Wheat and Barley Production, 2024, p. 2

(2) It is a method in scientific research that relies on numbers, measurement, and statistics to analyze phenomena in order to reach accurate results.

(*) It is a measure used to measure the degree of dispersion of data around the mean in a given distribution.

(**) A statistical term that expresses the relationship of a specific value to the average of a set of values. This relationship can be negative, positive, or equal to the arithmetic mean if its value is zero. It exists at several levels depending on the value, and these levels include:

1. Level One: More than 1
2. The second level is between (1+) and (0.51+)
3. Level three, between (0.50+) and (0)
4. Level four, between (-0.1) and (-0.50)
5. Level five, between (-0.51) and (-1)
6. Level six is less than (-1)

(*) Productivity is calculated by dividing the quantity of produce harvested from the field by the total area of the field.

.Ministry of Agriculture, Muthanna Agriculture Directorate, Agricultural Production Division, 2025 Data⁽³⁾

Table (3) Investment areas, production quantities and productivity of wheat crop for the period from 2018-2025 in Al-Rumaytha district

Standard grade	Yield kg	Standard grade	Production quantity ton	Standard grade	cultivated area ton	agricultural season
-1.19	312	-1.81	62	-1.62	200	2018-2019
-0.73	323	-0.75	104	-0.73	322	2019-2020
-0.56	327	-0.36	126	-0.26	387	2020-2021
0.02	341	-0.07	142	-0.04	417	2021-2022
-0.14	337	0.41	170	0.69	506	2022-2023
0.90	362	0.73	188	0.70	521	2023-2024
1.70	381	1.53	233	1.37	614	2024-2025
	340.4		146.4		423.8	arithmetic mean
	23.8		56.4		137.9	standard deviation

Source: Researcher's work based on

1. Data from the Directorate of Agriculture of Al-Muthanna Governorate, Agricultural Production Division for the year 2025.
2. Investment Authority in Al-Muthanna Governorate, data 2025.

T. Al-Khader District:

From Table (4) and Map (4), it is clear that the largest area cultivated with wheat in Al-Khader district reached (507) dunams, with a standard score of (1.21), in the 2024-2025 agricultural season. The smallest area cultivated with wheat was in the 2018-2019 agricultural season, with a cultivated area of (170) dunams with a standard score of I arrived at (-1.29), as for the production quantities achieved for the cultivated lands in Al-Khader district for the wheat crop, the highest production quantity was in the 2024-2025 agricultural season, as the production quantity reached (200) tons, with a standard degree of (1.39). As for the lowest production quantity for the wheat crop in Al-Khader district, it reached (52) tons for the 2018-2019 agricultural season, with a standard degree of -1.25 for that season. As for the productivity per dunam, we note that the highest production quantity for the wheat crop in Al-Khader district was

Table (4) Investment areas, production quantities and productivity of wheat crop for the period 2018–2025

In the district of Al-Khader

Standard grade	Yield kg	Standard grade	Production quantity ton	Standard grade	cultivated area	agricultural season
-1.38	317	-1.25	53	-1.29	170	2018-2019
-0.81	333	-0.95	70	-0.99	211	2019-2020
0.94	383	-0.71	83	-0.73	246	2020-2021
-0.50	342	0.07	127	0.21	373	2021-2022
-0.14	352	0.58	155	0.72	442	2022-2023
0.52	371	0.86	171	0.86	461	2023-2024
1.40	396	1.39	200	1.21	507	2024-2025
	356.2		122.7		344.2	arithmetic mean
	28.3		55.6		134.3	standard deviation

Source: Researcher's work based on

1. Data from the Directorate of Agriculture of Al-Muthanna Governorate, Agricultural Production Division for the year 2025.
2. Investment Authority in Al-Muthanna Governorate, data 2025.

This was in the 2024-2025 agricultural season, where the yield per dunam reached (396) kg, with a standard grade of (1.40). The lowest yield was in the 2018-2019 agricultural season, where it reached (317) kg per dunam with a standard grade of (-1.38)).

Th. Warka District:

By analyzing Table (5) and Map (5) of data on cultivated areas, production quantities, and productivity per dunam invested in wheat cultivation in the Warka district, we note that the highest cultivated area was in the 2024-2025 agricultural season, reaching (306) dunams with a standard score of (1.93). The lowest cultivated area for wheat was in the 2018-2019 agricultural season, reaching (93) dunams with a standard score of (-0.58), as for the total production achieved in Al-Warka district for the wheat crop, the highest quantity in the 2024-2025 agricultural season was (119) tons, and its standard degree reached (2.02), while the lowest production quantity in Al-Warka district was in the 2018-2019 agricultural season, as it reached (27) tons and a standard degree reached -0.28), as we note that the highest productivity per dunam in Al-Warka district reached (389) kg for the 2024-2025 agricultural season, and a standard degree reached (2.00), while the lowest productivity in Al-Warka district was in the 2018-2019 agricultural season, as the productivity reached (293) kg and a standard degree reached (-1.17).

Table (5) Investment areas, production quantities and productivity of wheat crop for the period 2018–2025

In the district of Warka

Standard grade	Yield kg	Standard grade	Production quantity ton	Standard grade	cultivated area	season
-1.17	293	-0.81	27	-0.85	93	2018-2019
0.58	311	-0.63	33	-0.64	109	2019-2020
-0.41	316	-0.54	36	-0.54	117	2020-2021
-0.14	324	-0.41	40	-0.45	124	2021-2022
0.11	332	-0.20	47	-0.20	143	2022-2023
0.21	335	0.60	73	0.77	218	2023-2024
2.00	389	2.02	119	1.92	306	2024-2025
	328.5		53.5		158.5	arithmetic mean
	30.1		32.4		76.5	standard deviation

Source: Researcher's work based on

1. Data from the Directorate of Agriculture of Al-Muthanna Governorate, Agricultural Production Division for the year 2025.
2. Investment Authority in Al-Muthanna Governorate, data 2025.

C. Al-Najmi District:

From Table (6) and Map (6), we observe that the 2024-2025 agricultural season saw the largest area cultivated with wheat relative to the land invested in this crop, with the cultivated area reaching (631) dunams and a standard score of (1.81). The smallest area was recorded for the 2018-2019 agricultural season, with (327) dunams and a standard score of (-1.06), as for the production quantities, the highest production quantity was recorded for the 2024-2025 agricultural season, as the production quantity for this season reached (246) tons, and with a standard degree that reached (1.65), and in contrast, the 2018-2019 agricultural season recorded the lowest production quantity for Al-Najmi district, reaching (92) tons, and with a standard degree that reached -1.15. As for the productivity per dunam, the 2024-2025 agricultural season recorded the highest production quantity per dunam, as this season recorded a production quantity that reached (391) kg, and with a standard degree that reached (1.09), while the lowest production quantity per dunam was recorded in the 2018-2019 agricultural season, as it reached (283) kg, and with a standard degree that reached (-1.46).

Table (6) Investment areas, production quantities and productivity of wheat crop for the period 2018–2025In the district of Najmi

Standard grade	Yield kg	Standard grade	Production quantity ton	Standard grade	cultivated area	season
-1.46	283	-1.15	92	-1.06	327	2018-2019
-0.89	307	-1.01	109	-0.78	356	2019-2020
-0.56	317	-0.62	121	-0.54	382	2020-2021
0.26	356	-0.13	148	-0.26	411	2021-2022
0.78	378	0.22	168	0.06	446	2022-2023
0.87	382	0.88	204	0.78	522	2023-2024
1.09	391	1.65	246	1.81	631	2024-2025
	334.8		155.4		439.2	arithmetic mean
	42.3		54.9		105.8	standard deviation

Source: Researcher's work based on

- (1) Data from the Directorate of Agriculture of Al-Muthanna Governorate, Agricultural Production Division for the year 2025.
- (2) Investment Authority in Al-Muthanna Governorate, data 2025.

H. The Judiciary of Glory:

Analysis of Table (7) and Map (7) reveals that the largest area cultivated with wheat in Al-Majd district was in the 2024-2025 agricultural season, with a cultivated area of (268) dunams and a standardized yield of (1.27). The smallest area cultivated with wheat in Al-Majd district was recorded in the 2018-2019 agricultural season, with a cultivated area of (83) dunams and a standardized yield of (1.34). The highest production quantity was recorded in the 2024-2025 agricultural season, reaching (100) tons, with a standard value of (1.35). The lowest production was recorded in the 2018-2019 agricultural season, reaching (26) tons, with a standard value of -1.22. As for the productivity per dunam, the highest productivity per dunam was recorded in the lands cultivated for wheat in the district.

Table (7) Investment areas, production quantities and productivity of wheat crop for the period 2018–2025

In the district of glory

Standard grade	Yield kg	Standard grade	Production quantity ton	Standard grade	cultivated area	season
0.59-	320	-1.22	26	-1.34	83	2018-2019
1.42-	297	-1.01	32	-0.95	111	2019-2020
0.67-	318	0.63-	43	-0.59	136	2020-2021
0.01	337	0.03	62	0.05	182	2021-2022
0.18	342	0.48	75	0.60	221	2022-2023
1.08	367	1.00	90	0.97	247	2023-2024
1.40	376	1.35	100	1.27	268	2024-2025
	336.7		61.1		178.2	arithmetic mean
	27.9		28.7		70.7	standard deviation

Source: Researcher's work based on

- (1) Data from the Directorate of Agriculture of Al-Muthanna Governorate, Agricultural Production Division for the year 2025.
- (2) Investment Authority in Al-Muthanna Governorate, data 2025.

The highest yield in the 2024-2025 agricultural season was 376 kg, with a standard score of 1.40. The lowest yield was recorded in the 2019-2020 agricultural season at 297 kg, with a standard score of (-1.42)).

H. Al-Hilal District:

From Table (8) and Map (8) of the cultivated areas, production quantity, and yield per dunam for wheat in Al-Hilal district for the period from 2018 to 2025, we observe that the largest cultivated area was in the 2024-2025 agricultural season, where the area cultivated for wheat reached (237) dunams, with a standard value of (1.24). The smallest area utilized for wheat cultivation was in the 2018-2019 agricultural season, reaching (67) dunams, with a standard value of (1.30)), while the quantity of production achieved from the investment of agricultural areas was the highest production quantity for the 2024-2025 agricultural season, as the production quantity in Al-Hilal district for this season reached (93) tons, with a standard degree of (1.35), while the lowest production quantity achieved was recorded in the 2024-2025 agricultural season, as it reached (18) tons, and with a standard grade that reached (-1.22)), while the productivity per dunam for the seven recorded seasons was highest in the 2024-2025 agricultural season, as the productivity per dunam reached (396) kg, with a standard degree of (1.31), while the lowest productivity was recorded in the 2018-2019 agricultural season, as it reached (281) kg with a standard degree of (-1.26).

Table (8) Investment areas, production quantities and productivity of wheat crop for the period from 2018-2025 in Al-Hilal district

Standard grade	Yield kg	Standard grade	Production quantity ton	Standard grade	cultivated area	season
1.26-	281	1.22-	18	1.30-	67	2018-2019
1.01-	292	0.98-	25	0.98-	88	2019-2020
0.57-	312	0.74-	32	0.74-	104	2020-2021
0.07-	334	0.14	58	0.32	176	2021-2022
0.64	366	0.56	70	0.58	193	2022-2023
0.95	380	0.90	80	0.88	213	2023-2024
1.31	396	1.35	93	1.24	237	2024-2025
	337.2		53.7		154	arithmetic mean
	44.6		29.1		66.8	standard deviation

Source: Researcher's work based on

- (1) Data from the Directorate of Agriculture of Al-Muthanna Governorate, Agricultural Production Division for the year 2025.
- (2) Investment Authority in Al-Muthanna Governorate, data 2025.

Dr. Qadaa Al-Suwaitr:

From Table (9) and Map (9), we observe that the largest cultivated area invested in wheat in Al-Suwaitr district reached (182) dunams in the 2024-2025 agricultural season, with a standard score of (1.52) for that season. As for the smallest cultivated area recorded, it was in the 2018-2019 agricultural season, reaching (44) dunams, with a standard score of (-1.35)), and regarding the production quantities recorded in the investment of agricultural lands in Al-Suwaitr district, the highest production quantity was recorded in the season.

Table (9) Cultivated areas, production quantities and productivity of wheat crop for the period from 2018–2025
 In the district of Al-Suwaitr

Standard grade	Yield kg	Standard grade	Production quantity Ton	Standard grade	cultivated area	season
1.16-	271	1.17-	12	1.35-	44	2018-2019
0.82-	288	0.84-	19	0.87-	67	2019-2020
0.70-	294	0.47-	27	0.29-	95	2020-2021
0.36-	311	0.28-	31	0.14-	102	2021-2022
0.72	365	0.22	42	0.16	117	2022-2023
0.98	378	0.96	58	0.97	156	2023-2024
1.36	397	1.61	72	1.52	182	2024-2025
	329.1		37.2		109	arithmetic mean
	49.8		21.5		48	standard deviation

Source: Researcher's work based on

(1) Data from the Directorate of Agriculture of Al-Muthanna Governorate, Agricultural Production Division for the year 2025.

(2) Investment Authority in Al-Muthanna Governorate, 2025 data.

In the 2024-2025 agricultural season, the total production reached (72) tons with a standard value of (1.61). The lowest yield per dunam was recorded in the 2018-2019 agricultural season, reaching (12) tons with a standard value of (-1.17). As for wheat yield per dunam in the cultivated lands of Al-Suwaitr district, the highest yield per dunam was recorded in the 2024-2025 agricultural season, reaching (397) kg with a standard value of (1.36). The lowest yield per dunam was in the 2018-2019 agricultural season, reaching (271) kg with a standard value of (-1.16)).

Mr. Qadaa Al-Salman:

Al-Salman district is one of the largest administrative units in the study area (Al-Muthanna Governorate), with an area of (46832) km². Table (10) and Map (10) show that the largest cultivated agricultural areas

Table (10) Investment areas, production quantities and productivity of wheat crop for the period from 2018-2025 in Al-Salman district

Standard grade	Yield kg	Standard grade	Production quantity ton	Standard grade	cultivated area	season
1.44-	489	1.89-	1779	1.10-	3639	2018-2019
1.41-	491	0.84-	3405	0.77-	6936	2019-2020
0.62	610	0.74-	4094	0.79-	6712	2020-2021
0.35	617	0.32-	6925	0.34-	11225	2021-2022
0.57	632	0.52	12709	0.54	20110	2022-2023
0.83	651	0.08	16460	1.06	25285	2023-2024
0.83	651	1.40	18630	1.40	28618	2024-2025
	591.5		9143.1		14646.4	arithmetic mean
	71		6755.5		9945.7	standard deviation

Source: Researcher's work based on

1. Data from the Directorate of Agriculture of Al-Muthanna Governorate, Agricultural Production Division for the year 2025.

2. Investment Authority in Al-Muthanna Governorate, 2025 data.

Wheat cultivation is concentrated in the Al-Salman district. The largest area cultivated with wheat was in the 2024-2025 agricultural season, reaching 28,618 dunams with a standard value of 1.40. The smallest area was cultivated in the 2018-2019 agricultural season, reaching 3,639 dunams with a standard value of [missing value]. As for the quantity of production, the agricultural season 2024-2025 had the highest recorded quantity of production, which amounted to (18630) tons, with a standard degree of (1.40). As for the lowest quantity of production, it was in the agricultural season 2018, 2018, as it amounted to (1779) tons with a standard degree of -1.89. As for the productivity per dunam in Al-Salman district, we export the two agricultural seasons 2023-2024 and 2024-2025 with a productivity of (651) kg with a standard degree of (0.83). As for the lowest productivity, it was in the agricultural season 2018-2019, as the productivity amounted to (489) kg - tons with a standard degree of -1.44.

Conclusions

- Geographic technologies, including the program (GIS) plays a major and clear role in choosing the optimal location for agricultural investments to cultivate wheat in Al-Muthanna Governorate. This gives an impression and a roadmap for planners and stakeholders to rely on the outputs of this study in choosing the appropriate location of agricultural lands and the presence of water reservoirs.
- The study proved that Geographic Information Systems (GIS) programs have the ability to provide a comprehensive and complete view of the agricultural environment of the study area, including the investment in wheat production areas in the governorate. They can also provide sufficient indicators and play a role in selecting the best sites in the future, and assist in cartographic analysis and representation processes, represented by the program (ARC GIS 10.8) and the ability to design, output, input, process and represent data cartographically.

Recommendations

- The need to make extensive use of the technologies of Geographic Information Systems (GIS) programs and their various applications in the process of making appropriate decisions by stakeholders, planners, and strategists in order to improve the reality of agricultural investments, including investment in wheat production in the governorate, especially in the field of map preparation.
- Creating a database related to land uses in the study area and linking it spatially through geographic information systems programs, and working to update it temporally and link it to the various governorate departments, to ensure its ease of use and future updating.
- It is necessary to introduce modern technologies for Geographic Information Systems programs in natural and human geographic studies, as they facilitate analysis and processing processes and are characterized by speed of processing, and to provide technical and material support for agricultural map production and preparation projects, given their clear role in the process of producing diverse maps, which serve as an effective and realistic tool for speeding up research and producing quick, accurate, and necessary results to support agricultural projects.

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