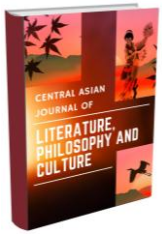

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Article

The Impact of The Decrease in The Water Share of The Musayyib Project on The Agricultural Plan in The District of Kothi in Babylon Province

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Abstract: The large Musayyib project is one of the important irrigation projects in the province of Babylon and is located 65 km south of the city of Baghdad, and is considered the main water source in the district of Kothi, which penetrates most of the territory of the district and its branches to irrigate cultivated crops, and the problem of the study came to highlight the impact of the low water share of the Musayyib project on the agricultural plan in the district of Kothi; One of the objectives on which the study was built is the analysis of climatic elements in a quantitative manner to give specific quantitative results that differ from the descriptive method of the study area, and the division of the study area into rain and thermal ranges to show the climatic variation between the north and the south, and the research adopted the method of scientific analysis and based on the presentation of the subject of the research in addition to the quantitative method in the statement of the temporal and spatial distribution of the water share of the Musayyib project in the study area and its relationship to the agricultural development plan.

Keywords: musayyib project, water share, agricultural crops, agricultural plan.

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1. Introduction

The Musayyib project is one of the important irrigation projects in the province of Babylon and is located 65 km south of Baghdad and within the management of the Directorate of Water Resources in the project (Jableh) and began work in 1951 and began operating in 1955 and irrigates its lands from the main project channel branching from the Euphrates River provider of the Indian dam at km 596 discharge of 40 cubic meters per second and a length of 49.5 km and the area irrigated by 384274.8 dunums, and has also been the establishment of sub-channels, secondary and field and all these channels are Padded, as well as the work included the implementation of a large number of installations of chest and cutter regulators, bridges and ferries [1], [2], [3].

It is considered the main water source in the district of Kothi, which penetrates most of the territory of the district and its branches to irrigate crops grown throughout the year of winter crops such as barley, wheat and crops, and the study will include several axes, including the course of the project, the designs for the project and the water share of the project during recent years, and its relationship to the agricultural plan for the judiciary and the problems facing agriculture and the possibility of developing appropriate solutions and proposals [4].

1. Study problem:

This study came to shed light on the impact of the low water share of the Musayyib project on the agricultural plan in the district of Kothi, so the problem of the study can be determined by the following question whether the decrease in the water share of the Musayyib project affected agricultural development in the district of Kothi in Babylon governorate [5], [6].

2. Hypotheses of the study:

The hypothesis of the research was therefore determined by the impact of the decrease in the water share of the Musayyib project on agricultural development in the study area From the hypotheses of the study there is a close relationship between the quantity of water in the study area and the quality of agricultural crops, and there is a close link between the spatial variation in the distribution of temperature and rain in the study area and the geographical distribution of crop composition, and the change of climate elements leads to fluctuation of agricultural production of agricultural crops in the study area [7], [8], [9].

3. Objectives of the study:

One of the objectives on which the study was based is to analyze the climatic elements in a quantitative manner to give specific quantitative results that differ from the descriptive method of the study area, and to divide the study area into rain and thermal ranges to show the climatic variation between the north and the south, and to shed light on the study of the correlation between climatic elements and agricultural productivity, in order to avoid the negative effects of climate elements and avoid the dangers [10] resulting from sudden climatic fluctuations, and benefit from the positive effects to reach the best productivity per acre, and address the problems of negative effects resulting from agricultural problems by trying to benefit from them, studying the assessment of the impact of water policy on agricultural crops in the study area and the extent of its impact on productivity, and creating a digital database using geographic information systems, which makes it easier for the researcher to retrieve, process, and add to them at any time [11], [12].

2. Materials and Methods

The research adopted the method of scientific analysis based on the presentation of the research subject in addition to the quantitative method in explaining the temporal and spatial distribution of the water share of the Musayyib project in the study area, and its relationship to the agricultural development plan.

Boundaries of the Study Area

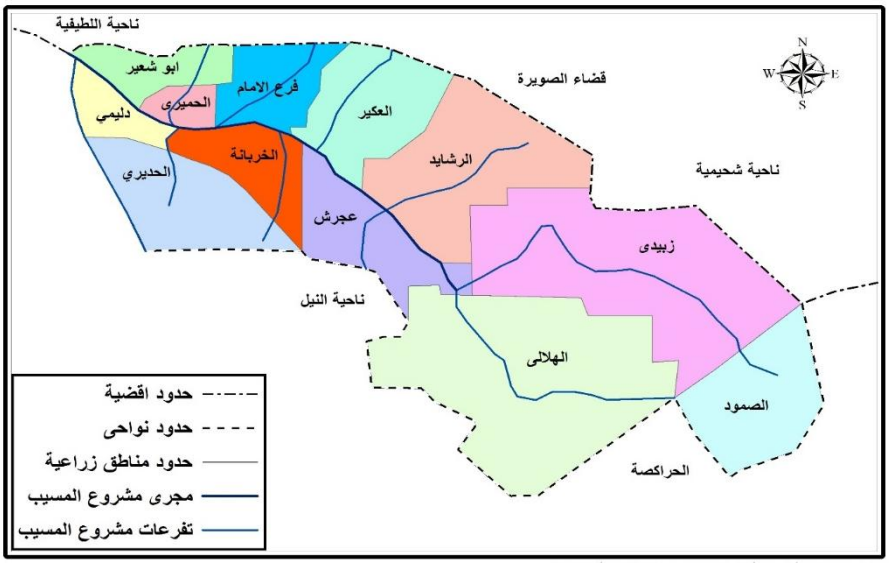
The study of the geographical location is one of the main natural foundations that the geographer is interested in, and begins his study, and there are many types of sites in geography, including the astronomical site, i.e. the location of the region in relation to latitude and longitude, where the district of Kothi is located within the administrative boundaries of the province of Babylon between (6 32o: 8 33o) north and between longitudes (5 44o: 12 45o) east, and this determines Location The climatic characteristics prevailing in this region, and therefore the type of plant life, and this affects the human being in turn in terms of his geographical distribution, general characteristics, aspects of human activity prevailing and human needs and level of civilization.

The importance of geographical location in relation to the phenomena is due to the fact that it directly affects the human and cultural manifestations, especially with regard to the geographical distribution of educational services to the population, their density, composition, movements, level and economic activity. In determining the type of educational service, in addition to that, the spatial proximity of some educational services, and reduces the costs of transportation by virtue of the short distance between them, which increases the likelihood that the educational institution will perform the desired goal, which is to serve the largest possible number of residents of the region, unlike the situation in the case of the long distance between the place of service and the place of residence of

applicants to benefit from the educational service, which means an increase in the costs ofMobility, which leads to a decrease in the length of stay, at least for middle-income people, and the importance of the geographical location of the Kothi region is highlighted in being a link between most governorates, and their neighborhoods thanks to its middle location, and its middle location, which connects Baghdad, Wasit and Babylon, has helped, as shown in Figure 1. The study area is bordered to the north by Baghdad Governorate and Alexandria District, to the south by Qadisiyah Governorate, while it is bordered to the east by Wasit Governorate, and to the west by Imam and Nile District.

3. Results and Discussion

Figure 1. the Geographical Location of Kothy district in 2024.



Source: From the researcher's work based on the Arc GIS program and the data of the General Authority for Survey, administrative map of Iraq, scale 1/1000000, for the year 2024 AD and the General Authority for Meteorology and Seismic Monitoring.

The first topic: geographical factors affecting agricultural development in the district of Kothi:

Natural factors have a major role in drawing the features of the nature of agricultural activity in any region, as natural factors are what decide the possibility or non-possibility of growing certain agricultural crops in one region without other crops, and the variation of these factors between one region, and another led to the variation of agricultural investment in it, and despite the developments and techniques reached by man in the field of agriculture, but his potential is still limited in front of the impact of natural factors on agricultural activity [13], [14], [15].

1. Surface geological deposits:

The importance of studying the geological structure factor in the field of agricultural geography is limited to its role in determining the characteristics of local soils, whose atoms are based on the basic rock layer from which they fragmented, meaning that geological structure is one of the factors that contribute directly and indirectly to the identification of some soil characteristics that affect patterns of agricultural exploitation [16], [17].

Iraq was part of the Tish basin at the edge of the continents, and the plates that had an important role in our part of the world are (the Arab plate, the Turkish Anatolian plate and the Syrian plate), and the movement of these plates with their divergence and convergence due to the ground movements that they were exposed to during geological times and eras had a major role in setting the tectonic framework For Iraq، as the land of Iraq was exposed in the era of the Pliocene last eras of the third time to (torsional movements), which are the major movements that led to the formation of the mountains of Iraq, these movements continued to the early fourth time (Pliostocene) and completed

the formation of the mountains of Iraq and we are heading for these ground movements that formed the mountains of Iraq, it has led to the decline of the southern parts of it, which is the area of the sedimentary plain currently, flooded by sea, and formed sediments (Buhtari) [18].

Most of the geological deposits in the study area date back to the modern quaternary period, and they consist of silt, clay and sand, which appear in most parts of this plain, while larger sediments and gravel (river gravel) abound in its edges, so most of the lands of the study area are suitable for agricultural activity and investment, with the exception of some areas with gravel gypsum formations that need intensive reclamation operations for the purpose of investing them in agriculture [19], [20], [21].

We conclude from this that the geological formation of the study area was an encouraging factor for agricultural production, as it provided sedimentary soil suitable for agricultural exploitation, which is based on a base of clay, silt and sand rocks, as well as the location of the study area within the flood sedimentary plain, and this encouraged the population to invest in agriculture and settle in it, and this is a positive factor encouraging agricultural development [22].

2. Surface characteristics:

Agricultural operations are determined in the light of the external shape of the terrain and thereforethe first stage facing the agricultural product is to find the nature of the surface of the earth that is consistent with the nature of agricultural production, whether it is related to the nature of the plant or in the nature of the processes it needs and the impact of the surface on agricultural activity in two forms (directly and indirectly), as its direct impact is to determine the slope of the earth's surface, soil thickness and state of effect Indirect: It is represented in the concentration of agriculture in discharge, either the the plain areas more than other areas, and thus the surface features are either a factor that helps to develop agricultural activity or may be the opposite, they show the extent of human adaptation to topographic reality

The surface suitable for the cultivation of all types of agricultural crops is at the degree of slope (1.3) degrees, because the flatness of the land makes it suitable in terms of soil composition and ease of water leakage and drainage, and in the event that the slope of the land exceeds (15) degrees, it is an obstacle to the practice of agricultural activity, and at the same time the soil is exposed to erosion and lack of water retention and it is difficult to use agricultural machinery, which requires following another system in agriculture that can overcome such determinants using means Modern irrigation (sprinkler irrigation) [23], [24].

3. Changing the characteristics of climatic elements:

Climate greatly affects the form of agricultural investment for any region, as its climate determines the nature of its agricultural crops, if modern technologies are excluded, as climate affects the determination of the nature of agricultural crops, and helps in the composition of the soil and the different types and degree of fertility, and the impact of each element of the climate varies from one crop to another. The climate of Iraq is generally described as a dry continental subtropical climateIt is classified within the Mediterranean climate, which is characterized by rainfall and low temperatures in the winter, with its absence and high temperatures in the summer, and that these two climatic elements and the presence of other climatic elements associated with them, such as wind, relative humidity and solar radiation, have a tangible impact on agriculture. The impact of climate varies from crop to crop, for example, rain may be the most important factor determining the production of a particular crop, while temperature temperatures may be the most influential factor on another crop.Each agricultural crop needs certain climatic conditions that differ from other crops, and this explains the existence of agricultural crops in one area and not others Table 1.

Table 1. Suitable climatic requirements for the growth of various agricultural crops.

Rain /Mm	Wind requirements m/s	Humidity (%)	Optical requirements /Clock	Crop name
350 - 450	5-6-7	70	14	Wheat
200 – 300	5-6-7	70	14	malt
910	5-6-7	80 – 70	10	Rice
500 - 800	5-6-7	70	14 – 12	Yellow corn
400 - 650	7-9	70- 60	14 – 12	Fruits
250 - 350	5	80 – 70	14	Winter vegetables
200 – 450	5	60	14 – 10	Summer vegetables

Source: Ministry of Agriculture, Directorate of Agriculture of Babylon Governorate, Planning and Follow-up Department, unpublished data, 2024.

4. Soil:

Soil is one of the most important sources of natural wealth that can not be replaced by something else to grow plants and produce human food and what it needs from the necessary materials orother for the continuation of life and soil is defined as a dynamic natural body independent consisting of a mixture of materials (rock, mineral and organic) fragmented, as well as water and air covering the surface of the earth in which plants grow· [25]

Soil is one of the most prominent changing natural phenomena that affect the variation and variation of agricultural land uses from one place to another, note map (5) as it has attracted the attention of the farmer since ancient times, so he succeeded in controlling it by adding some compounds and organic matter to change its properties and convert it from its old state to a new state more useful in the cultivation of various agricultural crops. The soil of the study area is of the type of soils (sedimentary - movable), as it was formed by the collection of various materials transported by the rivers of rock crumbs, dissolved salts and others, as well as the accumulation of air sediments transported by the wind from areas adjacent to the sedimentary plain (i), these soils are characterized by being newly formed and with a flat topography and the original material is river sediments, and its fabric is medium soft in general, except for the soils of depressions, which are characterized by soft texture and some of them are characterized by being of high salinity [26], [27].

5. Water Resources:

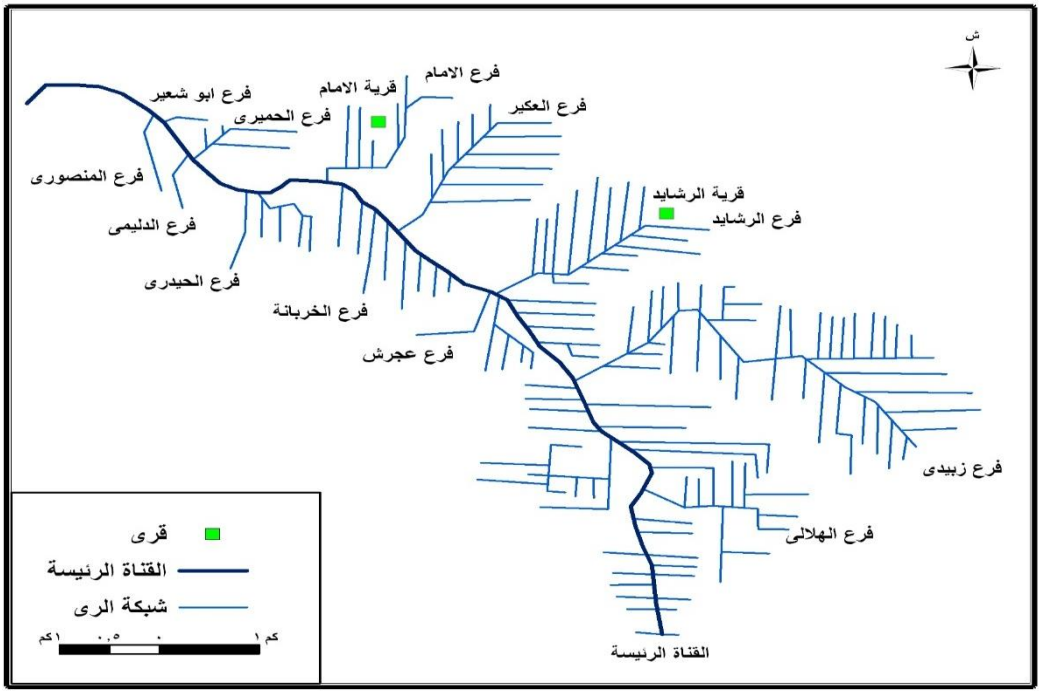
The project feeds the main water branches called water streams, dug by the government to feed the project from a main branch that penetrates the area with its extension from the north-west to the south-east, and each of these main branches heads towards one of the villages to which a specific division of cultivated land has been allocated, to meet its water needs, and vary in its lengths and areas on which it depends for irrigation. As shown in Table 2.

Table 2. Lengths of Main Water Branches and Traffic Areas in Kothy District in 2024.

Average quantity service (dunum/km)	(٪)	Irrigated cultivated areas (dunums)	(٪)	Length (km)	Water branches
889	0.58	1334	1.55	1.500	Abu Shaer
774	1.20	2773	3.69	3.580	Al , Dulaimi
2133	2.31	5334	2.58	2.500	Alhumairi
3139	5.84	13500	4.43	4.300	Al , Haidari
1190	4.32	10000	8.66	8.400	Forward
1000	1.73	4000	4.12	4.00	Kharbana
2000	7.52	17400	8.97	8.700	Ekair
2354	9.57	22131	9.69	9.400	Alrasheed
5191	8.98	20766	4.12	4.00	Ajrash

2531	**23.50**	**54333**	**22.13**	**21.460**	**Al , Hilali**
2163	**20.58**	**47600**	**22.69**	**22.00**	**Zubeidi**
2384	**100**	**231250**	**100**	**96.98**	**Sentence**

Source: Directorate of Water Resources, Kothi District in Babylon, 2024



Source: Based on Table 2

Figure 2 .Main branches of the Musayyib project

By noting Table 2 and the figure 2 above, it was shown as follows:

1. The lengths of the main water branches to irrigate the project lands amounted to about 96.98 kilometers, bringing the cultivated area of these lengths to 2384.5 dunums - linear km, which reflects this digital significance The breadth of the cultivated area compared to the lengths of the irrigation network, and therefore the project needs here to open new branches or rely on modern irrigation methods, such as sprinkler irrigation in large areas as in Zubaidi and Rasheed, and other branches of sub-water streams branch from the main branches between the cultivated basins to cover the project with an integrated engineering network of irrigation water [28], [29], [30].
2. The Hilali and Zubaidi branches are the longest main branches by about 21.4, 22 km and a percentage of together 44.8% of the total lengths of the main branches of the project to branch out from them many water branches irrigate about 101.9 thousand dons to reach the share of what serves the cultivated area of the longest here 2344.7 dunums linear km, and this indicates the southern scope of the project if there is no clear water ration for crops to obtain their actual water needs; These southern areas are Al-Rasheed, Al-Zubaidi, Al-Hilali and Ajrash because the southern network irrigates approximately 44.08% of the area of cultivated land in the project [31].
3. It is also noted as a result of the longitudinal extension of the project in the form of an arc by the nature of the breadth of the cultivated lands, although it represents an area of up to 129.3 thousand dunums, by 55.92% of the total areas of the project's lands, which reflects the presence of multiple large and small holdings served by 53.52 linear km of canals or main water branches, bringing the share of the cultivated area here from the lengths of the branches about 2415 dunums. If the water ration is not used here with cultivated crops, the soil deteriorates and is exposed to many problems, including the high ground water level, soil salinization, and low land production capacity, especially since the branches feeding the lands of this northern range of the project are always clogging with plant dams (floating plants) due to the constant stagnation of water.

The second topic: the crop complex in the district of Kothi:

Surface water is the main and vital resource for agricultural production and its direct impact on agricultural activity in the study area is highlighted in the capacity of cultivated areas that extend along the length of rivers, represented by (the Euphrates River and Shatt al-Hilla), as the cultivation of field crops, orchards and various other agricultural crops prevails near the riverbeds in the study area

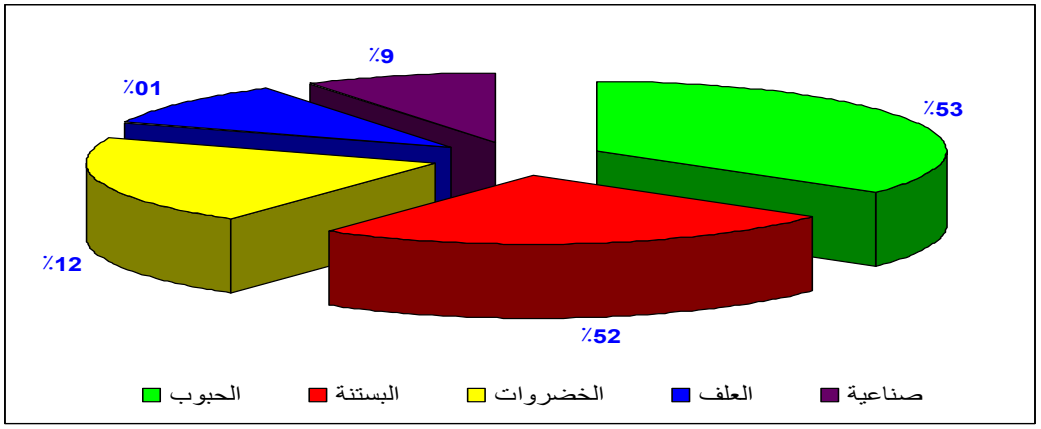
It is clear from Table 3 and Figure 3 that grain crops ranked first in terms of area, as they constituted (62.2%) of the total cultivated area in the study area, followed by horticultural crops in second place and (19.4%) of the total cultivated area in the study area, followed by vegetable crops in third place, accounting for (11.8%) of the total cultivated area in the study area, then fodder crops ranked fourth and (6.4%) of the total cultivated area in the study area. Finally, industrial crops ranked fifth with a percentage of (0.2%) of the total cultivated area in the study area.

Table 3. Areas planted with agricultural crops and their percentages in Kothi district for the year 2023.

(٪)	Cultivated area / thousand dunums	Crop name
35.2	**74**	**Grain**
24.7	**52**	**Gardening**
20.9	**44**	**Vegetables**
10.0	**21**	**Fodder**
9.0	**19**	**Industrial**
100	**210**	**Total**

Source: Ministry of Agriculture, Babylon Agriculture Directorate, Project Agriculture Division, unpublished data, 2024.

Figure 3. Areas planted with agricultural crops and their percentages in Kothi district for the year 2023.



Source: Based on Table 3.

1. Grain crops:

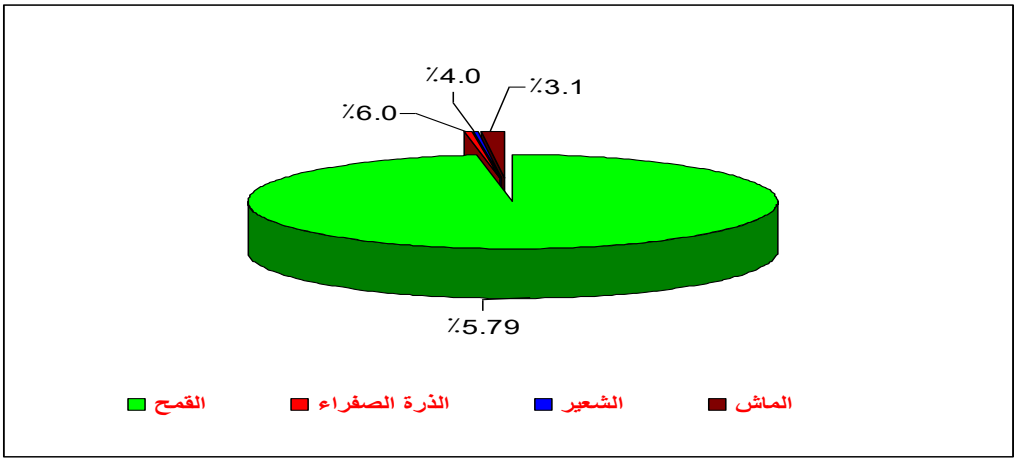
Grain crops belong to the grass family, which are crops that are grown in order to obtain their grains, which are mainly used in human food, such as wheat (wheat), barley, rice (chlep), yellow corn and cattle, and grain crops are used as animal feed or for the purposes of manufacturing various food products, and cereal crops are considered the daily food basis for all the world's population, as about 70% of the calories in human food come from the grains that humans eat in their various meals (Faqi Shaker Shamma, Abdul Hamid Ahmed Younis, 1970, p. 7), and grain crops are one of the most important agricultural crops in the study area in terms of area, as the area occupied by these crops (38.2) thousand dunums constituted (25.6%) of the total cultivated area with various agricultural crops in the study area, and the grain crops in the study area are (wheat, barley, yellow corn, chili and mash), and these crops vary among themselves in terms of the area they occupy and the quantities of their production.

Table 4. Cultivated areas of cereal crops and quantities of their production in Kothi district for the year 2023.

(٪)	Production quantity (thousand tons)	(٪)	Areas (Dunum)	Crop
70.6	75.3	97.5	36100	Wheat
11.4	12.2	0.6	250	Yellow corn
7.4	7.9	0.4	150	malt
1.5	11.2	1.3	500	Mash
100	106.6	100	37000	Total

Source: Ministry of Agriculture, Directorate of Agriculture of Babylon Governorate, Project Agriculture Division, unpublished data, 2024.

Figure 4. Areas planted with cereal crops in Kothi district for the year 2023.



Source: Based on Table 4 data.

By observing Table 4 and Figure 4, we find that the wheat crop ranked first in terms of area and production, as it formed a percentage of (94).5%) of the total area planted with grain crops in the study area, meaning that the wheat crop constituted more than half of the area planted with grain crops in the study area, with a production rate of (75.3%) of the total production of grain crops in the study area, followed by the mash crop in second place with an area of (1.3%) and a production rate of (11.2%), then came the yellow corn crop In third place with an area of (0.6%) and a production rate of (11.4%), and finally the barley crop came in fourth place with an area of (0.4%) of the total area planted with cereal crops and a production rate of (7.9%) of the total production of grain crops.

2. Horticultural crops :

Horticultural crops represented by palm trees and fruit trees came in second place after grain crops, as the area invested in these crops reached (44.5) thousand dunums, constituting a percentage (17).1%) of the total cultivated area in the study area, and by looking at Table 5 and Figure 5 shows that there are nine varieties of horticultural crops spread cultivation in the study area, which are trees (palm, grapes, berries, citrus, pomegranates, stone fruits, apples, olives, and buckthorn), and these varieties vary among themselves in terms of the area occupied, the number of trees and the quantities of production, as palm trees acquired ratio (22.9%) of the area planted with horticultural crops and by (19.3) From the number of fruit trees in the study area, that is, more than three quarters of the area exploited by horticultural crops and the number of trees was occupied by palm trees , followed by grape trees, then berries, citrus fruits, pomegranates, stone fruits and apples, and finally came olive trees and buckthorn trees.

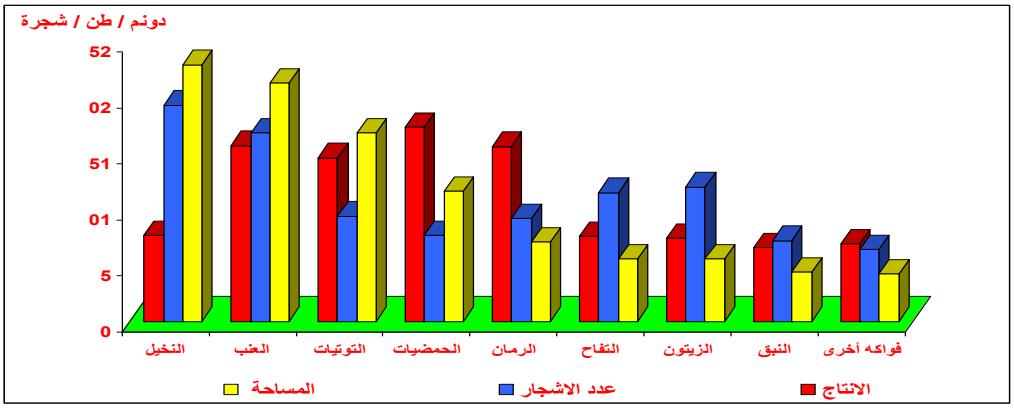
Table 5. Areas planted with horticultural crops, tree numbers and production quantities in Kothi District 2023.

(٪)	Production (thousand)	(٪)	Trees (thousands)	(٪)	Area (thousand)	Crop

7.7	**22.5**	**19.3**	**25.5**	**22.9**	**10.2**	**palms**
15.7	**45.5**	**16.8**	**22.2**	**21.3**	**9.5**	**Grapes**
14.6	**42.2**	**9.4**	**12.5**	**16.8**	**7.5**	**Mulberry**
17.3	**50.2**	**7.7**	**10.2**	**11.6**	**5.2**	**Citrus**
15.6	**45.2**	**9.2**	**12.2**	**7.1**	**3.2**	**pomegranate**
7.6	**22.2**	**11.5**	**15.2**	**5.6**	**2.5**	**Apple**
7.4	**21.5**	**12.0**	**15.8**	**5.6**	**2.5**	**Olive**
6.6	**19.2**	**7.2**	**9.5**	**4.4**	**2.0**	**Buckthorn**
6.9	**20.2**	**6.4**	**8.5**	**4.2**	**1.9**	**Other Fruits**
100	**288.7**	**100**	**131.6**	**100**	**44.5**	**Total**

Source: Ministry of Agriculture, Directorate of Agriculture of Babylon Governorate, Project Agriculture Division, unpublished data, 2024.

Figure 5. Areas planted with horticultural crops, tree numbers, and production quantities in Kothi district 2023.



Source: Based on Table 5 data.

3. Industrial Crops:

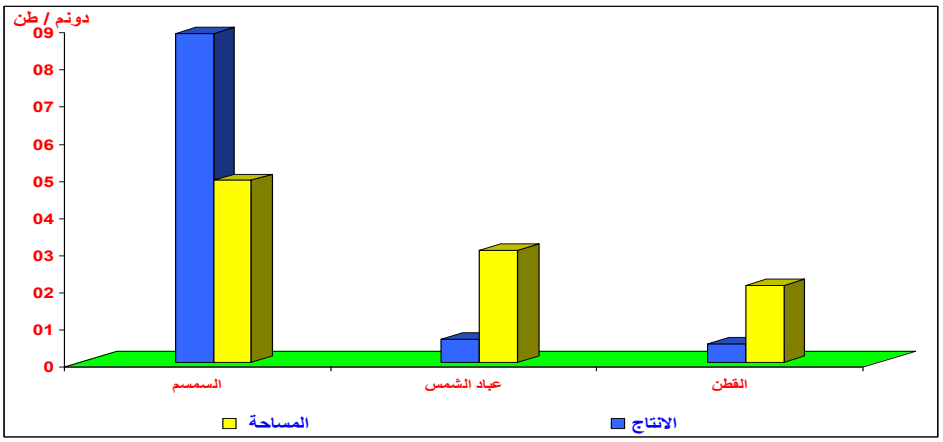
Industrial crops come in fifth place among agricultural crops in the study area in terms of the area they occupy, which amounted to (1.8%) of the total area planted with agricultural crops, and includes industrial crops in the study area each of the crop (sesame, sunflower, cotton) and these crops vary among themselves in terms of the area they occupy and the quantities of their production as shown in Table 6 and figure 6 as the sesame crop exports the rest of the industrial crops in the area it occupies, which formed a percentage (49.0%) of the total area planted with industrial crops in the study area, and this crop topped the rest of the industrial crops in terms of the amount of production, which constituted a percentage (88.6%) of the total production of industrial crops in the study area, then came after the sesame crop, sunflower crop, then the cotton crop in the percentage of area and production quantities.

Table 6. Areas planted with industrial crops and production quantities in Kothi District 2023.

(٪)	Output (Tons)	(٪)	Area (Dunum)	Crop
88.6	210	49.0	52	**Sesame**
6.3	15	30.1	32	**sunflower**
5.0	12	20.7	22	**Cotton**
100	237	100	106	**Total**

Source: Ministry of Agriculture, Directorate of Agriculture of Babylon Governorate, Project Agriculture Division, unpublished data, 2024.

Figure 6. Areas planted with industrial crops and production quantities in Kothi District 2023.



Source: Based on Table 6 data.

4. Fodder Crops:

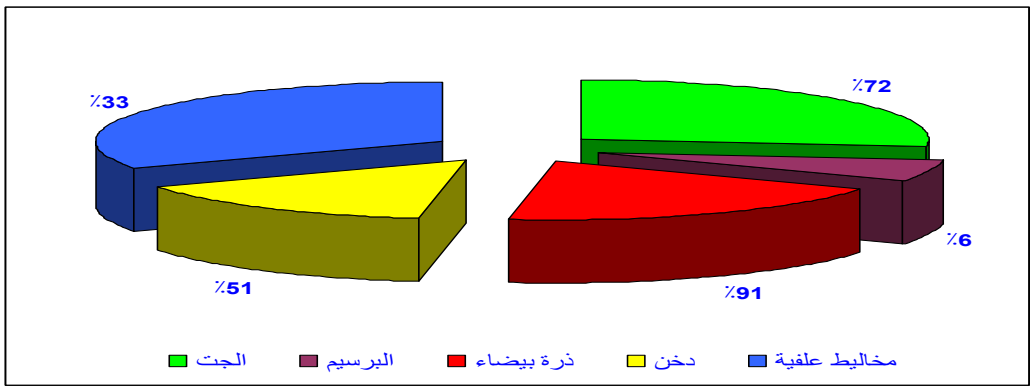
Fodder crops rank fourth among agricultural crops in the study area in terms of the area they occupy, which amounted to (5.3%) of the total area planted with agricultural crops, and includes fodder crops in the study area crops (jit, alfalfa, sorghum, millet, and fodder mixtures), and these crops vary among themselves in terms of the area they occupy and production quantities .

Table 7. Cultivated areas of fodder crops and production quantities in Kothi District for the year 2023.

(٪)	Output (Tons)	(٪)	Area (Dunum)	Crop
43.8	12202	26.8	1750	Jet
34.4	9584	6.1	400	Clover
9.1	2540	19.1	1250	White corn
3.5	980	15.3	1000	smoke
9.0	2520	32.5	2120	Fodder crops
100	27826	100	6520	Total

Source: Ministry of Agriculture, Directorate of Agriculture of Babylon Governorate, Project Agriculture Division, unpublished data, 2024.

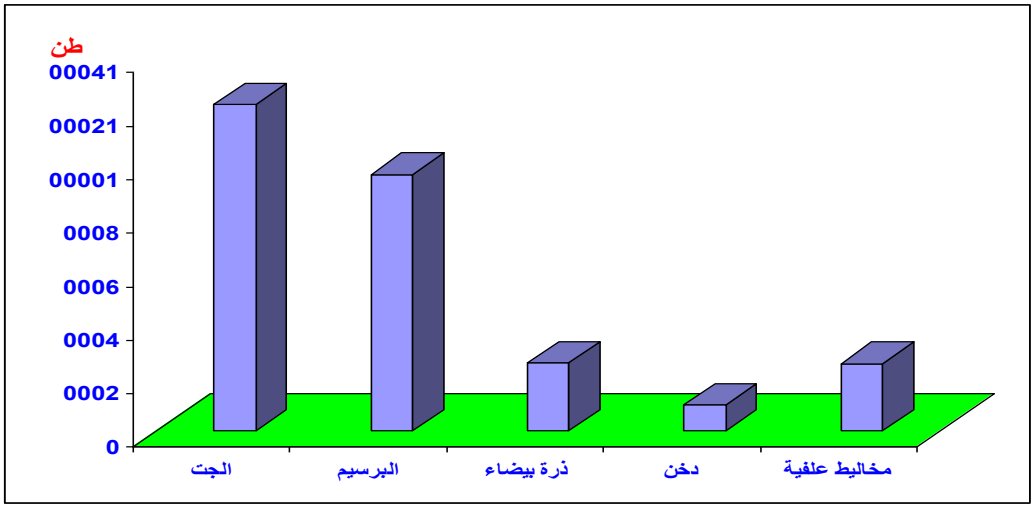
Figure 7. Cultivated areas of fodder crops and production quantities in Kothi district for the year 2023.



Source: Based on Table (7).

In Table 7 and Figure 7 and 8, the mixed fodder crop topped the rest of the fodder crops in the area it occupies, which constituted a ratio of (32).5%) of the total area planted with fodder crops in the study area, as well as this crop topped the rest of the fodder crops in terms of production quantities, which constituted a percentage (9.0%) of the total production of fodder crops in the study area, followed by jet and alfalfa crops, then white corn crop and feed mixtures.

Figure 8. Production quantities of fodder crops in Kothi district for the year 2023.



Source: Based on Table 7.

The fourth topic: the problems facing the agricultural plan in the district of Kothi:

Through the previous presentation of the natural and human potential affecting plant production in the study area and the study of the reality of the state of this plant production, it was found that there are several problems that stand in front of its development, which are due to natural conditions and human factors, so this chapter dealt with the most important of those problems (natural and human) suffered by agricultural production (plant) in the district of Kothy and the development of the most important solutions proposed to address them, as well as designing a model for the suitability of geographical factors (natural and human) for agricultural in the study area As follows:

1. The problem of soil salinization:

The problem of soil salinity faces a lot of soils in dry and semi-arid areas, which is the basis for its unsuitability for agriculture, due to the disruption of the balance of salts in the soil and an increase in the safe limits, which leads to a change in its physical and chemical properties permanently that refers the soil to saline soil or alkaline soil or alkaline saline soil, which leads to a decrease in the quantity of production and poor quality and may lead to the cessation of agricultural production at all, and the problem of salinity appears in particular in the area Sedimentary plain, of which the study area is a part, and this problem has become one of the complex dilemmas facing agriculture and agricultural development in many regions of Iraq, including the study area, as the increase in soil salinity led to a decrease in agricultural production to the minimum [(ii),] the field study showed that the percentage (58.5%) of the farmers of the study sample suffer from the problem of soil salinization, and this problem varied between the areas of the study area, the highest was in the Jableh district by (41.2%) It was followed by Al Sumud (35.8%), Dulaimi (12.8%) and Haidari (10.2%**).**

2. The use of trocars and wells in irrigating agricultural lands:

The water of trocars and wells is used in irrigation by raising them by pumps to some agricultural landsin the study area, and the reason for this is due to the distance of these lands from irrigation streams and channels, as well as the tolerance of some agricultural crops to high and medium salinity concentrated in the water (trocars and wells) in those areas such as palms, barley and spinach, but the use of trocars and wells in irrigation for a long time poses a great danger that threatens agricultural land, because it leads to salinization in the long term The reason for the high percentage of salt concentrations in groundwater and trocar water in the study area, it is highly saline water and unfit for human use, especially agricultural activity, the rate of electrical conductivity of groundwater (**EC)** millimoz / cm, we find that the total area of irrigated agricultural land from trocar water in the study area amounted to (20.2) thousand dunums, as trocar water was used to irrigate some agricultural land in most administrative units in the study area.

3. The problem of soil watering:

Water-soaked soils are known as soils that fall under the continuous or seasonal influence of water due to surface immersion, or under the influence of capillary property due to the presence of shallow ground water, and these soils are described as pore The surface layer (root layer) is saturated with water to the point where the spread of gases from outer space to this layer stops, which leads to a disorder in the ventilation process and negatively affects the growth of plant roots and the efficiency of their absorption of water and nutrients necessary for the growth of plants in a way The total area of the flooded land in the study area was (12.2) thousand dunums.

Among the proposed solutions to address the problem of soil salinity and waterlogging in the study area:

a. Washing the soil with water and trying to drain it superficially away from the roots of plants, the field study showed that (19%) of the farmers of the study area use this method in treating their land from soil salinity.
b. Biological treatment is done by planting agricultural crops saline (salt-loving) any that has the ability to absorb salinity well such as barley, alfalfa and spinach, grow these crops without causing any damage to the land, as the accumulation of excess salts in the soil in the surface parts (air) of these crops, the field study has shown that (28.5%) of the farmers of the study area use this method in the treatment of their land from soil salinity.
c. Add chemical and organic fertilizers to increase the fertility of the reclaimed land by washing before the planting process, because the washing process loses the soil fertility.
d. Educating the farmers of the study area through the establishment of extension seminars on the need to adopt water bottles commensurate with the needs of each crop, to prevent.

4. The problem of desertification and sand dune encroachment:

Desertification affects dry, semi-arid or semi-humid lands in the world, and it means the problem of decreasing and degradation of the biological capacity of the environment, which leads to the creation of conditions that make it closer to desert conditions or driest, as for the close meaning of desertification, it is the low degrees of interest and productivity of agricultural land, and sand dunes are one of the most prominent manifestations of desertification, which are sand hills varying in size, extensions and shapes, several factors combine in their composition, including the misuse of resources. Natural (soil, water and natural vegetation) as well as the climate factor, which is the lack of rainfall and high evaporation values, and the encroachment of sand dunes is one of the most serious problems facing agricultural activity, especially when moving sand dunes fixed or formed sand dunes active cause flooding of large areas of agricultural and pastoral land with sand, which turns them into areas completely desertified and through the field study found the researcher the presence of desertified lands in the middle of the study area, specifically east of the Nile hand, It also turned out that the sand dunes in the study area appear in different forms affected by the prevailing winds, the amount of sand and the nature of the surface manifestations in the areas of their presence, as well as the influence of human factors, and the most prominent of these forms are the crescent dunes, which are sand dunes ranging in height between (2-4) meters, and are formed by the prevalence of the northwest winds that feed them with wind sediments, and they are moving dunes whose direction changes when the southeast winds blow, as they move and change direction from a northwest direction To the southeast, these dunes are clearly spread in the Jableh district.

The proposed solutions to address the problem of desertification and sand dune encroachment:

a. The need to establish centres and organizations specialized in combating desertification, through cooperation between the Government and those research and scientific centres and institutions to curb the spread of desertification

b. Attention to natural vegetation cover and the prevention of overgrazing, and this matter requires a comprehensive survey of the natural pastures in the study area and determine their absorptive capacity of various animals, which provides rational use of pastures, as well as encouraging farmers to grow fodder crops for livestock in order to reduce pressure on pastoral areas and preserve the natural vegetation to reduce the problem of desertification.
c. Expanding the increase in green spaces, including increasing the number of nurseries in various places of the study area at subsidized prices, as well as the need to implement joint projects between the Ministries of Environment and Agriculture to establish forests of evergreen trees to reduce the phenomenon of desertification.

5. The problem of water deficit:

The problem of lack of irrigation water is one of the main problems that affect agricultural expansion because of the dependence of the largest part of the cultivated areas in Iraq on irrigation water, especially in the central and southern section of it and within the study area, as the amount of water secured will be determined in the light of the area of land that can be cultivated, and therefore the achievement of any increase in agricultural production will depend on the availability and efficiency of the exploitation of water used in irrigation, the Euphrates River is the main source that The field study showed that the percentage (93.8%) of the farmers of the study sample The Euphrates River is the main provider of water to irrigate their lands, but it suffers from a scarcity of water, which led to causing a water deficit in the rivers and streams branching from it in the study area, and the study showed that the percentage (71.5%) of the farmers of the study sample suffer from scarcity of irrigation water, and this percentage varied. The districts of the study area, as it came in Jableh district (46.7%), followed by Al-Haidari district (21.6%), then Al-Sumud district (18.8%), and Dulaimi district (12.9%).

Many farmers complain about the power of some influential and officials in the state on the water quotas in favor of their farms in the study area, as many irrigation channels are completely monopolized for their land, and many farmers exceed the water quotas in many ways, including the installation of huge water pumps on irrigation tables to withdraw the largest possible amount of irrigation water exceeding their prescribed shares, or the farmer may demolish a side or part of the irrigation channel adjacent to his land to flow Water to its land easily and in large quantities and continuous with the continued release of water quotas in the main streams feeding these channels indifferent to the shares and need of other agricultural lands.

For the purpose of clarifying the water deficit suffered by the study area, it was necessary to extract the hydro-climatic budget, which is intended from the point of view (climatic - agricultural) as the relationship between the amount of water needed by the crop and the amount of rain falling during its growth period, as the need for agricultural crops is closely related to the process of evaporation / transpiration, which is affected by the various elements of the climate, and another simple concept of water-climatic balance can be formulated as representing the relationship between the amount of precipitation on the one hand and the amount of evaporation / Possible transpiration, on the other hand, in this sense the hydroclimatic balance is subject to a different influence of the prevailing climatic elements by their influence on the amount of evaporation/transpiration possible[iii].

the results of the hydro-climatic budget for the study area for the period from (1990 - 2020) Note Table 7 and Figure 9, that the amount of evaporation / transpiration was much higher than the amount of precipitation, the annual total of evaporation / possible transpiration reached (2241.3) mm, while the annual total amount of rainfall reached (105.41) mm, and thus the annual total of water water (-2168.51 mm), as All months of the year suffered from a water deficit, but the average contrast between them was noted Figure No. (69), as it rose in the summer due to the lack of rainfall and high temperatures in the summer, the month of July recorded the highest rate of water deficit amounting to

(-352.80) mm, while this deficit decreased in the winter due to low temperatures and rainfall, January recorded the lowest rate of water deficit rate It reached (-40.76) mm.

The proposed solutions to address the problem of water deficit:

a. Encouraging farmers in the study area to use modern irrigation methods (drip irrigation and sprinkler irrigation) and help them to acquire their systems at prices subsidized by the state and pay their amount in installments comfortably, and this leads to the investment of water economically and reduce its waste during the irrigation process.

b. Introducing farmers through guidance seminars to water rationing and the need to adopt it in irrigating their crops, each according to its water needs, as well as introducing them to the damage of wasteful irrigation water on their agricultural production and agricultural land in the long term, and the need to educate them to know the size of the problem of water scarcity and the importance of their role in participating in confronting this problem and reducing its effects.

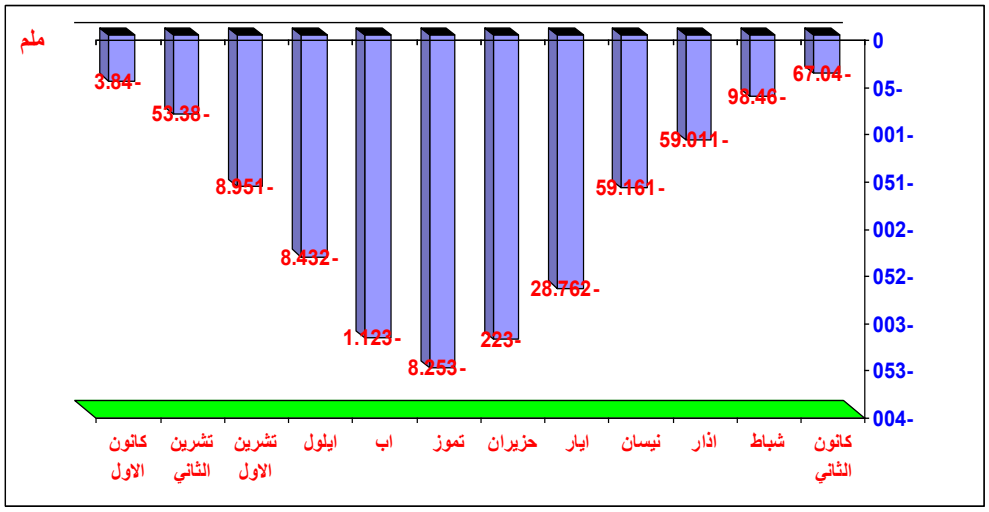
Table 8. Water Climate Budget in Kothi District Using CROPWAT 8.0 Program for the Period (2023-2020).

Water deficit (mm)	Evaporation – transpiration[v] (mm)	Amount of precipitation Effective (mm)[iv]	Rain coefficient Effective (mm)	Amount of rainfall (mm)	Month
-40.76	55.9	15.15	0.65	23.3	January
-64.89	73.4	8.52	0.65	13.1	February
-110.95	122.2	11.25	0.75	15	March
-161.95	172	10.05	0.75	13.4	April
-267.82	270.3	2.48	0.8	3.1	May
-322.00	322	0.00	0	0.01	June
-352.80	352.8	0.00	0	0	July
-321.10	321.1	0.00	0	0	father
-234.80	234.8	0.00	0	0	September
-159.80	162.6	2.80	0.7	4	October
-83.35	94.2	10.85	0.7	15.5	November
-48.30	60	11.70	0.65	18	December
-2168.51	2241.3	72.79	5.7	105.41	Total

Source: The work of the researcher based on Table 7.

c. Water harvesting or collection: Water harvesting means collecting surface water caused by rain mainly and benefiting from it in several areas, the most important of which is the cultivation and production of agricultural crops, and this is through the process of collecting or concentrating rain as a surface liquefaction from a spot of land (Jabia) with a relatively large area to a relatively small area, and then the latter water is shed either to the agricultural field adjacent to Jabiya or stored in a suitable storage facility near or inside the farm for agricultural

Figure 9. Water Climate Budget in Kothi District.



Source: The work of the researcher based on Table (7).

d. Increase soil fertility using various fertilizers, as the plant absorbs less water needed in the case of fertile soil.
e. Cultivation of crops that have a relatively salinity tolerance in the case of a high level of salinity in the soil or in the case of irrigation with salt water

4. Conclusion

In light of the foregoing, the impact of the low water share of the Musayyib project on the agricultural plan in the district of Kothi in Babylon Governorate and the identification of the natural and human components and the geographical distribution of agricultural production in the study area, the study concluded a number of conclusions and recommendations as follows:

The study highlights that the strategic location of the area in central Iraq, surrounded by multiple provinces and major consumer markets, has significantly supported agricultural activity. The flat terrain with a gentle north–south slope favors irrigation channel development and mechanized farming, though it also contributes to soil salinity and waterlogging due to poor drainage. Agriculture here depends almost entirely on surface water from the Euphrates, with supplementary but saline groundwater suitable only for certain crops. Rainfall is minimal and inconsistent, limiting reliance on rain-fed farming. Natural vegetation is generally sparse due to the prevailing dry climate, though riverside plants thrive where water resources are available. Inefficient drainage networks, obstructed by reed and papyrus growth, exacerbate salinity and flooding. Crop diversity is low, with cereals dominating over 60% of cultivated land. A critical water deficit, driven by reduced allocations, has curtailed agricultural land and affected production.

Recommendations

a. Implement scientifically planned surface water storage to counter seasonal and annual flow reductions.
b. Promote modern irrigation techniques (sprinkler, drip) to conserve water and reduce salinity.
c. Rehabilitate land affected by waterlogging and salinity through expanded drainage networks, avoiding reuse of drainage water for irrigation.
d. Upgrade and maintain irrigation channels to minimize losses.
e. Ensure affordable supply of fertilizers, improved seeds, and pesticides to boost productivity.
f. Expand rural paved road networks to improve market access.
g. Improve agricultural marketing through better transport, refrigerated storage, and crop preservation facilities.

h. Provide affordable agricultural machinery via government support or leasing programs.
i. Revitalize cooperative agricultural banks and facilitate farmer access to loans.
j. Diversify crop production to match the area's geographical potential.
k. Expand protected agriculture (greenhouses, tunnels) for year-round production.
l. Control desertification and sand dune encroachment through coordinated government and research efforts.
m. Limit urban expansion onto fertile land via legal restrictions and alternative land use planning.
n. Establish agricultural research centers to develop high-yield, climate-adapted seeds.
o. Foster agro-industrial integration to process surplus and perishable crops.
p. Raise farmer awareness on soil-specific cultivation techniques to restore fertility.
q. Strengthen agricultural extension services and associations through targeted government support.
r. Conduct regular agricultural training programs to enhance farmer knowledge.
s. Support and organize agricultural cooperatives to improve production efficiency and investment.

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