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Spatial Variation in Agricultural Land Use in Ain Tamr District, Karbala Governorate

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Abstract: This research aims to study the spatial variation of agricultural land use in the Ain Tamr district of Karbala Governorate, to understand patterns of agricultural land use and the spatial distribution of cultivated crops. The research relies on a descriptive-analytical approach to study the distribution of agricultural land and the impact of geographical factors, such as soil, climate, and water availability, on agricultural production.

Keywords: Pome fruit orchards, flower, bronze beetle, damage, species composition, apple, pear, quince, vegetation, occurrence level.

Introduction: The research focused on the challenges facing the agricultural sector in the region, such as soil degradation and water resource scarcity, while offering proposals to address the problems facing the study area and enhance agricultural sustainability.

The research found a close relationship between the distribution of agricultural land in the Ain Tamr district and surrounding factors, such as water availability and topography. There is also significant variation in agricultural land use, reflecting the natural and economic diversity of the study area. Furthermore, lands of high agricultural value are concentrated in specific areas within the district, which calls for measures to protect these lands and enhance their sustainability. Chapter One: Theoretical Framework of the Research

Population growth in the study area is one of the most important reasons for the continuous increase in demand for food, leading to changes in agricultural land use and future trends. Therefore, we must use scientific methods to plan agricultural land use and study the natural and human geographical characteristics of the region, with its various elements, to utilize them optimally. This requires future development and addressing the problems that arise.

First: The Research Problem:

The following question represented the problem of this research:

(What is the spatial variation in agricultural land use in Ain Tamr District?)

There are secondary problems represented by:

1 - What is the classification of land use in Ain Tamr District?

2 - How are agricultural land uses distributed geographically in Ain Tamr District?

3 - What are the problems facing agricultural land use in Ain Tamr District?

Second: The Research Hypothesis: The main research hypothesis was represented by the following:

(There is spatial variation in agricultural land use in Ain Tamr District.)

The researcher hypothesized a set of secondary hypotheses:

1 - Land uses in Ain Tamr District are classified according to crops and cultivated areas.

2 - Agricultural land uses vary spatially in the Ain Tamr District.

3 - Agricultural land use problems in the area are numerous, including misuse of land, poor planning, and failure to follow scientific methods.

Third: Research Objectives:

1. To clarify the geographical distribution of agricultural land uses in Ain Tamr District.

2. To identify changes in agricultural land uses in Ain Tamr District.

3. To identify the problems facing agricultural land uses in the study area to mitigate their risks or address them.

Fourth: The importance of the research:

The study of spatial variation in agricultural land use in Ain Tamr District is one of the most important studies that must be highlighted, given the vital role the agricultural sector plays in achieving food security and economic development. This type of study helps identify and understand spatial patterns of agricultural land use, which contributes to improving natural resource management and enhancing agricultural production efficiency. These studies also help uncover challenges facing the agricultural sector, such as soil degradation or water shortages, and provide scientific solutions that contribute to the development of the agricultural sector in the study area.

Fifth: Boundaries of the Research Area:

The study area lies between latitudes (32° 10 - 32° 45) north and longitudes (43° 15 - 43° 45) east, in the southwestern part of Karbala Governorate. The study area is bordered to the east by Al-Hur District, and to the rest of the way by Anbar Governorate. The northern parts also occupy a large portion of Lake Razzaza. The overall area lies within the western desert plateau, and the Ain al-Tamr District covers an area of 206,355 km2—map 1.

Sixth: Research Methodology:

The researcher relied on the descriptive and analytical approach to analyze the phenomenon, drawing on a variety of sources, including books, letters, dissertations, and government data. Seventh: Research Structure:

The research structure included four chapters. The first focused on studying: the theoretical framework of the research, including the research problem, the research hypothesis, its objectives, its importance, the research methodology, and the boundaries of the study area. The second chapter examined the use of agricultural land, its importance, and the classification of land uses. The third chapter included the use of agricultural land in the study area, while the fourth chapter included conclusions and recommendations.

Map (1) Location of the study area in Iraq and the holy Karbala Governorate

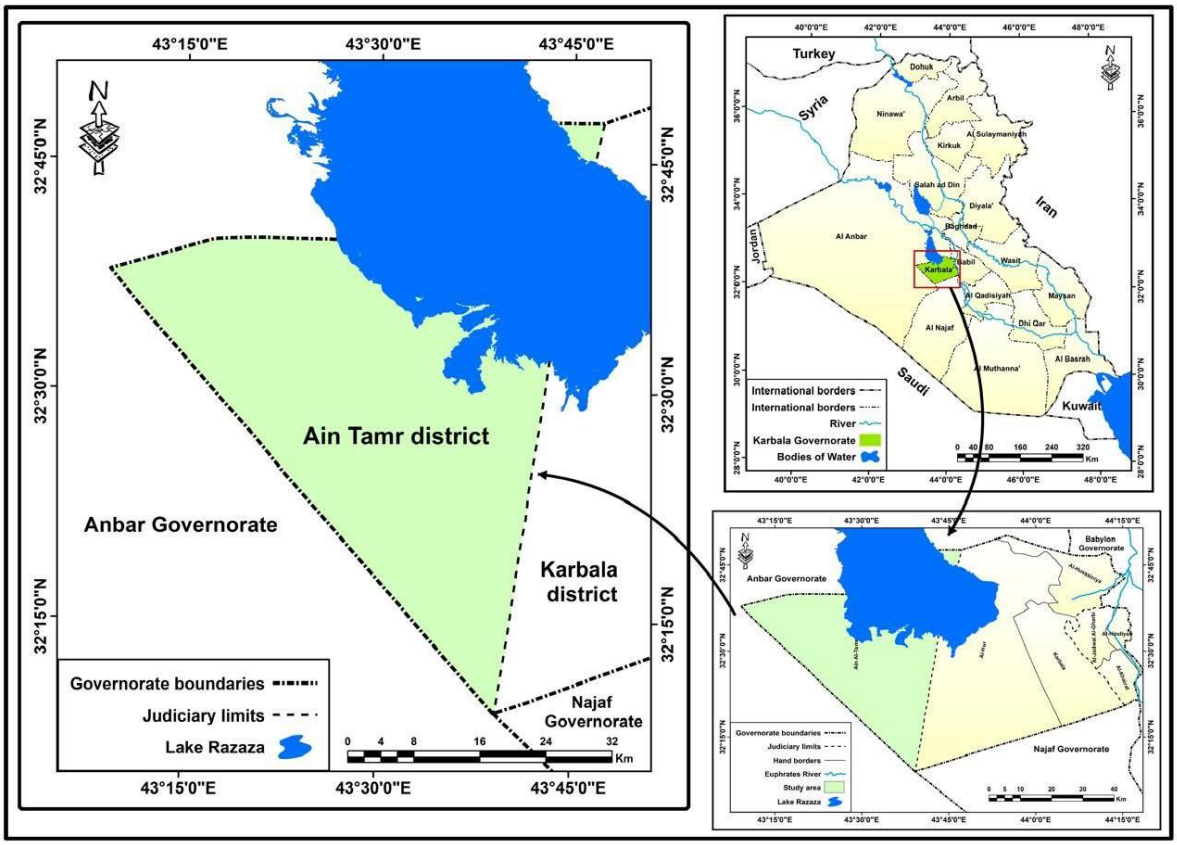
Source: Republic of Iraq, Ministry of Water Resources, General Survey Authority, Map Production Division, Administrative Map of Iraq at a scale of 1:000,000 for the year 2024.

Eighth: Concepts included in the research:

1- Land: It is the dry, solid area of the Earth (1), or it is the soil surface that serves as a field for various human activities and for establishing facilities, fields, and farms for plant production (2).

2. Land uses: There are various definitions of land use, including Bernhard's definition, which focuses on shedding light on spatial changes in agriculture and examining their causes (3).

Vink sees it as a fixed or periodic type of human intervention to secure human needs, whether material, moral, or both, from natural and industrial resources called land (4). It is also human activity on the land to which it is linked, and its use is limited to a specific area.



Land, whether urban or rural (5). The term "land use" is also used to describe the nature of human interaction with their environment, or as the activity by which humans interact with their environment, provided that this activity is represented within a portion of the land.

3. Agricultural land: Land invested in agricultural production by any method, or areas that combine the suitability of their soil for agriculture with their current agricultural status, thus being highly suitable for agricultural purposes at the same time that they are currently being cultivated (6).

Section Two: Classification of Land Uses in the Study Area

The agricultural land uses invested for plant production in the study area and their importance are classified as follows:

First: Agricultural land uses invested for grain crops:

The agricultural land uses invested for grain crops in the study area for the year 2022 include wheat, barley, mung beans, and yellow corn. These crops topped the other cultivated crops in terms of area, reaching 53,984 dunums, as shown in Table 2. The following is a presentation of these crops:

Table 2: Geographical distribution of agricultural crop areas in the study area for the year 2022

Percentage %	Cultivated Area / Dunum	Crops
39.8	53984	Grains
37.8	51350	Industrial
18.6	25221	Vegetables
2.7	3740	Horticulture
1.1	1450	Forage
100	135745	Total

Source:

Republic of Iraq, Ministry of Agriculture, Karbala Agriculture Directorate, Ain al-Tamr Agriculture Division, Planning and Follow-up, Implemented Agricultural Plan for 2022, Unpublished Data.

Republic of Iraq, Ministry of Agriculture, Karbala Agriculture Directorate, Karbala Agriculture Division, Plant Production, Areas of Land Cultivated with Palm Trees and Fruits, 2022, Unpublished.

1- Wheat Crop:

Wheat is one of the most important crops cultivated in the study area, with the area invested in cultivating this

crop amounting to 31,043 dunums, or 57.5% of the total grain area in the study area. Its production amounted to 9,728.95 tons, or 62.5% of the total grain production.

Table 3: Geographical Distribution of Cereal Crops According to Their Production Areas and Quantities in Ain al-Tamr District for 2022

Percentage	Production Quantity	Percentage %	Cultivated Area / Dunum	Crops
62.5	9728.95	57.5	31043	Wheat
22.3	3479.92	27.3	14742	Barley
11.2	1742	13	7000	Mung Beans
4	626.92	2.2	1199	Yellow Corn
100	15578.29	100	53984	Total

Source: Karbala Agriculture Directorate, Planning and Follow-up Department, Implemented Agricultural Plan for Cereal Crops for 2022, Unpublished

As shown in Table 3, the reason for this may be that there are areas of rain-fed land invested in cultivating this crop, and that no other crop competes with it, as well as the economic blockade on Iraq and government subsidies for its prices. Furthermore, wheat is a major crop whose multiple operations, such as plowing, sowing, irrigation, and harvesting, require a specific number of workers. Therefore, large areas of this crop can be cultivated with a small number of workers (5).

2- Barley:

It comes after wheat in importance, and its cultivation requires conditions similar to those of wheat, except that it tolerates greater temperature differences and is more tolerant of drought and humidity than wheat. Moreover, good soil conditions are not essential for barley growth as is the case with wheat (6). The rain-fed area invested in cultivating this crop was 1,040 dunums in 2002.

The area invested in cultivating this crop was 14,742 dunums, or 27.3% of the total area planted with grains. Its production amounted to 3,479.92 tons, or 22.3% of the total grain production in the study area in 2022, as shown in Table 3 3. Mung bean crop:

It is a summer crop that comes second to barley in importance. The area invested in it amounts to 7,000 dunams, or 13% of the total area planted with grains. Its production amounted to 1,742.5 tons, or 11.1% of the total grain production in the study area, as shown in Table 3.

Yellow corn crop:

Maize is a summer crop that comes second to mung bean in area. The area invested in planting this crop amounts to 1,199 dunams, or 22% of the total grain area in the study area. Its production amounts to 626.92 tons, or 4% of the total grain production in the study area, as shown in Table 3. The reason for this low percentage is due to the crop being exposed to the dangers of a number of animals, especially pigs, which leads to damage to the crop and a lack of motivation for farmers to cultivate it. The areas occupied by this crop remain very small, not commensurate with its importance as a human food or its potential for use in the production of various agricultural and industrial products, particularly vegetable oils. Furthermore, increasing its area could contribute significantly to the development of livestock in the study area. Second: Uses of agricultural land invested in industrial crops:

Uses of agricultural land invested for industrial crops (pistachios, cotton, and sesame) rank second after grain crops in terms of cultivated area in the study area. The total cultivated area is 4,016 dunums of the total cultivated area above.

The total cultivated area of this area is 51,350 dunums, or 37.8% of the total area cultivated with industrial crops in the study area, as shown in Table 4. The reasons that encouraged the expansion of this type of use are the encouragement of a large number of owners of various farms to grow it due to the sharp rise in its prices in local markets. Therefore, we find that the area of this type of crop has increased significantly. To reveal the nature of these crops, they were studied according to their importance in the study area, as follows.

Table 4

Geographical distribution of areas planted with industrial crops (pistachios, cotton, and sesame) and their production quantities for the year 2022

Percentage	Production Quantity	Percentage %	Cultivated Area / Dunum	Crops

90	28541.7	80.2	41200	Pistachios
7	2236	10.1	5200	Cotton
3	944.05	9.7	4950	Sesame
100	31721.75	100	51350	Total

Source: Karbala Agriculture Directorate, Planning and Follow-up Department, Implemented Agricultural Plan for the Cultivation of Industrial Crops for the Year 2022, Unpublished Data. 1. Field Pistachio Crop:

The field pistachio crop is one of the main crops grown in the study area, and its area and production exceed those of other industrial crops for successful cultivation. Throughout its life cycle, the field pistachio crop requires a hot, frost-free climate. A temperature of 30°C is ideal for germination and growth (7). Its need for light is minimal, as the crop can grow under the shade of perennial trees and can also be grown mixed with other annual plants. Its soil requirements are minimal compared to its climatic requirements, as well-drained, sandy, clayey soil is suitable for growing field pistachios. Field pistachios require abundant water during their growth period, as they require between 15 and 22 irrigations during their growth period (8). They also require a large workforce, starting from preparing the land for cultivation until harvesting after 6-7 months, and then collecting it for drying.

2. Cotton Crop

Cotton is one of the most important cash crops in the study area after pistachios, as it is a major source of income for farmers. This is due to the inability to consume its fibers or seeds directly before processing, unlike other crops such as wheat, barley, corn, and various legumes (9). The area planted with cotton in the study area amounted to 5,200 dunums, or 10% of the area of industrial crops in the region. Its production amounted to 2,236 tons, or 7% of the total cotton production in the study area, as shown in Table 4.

3. Sesame crop: The area planted with this crop amounted to 4,950 dunums in 2022, or 9.7% of the total area, and 944.05 tons, or 3% of the total production of industrial crops in the study area, as shown in Table 4.

Third: Uses of agricultural land invested in vegetable crops:

Vegetable crops rank third in agricultural land use in the study area in terms of cultivated area, and they are constantly increasing due to high demand and rising prices. Therefore, their production is strongly linked to marketing and consumption centers, as these crops are particularly sensitive, perishable, and highly susceptible to climatic conditions and weather fluctuations, requiring special care. The area planted with vegetables amounts to 25,221 dunums, or 18.6% of the total area planted with field crops in the study area, as shown in Table 5. These crops are classified in the study area according to their thermal requirements and their growing season into two main categories: summer vegetables and winter vegetables, as follows:

1 - Summer vegetables:

They come at the forefront of the vegetables planted in the study area in terms of crop area, as their area amounts to 20,119 dunums, or 79.8% of the total area planted with vegetables in the study area. As for their production quantities, they amounted to (46,228.3) tons, or 78.3% of the total vegetable production in the study area, as shown in Table 5. The reason for this is attributed to the increasing demand and high prices. 2- Winter vegetables (10):

They come after summer vegetables in importance in terms of the area invested in vegetables in the study area, because the largest use of land is for the cultivation of food crops such as wheat and barley. The area planted with winter vegetables in the study area amounts to 5102 dunams, or the equivalent of 2002) of the total area planted with vegetables for the year 2022. Their production amounted to (1280001) tons, or the equivalent of (2107) of the total vegetable production for the same year. Table 5

Table 5: Geographical distribution of the area and production methods of vegetable crops in the study area for the year 2022

Percentage	Production Quantity	Percentage %	Cultivated Area / Dunum	Crops
78.3	46228.3	79.8	20119	Summer Vegetables
21.7	12800.1	20.2	5102	Winter Vegetables
100	5028.4	100	25221	Total

Source: Karbala Agriculture Directorate, Planning and Follow-up Department, Agricultural Plan for Vegetable Crops for the Year 2022 (unpublished data).

Fourth: Uses of Agricultural Land Invested in Horticulture:

These uses ranked sixth in terms of crop area, with the area invested in them amounting to 3,740 dunums in 2022, representing 2.7% of the total land use area in the study area.

1 - Citrus Trees

ranked first among horticultural crops in terms of their numbers, with 98,900 trees, or 27.3% of their number, producing 2,700 tons, or 25.6% of the horticultural crop production in the study area, as shown in Table 6.

2- Pomegranate

Citrus trees are next in importance in terms of their numbers, reaching 78,100 trees, or 21.5% of the total number in the study area. They produced 2,003 tons, or 19.4% of the total production in the study area, as shown in Table 6.

3- Apple trees

These trees rank third in terms of their numbers among orchard trees in the study area, reaching 66,900 trees, or 18.4% of the total orchard trees in the study area, producing 1,525 tons, or 14.5% of the total orchard tree production in the study area, as shown in Table 6. The reason for their last position is attributed to competition from other crops, as well as the variation in geographical characteristics from one province to another.

Table 6: Number of fruit trees, their production quantities, and percentages in the study area for the year 2022

Percentage %	Production Tons/100	Percentage %	Number Of Trees/100	Trees	N
26	27	27	989	Citrus	1
19	20.47	22	781	Pomegranates	2
15	15.25	18	669	Apples	3
25	26.5	14	498	Palms	4
7	7.27	9	312	Olives	5
6	6.78	8	282	Grapes	6
2	2.023	3	96	Figs	7
100	105.3	100	3627	Total	

Source: Ministry of Agriculture, Karbala Agriculture Directorate, Plant Production Department, Number of Fruit Trees and Production Quantity for 2022, Miscellaneous Records (Unpublished Data).

4- Palm Trees:

Palm trees rank fourth in number among horticultural trees in the study area, with 49,800 trees, or 1307% of the total number of horticultural trees, and their production amounted to 2,646 tons, or 25.2% of the total horticultural production in the study area (Table 6). 5. Olive Trees:

Olive trees rank fifth in number among horticultural trees in the study area, with 31,200 trees, or 8.6% of the total number of trees in the study area. They produced 726 tons, or 6.9% of the total production in the study area (Table 6). This is due to the large area suitable for cultivation, on the one hand, and the availability of suitable natural conditions for their cultivation, on the other hand, particularly fertile soil and irrigation water.

6. Grape Trees

Grape trees rank sixth in number of horticultural trees in the study area, with 28,200 trees, or 7.8% of the total number of horticultural trees, and their production reached 678 tons, representing 6.4% of the total production of horticultural trees (Table 6). 7- Fig trees

They rank last in terms of the number of trees in the study area, amounting to 9,600 trees, or 2.6% of the total number of horticultural trees in the study area. They produced 203 tons, or 109% of the total horticultural crop production in the study area (Table 6). This is likely due to the availability of mixed soil and sufficient water, as well as their proximity to marketing centers. Fifth: Uses of Agricultural Land for Fodder Crops

Although fodder crops (alfalfa and clover) have been cultivated in Iraq since ancient times due to their high nutritional value, as they contain a high percentage of protein that may exceed 20% of dry matter (11), the land uses allocated for fodder crops in the study area rank last due to its geographical location within the steppe region, which is rich in grass plants, and due to

the weak connection between grain producers and livestock breeders, which is the direct basis for meeting the fodder needs of livestock (12). Furthermore, due to the nature of the fallow system and the lack of land invested in fodder production, grazing sources have declined in abandoned lands due to their unsuitability for agriculture, fallow lands, and hillsides. These sources do not meet the needs of livestock. Therefore, the area invested in fodder crops amounted to 1,450 dunams, or 1.1% of the total area invested in field crops in the study area.

Third Section:

Geographical Distribution of Agricultural Land Uses in the Study Area

The study of agricultural land use classification is one of the most prominent approaches to uncovering human activity undertaken to provide food, the types, nature, and intensity of which vary in patterns and systems, according to the varying areas and sizes of the holdings they occupy. This has led agricultural geography, in its distinct field of agricultural uses, to undertake the study and delve into its implications, adopting selected criteria to distinguish and classify them, and then evaluating them to achieve optimal use in light of the geographical factors influencing them (13).

Given the importance of these studies in the Ain al-Tamr region, geography has assumed a distinct role in establishing its existence, and geography has assumed its place through applied approaches, in light of the spatial analysis of these uses and the interest in spatial organization within their scope, based on the nature of their relationships, for the purpose of scientific interpretation, which falls under the purview of practical research. Through conducting repeated field studies in the study area by the concerned government agencies represented by the Agriculture Division, and identifying the components and problems that officially help or affect the areas of land reclaimed for agriculture or those that are not qualified for agriculture, here the concerned authorities and research must identify the obstacles and problems that in turn lead to the lack of agricultural expansion, the use of that land and its exploitation with agricultural crops or agricultural products in general, and clarify the climatic conditions or surface features and soil problems, as well as the percentage of rainfall in the study area and focus on the divided groundwater reservoirs, the Al-Tayyarat reservoir, which is the deepest water-bearing layer, as well as the Umm Ardhma reservoir and the Dammam reservoir, or surface water represented by flood water in the valleys or Al-Razzaza Lake, which is located east of the city of Ain Al-Tamr and is found in the study area, and provide some services that qualify for agriculture, including transportation roads and agricultural crops, as well as fertilizers, and provide the basic components in rehabilitating and exploiting that land for agriculture or encouraging the population to exploit that land through its cultivation, thus leading to getting rid of the phenomenon of desertification and providing vegetation cover in that area, as well as employing the largest number of hands The workforce and the provision of agricultural products undermine the government sector and the provision of consumer goods in general. Here, agricultural land can be divided according to the following table. Through field studies and visits to large areas of the study area, or repeated visits to the agricultural departments and divisions related to the district or the study area, the following was revealed:

1- The geographical distribution of agricultural land uses in the study area.

Table (7) and Figure (1) show that the total land in the study area in 2016 was 761,267 dunums, of which 601,661 were arable land, representing 79.0%. Meanwhile, unsuitable agricultural land constituted 159,606 dunums, representing 21.0%. The above shows that the percentage of arable land was higher than the percentage of unsuitable land. This is due to the fact that most of the region's residents are rural and practice agriculture as an economic resource to meet their current needs and source of daily income. However, in 2024, the percentage of arable land declined compared to what it was in 2023, the area of arable land reached (592,968) dunums, while the area of unsuitable land increased by (168,299) dunums. Regarding the percentage, the percentage of unsuitable land increased compared to the previous year by (22.1%), while the percentage of arable land decreased compared to the previous year, recording a percentage of (77.9%). Despite the decrease, it remained high compared to the unsuitable land for cultivation in 2024. The reason for the decrease in the percentage is the migration of many workers from the countryside to the city, in addition to the low productivity of agricultural land due to the prevailing climatic conditions, which are characterized by high temperatures and scarcity of water.

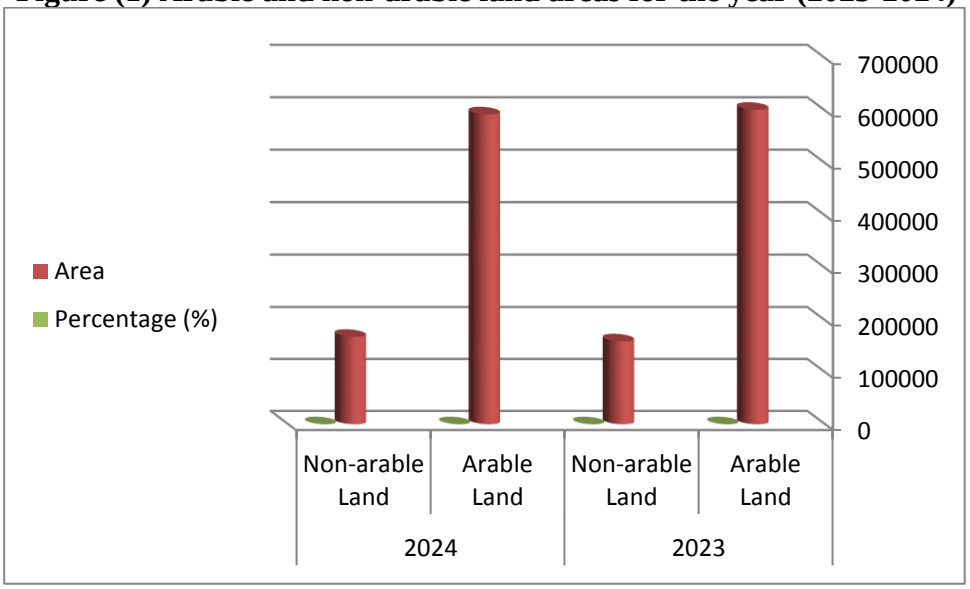
Table (7) Areas of arable and unsuitable land for the year (2023-2024)

2024			2023			Ain Tamr District
Total	Non-arable land	The land is suitable	Total	Non-arable land	The land is suitable	

761267	168299	592968	761267	159606	601661	Areas
100.0	22.1	77.9	100.0	21.0	79.0	Percentage

Source: Ministry of Agriculture, Directorate of Agriculture in Karbala Governorate, Agricultural Statistics Division, unpublished data for the year 2023-2024.

Figure (1) Arable and non-arable land areas for the year (2023-2024)



Source: Based on Table (7).

2- Agricultural land uses in the study area invested in plant production

The study area is characterized by its good agricultural potential, including the agricultural land area and the flood irrigation system provided by the Husseiniya and Bani Hassan canals and their branches, as well as other areas irrigated by pumps, in addition to the groundwater available. Therefore, agricultural production is not limited to meeting the local needs of the population alone, but also for export of a number of crops, most notably palm trees, fruits, and citrus fruits. This can be studied as follows:

A- Horticultural Crops

Horticultural crops include fruit trees and palm trees. Fruits are the fruits and seeds of edible trees and plants. They are currently considered among the main food products due to their nutritional, organic, and mineral content, as well as the vitamins essential to humans. Fruit trees and palm trees receive great attention from a large number of farmers due to their high economic returns compared to other agricultural crops. The study area is characterized by geographical factors suitable for the cultivation of fruit trees and palm trees, with the cultivation and production of fruit and palm trees being at the forefront. The governorate's agricultural crops offer farmers a high economic return compared to vegetable and field crops, and they are sufficient to meet demand and export to other governorates ( ). From Table (8) and Figure (2), it is clear that the areas of agricultural lands for orchard trees have gradually increased. The area of orchard trees was recorded at (8,000) dunums in 2023, and the number of palm trees reached approximately (8,372,177) palm trees, and the number of fruit trees was recorded at (14,450) trees. Meanwhile, the area of orchard trees increased in 2024 to (8,375,425), and the number of palm trees also increased to (8,375,425), while the number of fruit trees decreased to (13,980). The reason for the increase in areas for orchard trees is due to encouragement from government policies and continuous support. In addition, palm trees require little water and can withstand high temperatures. The reason for the decline in the number of fruit trees is due to the spread of diseases and high temperatures that cause these trees to dry out and die. In addition, fruit trees require a lot of water, especially in the summer, and thus the burden on farmers will increase.

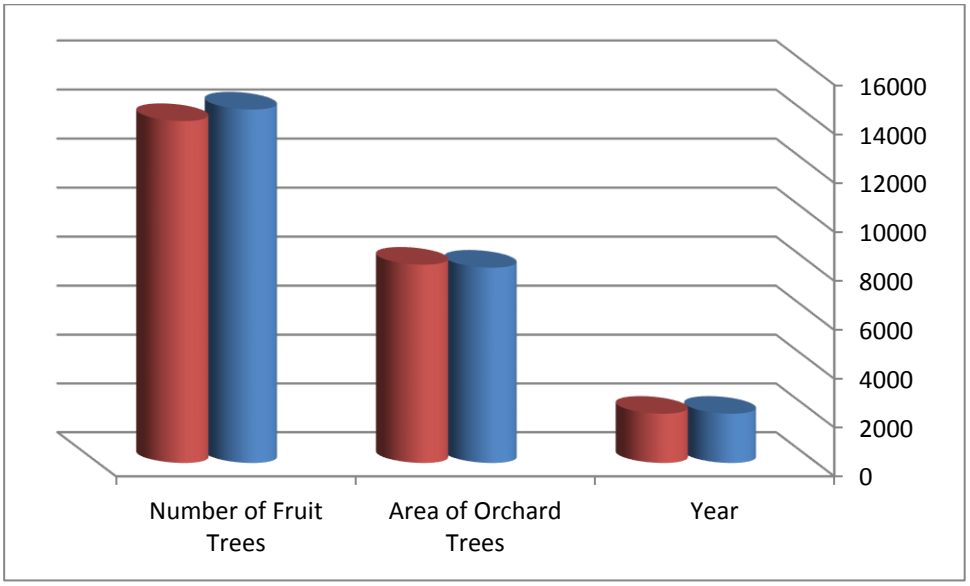
Table (8) Area of orchards, number of palm trees and fruits in Ain Tamr district

Number Of Fruit Trees (Tree)	Number Of Palm Trees (Palm Tree)	Area Of Orchard Trees	Year
14450	8372177	8000	2023

13980	8375425	8122	2024

Source: Karbala Governorate Agriculture Directorate, Agricultural Statistics Division, unpublished data for 2023-2024.

Figure (2) Area of orchards and number of fruits in Ain Tamr District



Source based on data from Table (8).

B- Vegetable Crops:

Vegetable cultivation is an important and profitable crop if provided with proper care and the necessary supplies. It is of great importance due to its nutritional value. It is rich in minerals and salts and contains adequate amounts of vitamins. Therefore, its production is constantly increasing in light of the high demand for it. It is also particularly sensitive, as it is a perishable crop and highly susceptible to climatic conditions. It requires special care (14).

3- Uses of Agricultural Land for Cereal Crops (Wheat and Barley)

The agricultural land used for growing cereals occupies an area estimated at approximately 16,600 dunums in 2023. Cereal crops include several types of crops, the most important of which are wheat and barley.

Table (9) shows that grain crops have been increasing over the study period. The total area under grain crops reached 16,600 dunums, and this area increased to 17,890 dunums in 2024. The reason for the increase in these areas is due to the low water requirements of these crops, as most of the areas depend on rainwater, and because they are winter crops. This, in turn, will provide for the cultivation of larger areas of land. Furthermore, there is ongoing support from the government, whether through the receipt of grains at competitive prices, which encourages the increase in areas, or through the distribution of water sprinklers, which in turn reduces the amount of water used.

Table (9) Area of winter and summer grain crops for the year (2023-2024)

Cereal Crops (Dunums)	Year
16600	2023
17890	2024

Source: Ministry of Agriculture, Directorate of Agriculture in Karbala Governorate, Agricultural Statistics (Planning and Follow-up), unpublished data for the year 2023-2024.

A- Wheat Crop

Table (10) shows an increase in the area of agricultural land during the study period. In 2023, it was recorded at (104,500) dunums, with a production volume of (28,900) tons and a production yield of (800) (kg/dunum). These areas continued to increase until they reached (123,205) dunums in 2024, while no information was available regarding the production quantity due to the incompleteness of the annual crop data for 2024.

Table (10) Wheat Crop Area in Ain al-Tamr District for the Year 2023-2024

Production Yield (Kg/Acre)	Production/Ton	Wheat / Dunum	Year
800	28,900	104500 Dunams	2023
-	-	123205 Dunams	2024

Source: Directorate of Agriculture in Karbala Governorate, (Agricultural Statistics and Marketing Division), unpublished data for the year (2023-2024).

B- Barley

Barley cultivation requires conditions almost similar to wheat cultivation. However, it is more resistant to drought and disease than wheat and more productive under favorable environmental conditions. Therefore, it is designated for areas unsuitable for wheat cultivation, such as those with poor soil and little water. However, a temperature drop of up to 2°C affects barley seeds more significantly than wheat. However, a temperature rise generally does not affect the yield as significantly as wheat, as barley can tolerate temperatures of up to 40°C, while wheat cannot. This is perhaps due to barley maturing earlier than wheat (15). Barley grows best and yields higher yields when grown in well-drained, fertile, loamy soils. However, it can also be grown in sandy and saline soils, making it more resistant to salinity than wheat.

Furthermore, its cultivation is primarily successful after bulrushes and legumes such as broad beans, lentils, and chickpeas. It also works well as a fodder mixture with clover. Table 11 shows that the barley crop area reached 500, with a recorded productivity of 130 kg/dunum, and a production yield of 400 kg/dunum. In 2024, the barley crop area reached 476 dunums. We note a decline in the barley crop area for 2024 compared to 2023. This is due to low demand for the crop, especially during a period when livestock populations were declining. As for productivity for 2024, it was not mentioned due to the lack of data, as the crop season had not yet ended.

Table (11) Barley crop area in Ain Al-Tamr district for the year 2023

Production Yield (Kg/Acre)	Production/Ton	Wheat / Dunum	Year
400	130	500	2023
-	-	476	2024

Source: Directorate of Agriculture in Karbala Governorate, Marketing Division (Agricultural Statistics), unpublished data.

5- Land Uses for Summer Cereal Crops

Corn is one of the main cereal crops in Iraq due to its importance in human and animal nutrition. It is used in the production of dry fodder at rates of up to 70%. It is also used in the production of vegetable oils, such as corn oil extraction (16).

Corn ranks first in agriculture in the district and the governorate as a whole due to its economic importance. The area planted with yellow corn in the district constitutes 68,196 dunams. It is also evident that the area planted with corn is distributed among the district's administrative units. 6: Livestock in the Study Area

Studying the uses of agricultural land invested in livestock production is of great importance in studying agricultural land use. Livestock is a key component of agricultural operations and, due to its high protein content, represents an important nutrient that supports farmers on their farms, as well as contributing to agricultural production. Furthermore, its waste can be utilized as organic fertilizers, which are important in stimulating soil productivity. To understand the geographical distribution structure of livestock production in the study area, it was distributed based on the type of animal, its importance, and its total number (Table 12). Table 12 shows that the number of sheep in 2023 was recorded at 20,000 ewes, while the number of cows reached 1,200. The number of buffalo was recorded at 400, and the number of camels was recorded at 2,000, while the number of poultry reached 50. As for 2024, no data was available for it at the end of the year, as the livestock is in the process of increasing.

Table (12) Numbers of livestock in Ain al-Tamr District for 2023

Number	Animal Type
20000	Sheep
1200	Cattle
400	Buffalo
2000	Camels
50حقل	Poultry
23600	Total

Source: Directorate of Agriculture in Karbala Governorate, Agricultural Statistics (Planning and Follow-up), unpublished data for 2023.

CONCLUSIONS AND RECOMMENDATIONS

The Ain Tamr district is an agricultural area. Like any other agricultural area, Ain Tamr faces a number of problems and requires appropriate solutions to ensure agricultural sustainability and maximize the use of agricultural land. These are some of the common problems and potential solutions:

Conclusions

1. There is a close relationship between the distribution of agricultural land in Ain Tamr district and surrounding factors such as water availability, topography, and climate change.

2. The researcher found significant variation in agricultural land use within the Ain Tamr district, reflecting the natural and economic diversity of the region.

3. The study found that high-value agricultural land is concentrated in specific areas within the district, which calls for measures to protect these lands and enhance their sustainability.

4. The data indicate changes in agricultural land use in the Ain Tamr district over time. This requires continuous analysis of agricultural patterns and trends to meet the needs of the population and conserve natural resources.

5. It is noted that there is a disparity in agricultural land use between urban and rural areas in Ain Tamr District, requiring the adoption of dedicated policies to promote sustainability in both contexts.

6. The data demonstrates an urgent need to improve the district's agricultural infrastructure, including improved irrigation and water management systems to increase productivity and enhance resilience to climate change.

Recommendations

1. Measures should be taken to conserve biodiversity in Ain Tamr District, including the conservation of agricultural land and crop genetic diversity.

2. Local authorities and relevant institutions should ensure the efficient and sustainable use of natural resources in the area, including providing support to farmers and rural communities.

3. Enhance spatial planning for agricultural use to ensure that agricultural land effectively meets the needs of residents and achieves environmental sustainability in the district.

4. Enhance public-private sector cooperation to provide the necessary funding and resources to develop agricultural infrastructure in Ain Tamr District, including modernizing irrigation systems and developing agricultural technologies.

5. The district's urban and agricultural planning authorities should develop integrated policies aimed at preserving available agricultural land and preventing unwanted conversions.

6. Enhance training and education for farmers in Ain Tamr district on sustainable agricultural practices and the adoption of modern agricultural technologies to increase productivity and profitability.

7. Conduct specialized studies and realistic assessments of agricultural land use in the district to track changes and better guide policies and measures.

8. Local authorities and relevant institutions should encourage innovation in agriculture and provide support to small and medium-sized agricultural enterprises to promote sustainable development in the region.

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