


Modeling the Climatic Requirements for Date Palm Cultivation in the Badra Region Using Predictive Statistical Methods



Feraqid Ubaid Kazem Al-Masoudi 

Geography Department, Open College of Education, Kut 52001, Iraq

Corresponding Author Email: bf428621@gmail.com

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ABSTRACT

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Wasit Governorate is one of the places where palm cultivation can be developed and model farms can be established. Therefore, the aim of the study was to establish model farms after overcoming the obstacles to palm cultivation in the area Badra especially the issue of control and scarcity of water for the orchards of Badra district. The need to develop national programs to revive palm groves, especially in border areas, and provide all means to restore life to them. After it became just large areas devoid of agriculture, finding solutions to the issue of the decline of dates in the city of Badra as a result of government negligence and other factors and causes that helped to do so, such as the fires that affected large areas of orchards in the governorate in recent years, in addition to the scarcity of water due to the interruption of water from torrents arriving from Iranian territory. The study explained after analyzing the climate of Iraq based on agricultural station data. And the use of modern geographical and statistical techniques, including programs for modeling geographic phenomena, including (ARCGIS - used in drawing maps, signing geographic phenomena, and processing satellite images (HEC-GIS) HEC-HEC - investing in watersheds coming from flood waters HAS4, its information is provided through an analysis program that contains based on a fully automatic statistical algorithm that can produce more details through a program SPSS (Statistical Package for the Social Sciences). The SPSS platform provides advanced statistical analysis, an extensive library of machine learning and text analysis algorithms, open source scalability And integration with big data and smooth deployment in applications). Based on satellite images and digital industrial, climatic and agricultural data to reach results through which the best areas are determined to establish model farms and to achieve double economic gains.

1. INTRODUCTION

Badra is classified as one of the most important areas where palm groves and fruits abound, which contained unique and rare varieties of Iraqi dates before the war machine reached them in the eighties.

The city of Badra is famous for the famous Iraqi dates, such as Al-Barhi, Al-Maktoum, Al-Qaytaz, Jamal Al-Din, Wasta Amran and Al-Barban. Wasit Governorate contains large areas of palm and fruit orchards, amounting to about 23 thousand dunums, distributed in several regions, and these orchards are famous for various fruit trees and palm trees.

And to encourage interest in production, the Directorate of Agriculture used to hold an annual exhibition of dates produced in the governorate with the participation of sub-agricultural divisions and owners of orchards, in addition to the Al-Kut palm station, which in turn displays dozens of varieties of dates available to it.

For decades, Iraq occupied the first place in the production of dates and kept the first place in the world in terms of palm trees and annual production. Owns less than half of the previous number because of the wars that destroyed Iraq's

palm trees and orchards, especially in the eastern border regions since 1980, in addition to infection with various diseases, including the donkey and dubas insects.

Wasit Governorate is one of the places where date palms can be cultivated. The aim of the study is to overcome obstacles to cultivation and solve problems, especially the issue of control and water scarcity in relation to the orchards of Badra district. And the need to develop national programs to revive palm groves, especially in the border areas, and to provide all means to restore life to them. After they became mere large areas and finding solutions to the issue of the decline of dates in the city of Badra as a result of government negligence and other factors and reasons that helped in this, such as the fires that affected large areas of orchards in the past years, in addition to the water scarcity due to the stopping of the water of the Kilal River coming from Iranian territory.

1.1 Research problem

The main problem can be clarified: Can the eastern part of Wasit Governorate be developed for palm cultivation? as well Are the climatic conditions in this part of the province

commensurate with the requirements of date palm cultivation?

What is the relationship of climate elements with determining the cultivation and production of palm trees in the eastern part of Wasit Governorate? What is the effect of climate elements on the variation and determination of date palm cultivation and production in the study area? What is the climatic factor that has the greatest influence on the variation and determination of date palm cultivation and production in Wasit Governorate?

Is it possible to identify suitable areas for date palm cultivation in the governorate using modern technologies?

Is the area suitable for palm cultivation for the purpose of its development?

What are the most important requirements for developing the cultivation of the best types of dates in Badra District?

1.2 Research hypothesis

The research hypotheses are based on the fact that climatic elements have an impact on the cultivation and production of each date palm in Wasit Governorate.

Its cultivation areas can be developed and expanded in accordance with the ideal climatic requirements for its cultivation.

New varieties can be grown, and vertical expansion can be achieved through intensification and diversification of agriculture in one area unit.

Horizontal expansion is carried out by exploiting other areas in addition to the currently exploited areas. To plant palm trees if conditions and other factors are available.

The rates of climatic elements available in the region are sufficient for the requirements of palm cultivation.

There is climatic variation at the governorate level that makes it possible to divide it into areas of varying productivity.

Investing flood water and exploiting rainfall intensity to create model farms based on climate station data.

1.3 Purpose of the study

The aim of the study is to provide predictions about determining the locations of the geographical phenomenon, which is the establishment of typical farms based on digital data that are consistent with the climatic elements and their suitability to achieve the economic goal, according to a quantitative statistical approach. The aim of the study is to highlight the importance of climate studies when setting agricultural policies in the country. Palm is one of the important agricultural food crops.

And the study of the relationship or the impact of climate on its cultivation is one of the modern topics that the researchers did not address in a precise and detailed manner. Therefore, the results that can be reached through this study are considered pioneering and important and serve planning and agricultural projects in the future, especially since the researchers worked hard to clarify and highlight this relationship between climate elements and the production of excellent palm trees.

1.4 Research justifications

Determining the most suitable areas for the cultivation of different agricultural crops is one of the most important goals of climatology.

Agricultural, which helps to improve the quality of production and increase its quantity. As the climate elements are among the most important elements on the basis of which the ideal and suitable areas are determined for the cultivation of these crops. The studies that deal with the productivity of date palms from the climatic point of view are limited and few, despite the importance of this vital aspect of the agricultural economy, which is not commensurate with the clear and important influence of the climatic elements in its cultivation, and to determine the regions or regions in which the cultivation of these crops can expand according to the types and varieties that are used. Its climatic requirements are compatible with the nature of the region's climate conditions.

2. STUDY METHODOLOGY

The climate of Iraq was analyzed through the data of the agricultural stations. The researchers tried, after using modern technologies, including digital programs (GIS). It is used to draw maps, sign geographic phenomena, and process satellite images (HEC-GIS) HEC-HEC to invest in watersheds coming from flood waters HAS4 his information is provided by an analysis program that contains a fully automatic statistical algorithm and can lead to further details, through a program SPSS (Statistical Package for the Social Sciences). The SPSS platform provides advanced statistical analysis, an extensive library of machine learning and text analysis algorithms, open source scalability, integration with big data, and seamless deployment in applications based on satellite visuals and Dem (Figures 1-4 and Tables 1 and 2).

2.1 Study area

The boundaries of the study area are located in Badra district in Wasit Governorate at coordinates 33°11'66.67" N 45°95'00.00" E. The area of the study area is 3650 square kilometers. The height of Badra area is 200 meters above sea level. Its population, according to the census, is 40,000 people (2006 census). The population density is high in the center of the district. It is bordered to the north and northeast by Diyala Province, to the east by the Islamic Republic of Iran, and to the southeast and south by the rest of the districts of Wasit Province. The city of Kut, the center of Wasit Province, is 180 km to the south of the capital, Baghdad, 180 km to the north of Nasiriyah, 160 km from Diwaniyah Governorate, and 196 km from the city of Amarah is the center of Maysan Governorate.

3. THE APPROPRIATE CLIMATIC REQUIREMENTS FOR PALM CULTIVATION

Including solar radiation / maximum, minimum and ideal temperature / wind speed / relative humidity / precipitation / evaporation / water resources / soil, climatic characteristics of the study area to reach the type of relationship in the proposed spatial determination of date palm cultivation in Badra district, spatial development associated with it, increasing settlements humankind, food industries associated with it, the use of modern technologies. The quantitative study relied on Tables 1-8, and Figures 1-4.

Table 1. Number of date palms in Wasit Governorate for the year 2020

Total Production	Production in Tons							Governorate
	other kinds	Derry	Khadrawi	Sayer	Al-Halawi	Khastawi	Alzohdi	
37570	7837	362	1499	222	393	4420	22837	Wasit

Source: Directorate of Agriculture [1].

Table 2. Distribution of palm trees in Badra district and other Wasit districts

The Total	Al-Hei	Al-Ahrar	Kut	Badra	Nomania	Azizia	Essaouira	Province
5503	300	160	684	1650	949	560	1200	Number of palms

Source: Directorate of Agriculture [1].

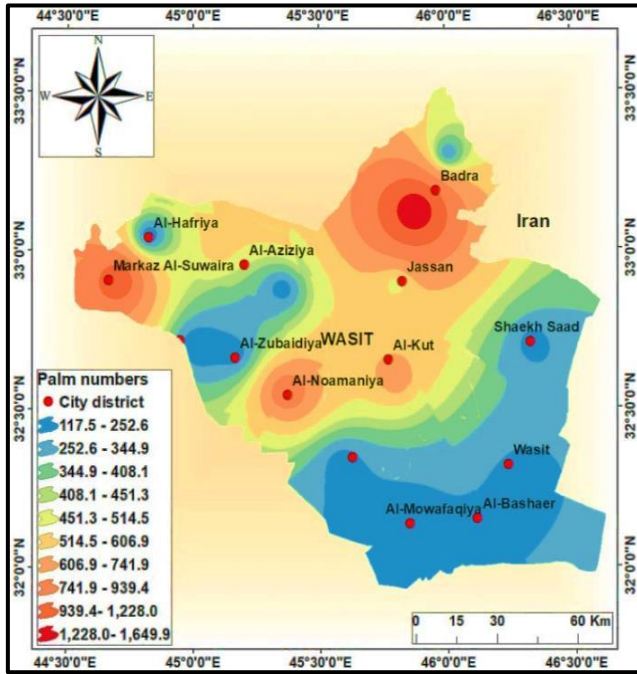


Figure 1. Distribution of date palm numbers in Badra district and Wasit governorate districts

The source is from the researchers' work based on Table 1.

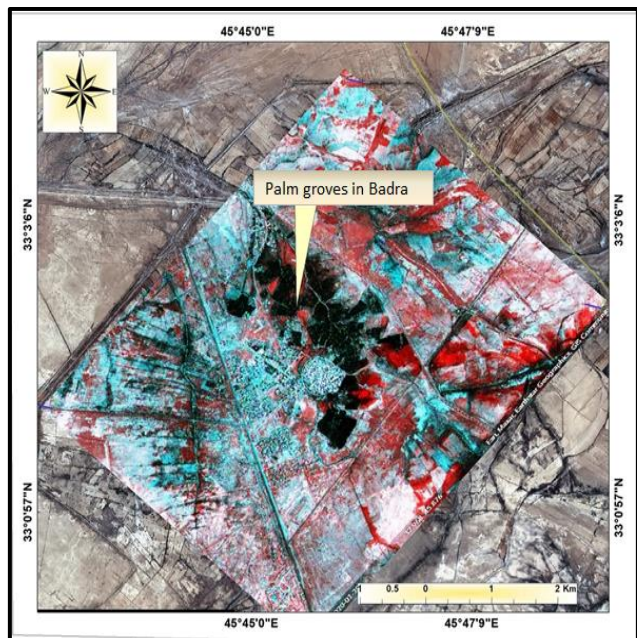


Figure 2. Satellite visual distribution of date palms in Badra district

Source: Satellite visuals and arc map GIS 10.7.



Figure 3. Palm groves in Badra district

Source: The photo was taken on 4/25/2023 in Badra district, east of Wasit Governorate, on Tuesday.

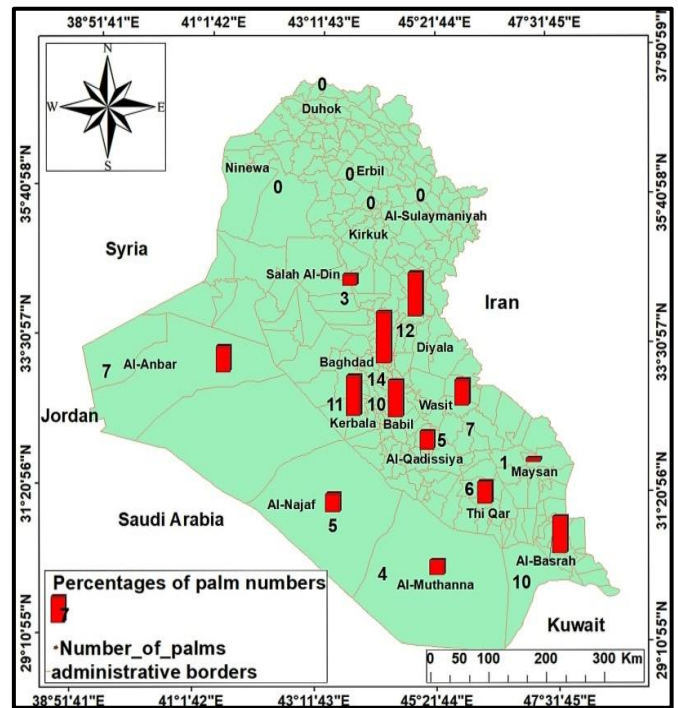


Figure 4. Number of date palms in Iraq

Source: Agricultural Meteorology Center [2].

4. DATE PALM CULTIVATION IN IRAQ

Iraq is one of the oldest date palm cultivation sites in the world, as the first documented appearance of the date palm tree in the ancient world was in the historic city of Eridu, located

in southern Iraq (about 4000 BC), which was a major area for date palm cultivation. There is also a seal in the Iraqi Museum. It contains two men with a date palm between them, dating back to the Akkadian era (about 2730 BC). The Obelisk of Hammurabi (about 1754 BC) contains seven laws related to palm trees, including a law that imposes large fines on those who cut down a palm tree, and other laws related to tree pollination and the relationship between the farmer and the owner. The land and penalties for negligence and lack of care, as it imposes on the farmer to pay the rent of the orchard in full to the owner if his neglect or lack of care for the trees caused a lack of production of dates. The Assyrians revered four things: the date palm, the plow, the winged bull, and the sacred tree [3-5]. Badra is part of the elevated undulating area and is distinguished in some Its parts are flatness and lack of slope, as it does not rise more than (25) meters above sea level (Figures 5, 6 and Table 3).

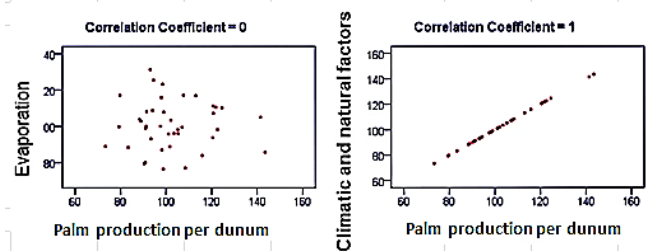


Figure 5. Pearson's correlation coefficient with variable elements

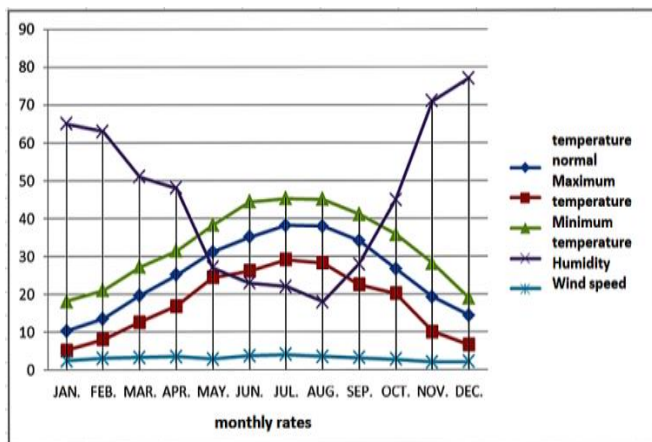


Figure 6. Climate data for Badra weather station

Table 3. Dates production schedule according to the years

Global Ranking Rate	Production Rate in Tons	Period
2	350,000	1964-1960
2	346,000	1965-1969
2	361,000	1970-1974
1	470,818	1975-1079
3	387,516	1980-1984
4	398,534	1985-1989
3	569,478	1990-1994
2	821,094	1995-1999
4	804,276	2000-2004
7	450,114	2005-2009
5	636,172	2010-2014
4	735,000	2020

Source: Food and Agriculture Organization of the United Nations [6].

5. RESULTS

5.1 The climate

Because the governorate is located in the subtropical region, its climate is part of the desert climate, which is characterized by high temperatures, dryness in summer and mildness in winter, and little, fluctuating rains that increase in the eastern parts of the governorate, ranging between (150-300) mm (See Table 3, the dates production schedule according to the years).

5.1.1 Temperatures

The ideal temperature for the growth of this tree is 32-38 degrees Celsius, and it tolerates high temperatures of up to 49-50 degrees Celsius, while palm trees are noticeably affected by low temperatures, as they stop growing if the temperature in the shade drops below (-12), (-9) degrees Celsius, and they also tolerate frost up to (-3) degrees Celsius. Ministry of Transport, Iraqi Weather Forecast and since the agricultural stations (Zurbiatiya, Badra) the temperatures rise between (44-47) degrees Celsius in the stations affiliated with the Ministry of Agriculture, while the Badra station of the Ministry of Transport and Communications recorded the highest temperature reaching 45 degrees Celsius. Thus, the province of Wasit, especially in its northeastern part, is suitable for palm cultivation and suitable for the establishment of palm groves.

But the bulk of the leaves leak out, while the final bud remains alive to continue growing in the summer. Next, therefore, the resistance of date palms to low temperatures differs in different varieties. There are varieties that are highly resistant to frost, such as Zuhdi and Khastawi, and varieties with medium resistance, such as Degla Nour and Al-Diri, and varieties with weak resistance, such as Al-Brim and Al-Halawi. For the fruits to ripen, there must be an average temperature higher than 18°C (varies according to the varieties) between early May and until October. According to Mason research in California, the following has been proven:

-The palm tree does not scientifically have a relative resting phase.

-Palm trees begin to grow at a minimum temperature of 9.5-10°C, the biological zero point.

-Growth does not stop at night, even at a temperature of zero, but rather -7 degrees Celsius, provided that the daytime temperature is higher than 10 degrees Celsius.

Palm growth is directly proportional to the importance of the daily maximum temperature, and this proportionality is less important compared to the average daily temperature.

Failure to grow continues with an average daily temperature of less than 10 degrees Celsius, provided that the daily maximum temperature is higher than 10 degrees Celsius, and palm trees need to complete fruit ripening to 1670-1854 degrees Celsius above 18 degrees Celsius.

In general, adult trees are more resistant than young trees because of the thick fibrous layers that cover the trunks.

The date palm does not bloom except at an air temperature higher than 18 degrees Celsius, and in order for the fruits to ripen, there must be an average daily temperature higher than 18 degrees Celsius between early May and until October [7].

And to use the Pearson correlation coefficient, the result was positive by 1, and this means that the relationship between palm production and the climatic factor is a strong linear relationship. Using a program SPSS (Looks at Figure 5).

$$r_{XY} = \frac{\sum_{i=1}^n (X_i - \bar{X})(Y_i - \bar{Y})}{\sqrt{\sum_{i=1}^n (X_i - \bar{X})^2} \sqrt{\sum_{i=1}^n (Y_i - \bar{Y})^2}}$$

After applying Pearson's correlation equation, the result was a strong and positive correlation with the natural elements, namely climatic elements, soil and water resources, while the correlation was weak between palm production and the excluded climatic element, which is evaporation. It was also noted that palm production decreased at higher rates Surface irrigation from well water can be used if the level is low to produce palm fruits.

5.1.2 Height above sea level

Palm trees grow at zero altitude above sea level and gradually reach medium heights. A palm tree can live up to 200 years, and its height can reach 30 meters. It grows between 30-45 cm per year. When palm seedlings are planted, they bear fruit after 3-8 years, reach their maximum production after 10 years, and continue to bear fruit until 100 years. Apart from the appropriateness of some temperature levels, palm trees need a temperature of 30 degrees Celsius to fertilize dates, while ripening dates need a temperature of up to 50 degrees Celsius. This contributes to accelerating the ripening of the date crop for fertilization and ripening in the high areas on the Iraqi-Iranian border in the northeast of Wasit Governorate or under the palm trees in the north of the governorate [8].

5.1.3 Rain

Palm trees thrive in rainfall rates ranging from 200-1100 mm, and date production is largely linked to the amount and distribution of rainfall and the degree of water retention in the soil. Although palm trees are among the most drought-tolerant trees, production is greatly affected by conditions of low rainfall and scarcity of irrigation sources. Agricultural stations in Zurbatiyah recorded an estimated rainfall of 200 mm, and stations affiliated with the Ministry of Agriculture, while Badra station affiliated with the Ministry of Transport and Communications recorded the total rainfall for 2021, which amounted to about 204.76 mm. Therefore, Wasit Governorate, especially in its northeastern part, is suitable for agriculture and orchards. As shown in Figure 5, and using the Pearson correlation coefficient, the result was positive 1, which means that the relationship between palm production and the climatic factor is a strong linear relationship.

5.1.4 The wind

The palm has a high ability to resist winds due to the flexibility of its trunks and the strength of its roots in the soil. The palm tree is also characterized by its flexibility and durability, but severe storms may drop the aged or developing palm in shallow soil. Some windbreaks around the orchard [9]. Accordingly, monitoring of strong winds, especially Khamsiniya, was observed to protect palm trees in the study

area. And to use the Pearson correlation coefficient, the result was positive by 1, and this means that the relationship between palm production and the climatic factor is a strong linear relationship.

5.1.5 Atmospheric humidity

High atmospheric humidity is not suitable for palm cultivation as it contributes to the spread and reproduction of pests, especially Dubas disease. Therefore, it is recommended to plant it away from areas with high humidity, as the stations affiliated with the Ministry of Agriculture recorded 51 mm, while the Badra station affiliated with the Ministry of Transport and Communications recorded annual humidity rates of about 45 mm in 2021. Although palm trees grow in humid places, the production of good fruits requires little rain and a dry climate during the pollination and ripening periods. During the pollination period, rain and high humidity help spread the disease that affects palm pollen and hinders the pollination process. As for the wet and date stages, the fruits may rot and ferment if the relative humidity increases. There must also be sufficient moisture in the soil for the growth of the tree and flowers and the development of fruits, especially when temperatures rise to high levels. After using the Pearson correlation coefficient, the result was positive 1, which means that the relationship between palm production and the climate factor is a strong linear relationship.

5.1.6 Evaporation

Evaporation levels rise in the study area between 970-1390 mm, and this level corresponds to date palm cultivation. See Table 4 and Figure 1, using Pearson's correlation coefficient, the result was positive by 0, which means that the relationship between date palm production and the climatic factor is weak.

5.1.7 Sunlight

The date palm loves direct light and is one of the most demanding fruit trees for sunlight. It has been observed that the growth of palm trees is not normal even in the hottest deserts if it does not receive its light needs. However, the strong solar radiation associated with a very high temperature limits and stops the growth of the palm tree. The sun's heat contributes greatly to the elimination of various palm pests. The number of hours of brightness increases in the study area to reach 12 to 10 hours due to cloudiness and dust storms. And to use the Pearson correlation coefficient, the result was positive by 1, and this means that the relationship between palm production and the climatic factor is a strong linear relationship. The annual, monthly and daily climate data of Badra Climate Station and data (precipitation, rain, and evaporation) as well as the physics of thunderstorms in the study area with what they carry of the potential energy driving thunderstorms the extent of the suitability of the study area for palm cultivation according to the available climate data (Tables 3-6 and Figures 6-11).

Table 4. Daily climate data from Badra Station

Year	Climate Elements	JAN.	FEB.	MAR.	APR.	MAY.	JUN.	JUL.	AUG.	SEP.	OCT.	NOV.	DEC.
2021	Normal temperature	10.3	13.5	19.7	25.1	31.2	35.1	38.2	38	34.1	26.7	19.3	14.4
	Minimum temperature	5.3	8.1	12.7	16.9	24.5	26.2	29.1	28.3	22.6	20.2	10.1	6.6
	Maximum temperature	18.2	21.1	27.2	31.5	38.3	44.4	45.3	45.1	41.1	35.8	28.2	18.9
	humidity	65	63	51	48	27	23	22	18	28	45	71	77

Wind speed	2.5	3.1	3.3	3.5	2.9	3.8	4.1	3.5	3.2	2.8	2.1	2.2
Rain	29	44	28	26	15	11	1	13	33	0.5	0.004	0.02
evaporation	93.9	119.9	138.8	285.5	343.8	486	488.4	475.2	335.4	231.4	89.8	53.9

Source: KAPITA [10].

Table 5. Monthly climatic data for Badra station

SRt	SR	WSMM	WSM	WS	Tmm	TMM	T	Tm	TM	Rain	Months
335.12	11.17	15.96	6.08	2.08	-3.36	24.85	11.92	3.85	20.08	4	January
390.82	13.96	19.47	8.13	2.16	1.6	28.97	13.82	5.35	22.29	37.7	February
524.89	16.93	16.45	9.51	2.55	4.39	33.78	18.45	9.94	26.96	5.5	March
685.08	22.84	16.81	10.51	3.32	6.81	43.11	26.74	16.86	36.62	1	April
807.21	26.04	16.17	9.89	2.31	16.7	46.61	31.75	21.56	41.94	0.2	May
1687.43	28.6	18.4	11.88	3.75	20.34	50.38	35.26	24.76	45.77	0	June
1627.25	26.68	16.08	10.47	3.8	24.13	52.79	38.36	28.76	47.96	0	July
1500	25	15	10	2.9	23	50	35	30	42	0	August
1300.17	21.67	14.58	10.5	2.88	14.97	49.33	32.61	21.65	43.11	0	September
522.81	16.86	12.14	8.24	2.12	9	44.16	25.89	15.25	36.7	0.1	October
337.98	11.27	17.6	6.23	1.5	5.35	36.37	19.14	10.56	28.2	1.8	November
258.33	8.33	19.06	8.26	2.48	-2.93	26.13	13.61	5.81	21.59	1.9	December

Table 6. Daily climate data at Badra station recorded on Sunday, 9/20/2020

The Highest Wind Speed	Average Wind Speed	Minimum Humidity	Super Humidity	Temperature Rate	Minimum Temperature	Super Temp.	Rain	Station	Governorate
14.11	3.56	11.88	51.4	34.34	22.9	43.7	0	Badra	Wasit
15.11	3.5	12.8	52.4	33.34	21.9	44.7	0	Zarbatiya	Wasit

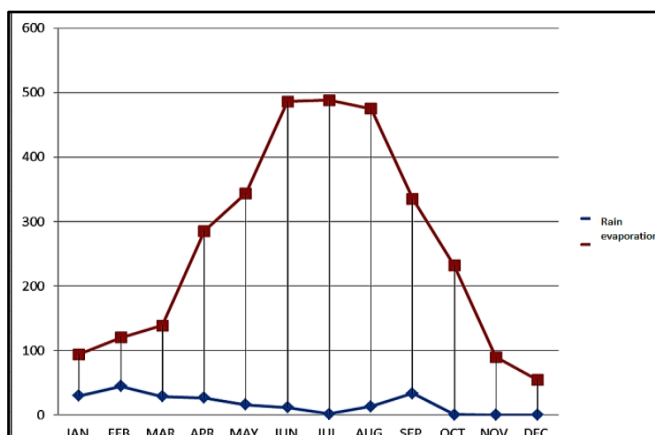


Figure 7. Climatic data for Badra climate station (rainfall, evaporation)

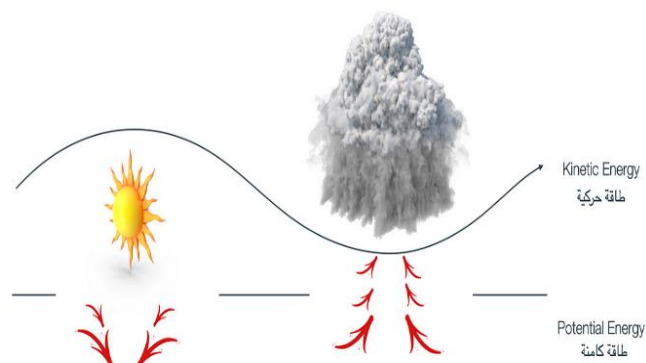


Figure 9. The potential energy driving a thunderstorm
Source: OXFAM [11].

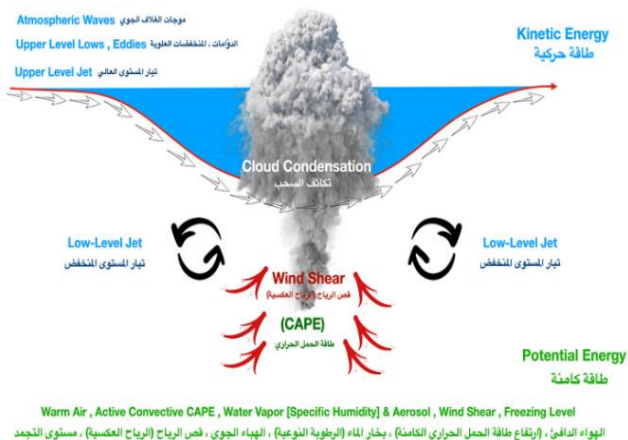


Figure 8. Physics of thunderstorms in the study area
Source: OXFAM [11].

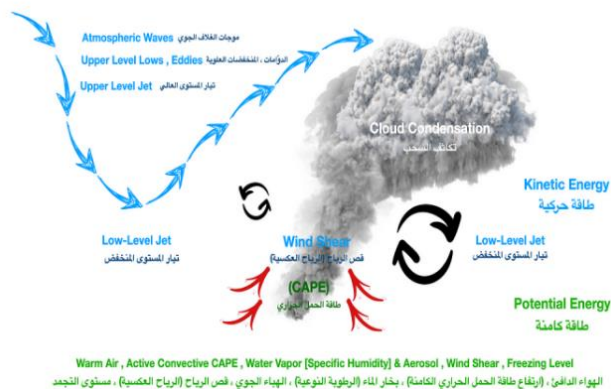


Figure 10. The shape of the shear current or reverse wind in the study area
Source: OXFAM [11].

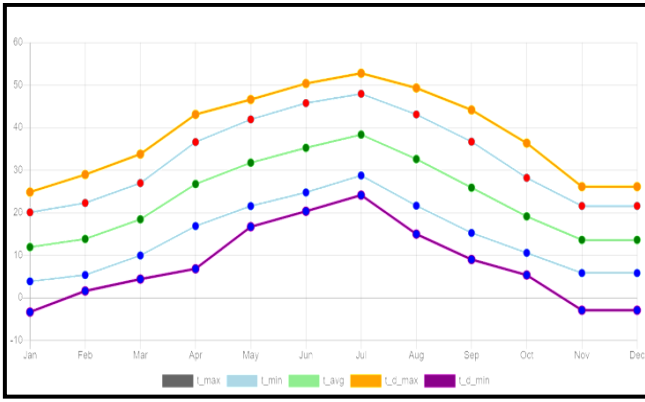


Figure 11. Climatic data for the Iraqi governorates
Source: Table 6, OXFAM [11].

5.2 Soil

Date palms can be grown in various types of agricultural soils, but it is better than light, deep, fertile agricultural soils, and the date palm tolerates salinity more than other plants, and this helps to grow it in lands that are not suitable for other plants, and the reason may be due to its ability to Except for the absorption of chloride from the soil solution, and its ability to absorb water without absorbing salts. It also works to convert carbohydrate compounds into sugars dissolved in water so that the osmotic pressure inside and outside the tissues is equalized and the palm tree tolerates soil submerged in water for about 20 days (Tables 7, 8) [12, 13].

As for the composition of the soil suitable for palm trees, it must be:

- 10-15% clay.
- 10-20% salt.
- 20-50% sand.

See Table 7 and to use the Pearson correlation coefficient, the result was positive by 1, and this means that the relationship between palm production and the climatic factor is a strong linear relationship [14-17].

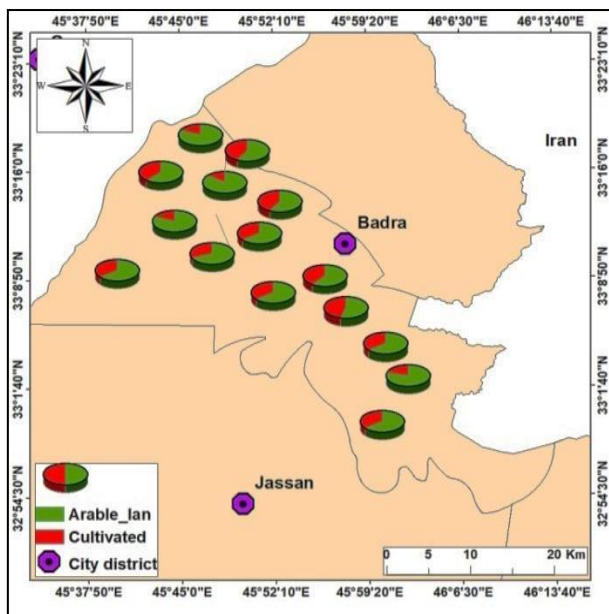


Figure 12. The percentage of arable land from the cultivated land
Source: Dematté et al. [15].

The total area and the arable and cultivated area in acre in the governorates of Iraq for the year 2020 (Tables 7 and 8, Figures 12-14).

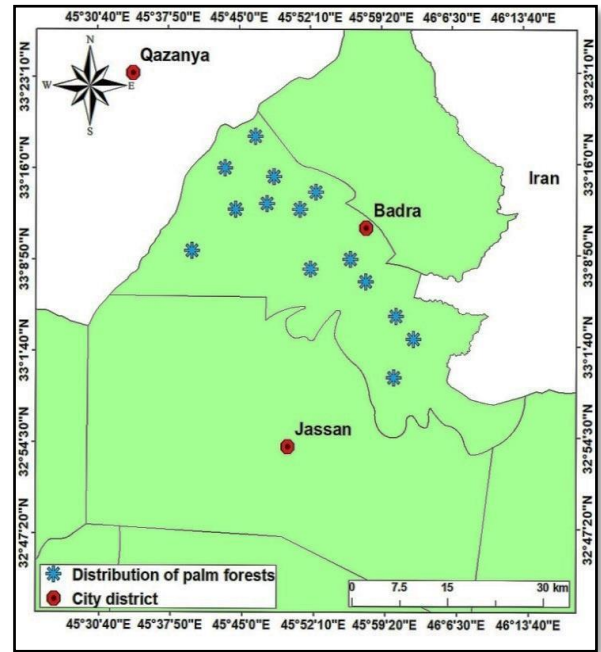


Figure 13. Model farm sites
Source: ARCMAP GIS/Digital statistical analysis [18].

5.3 Water resources

Groundwater: It is a vital source for economic activities in Badra District.

Al-Kalal and Al-Fintaz: It feeds many irrigation projects and agricultural lands in Badra District After analyzing and using programs and data, the researcher was able to draw maps and figures [19, 20]. The watersheds of the floods coming from Iran were identified to develop model palm groves in the study area through a program HEC-GeoHMS identifies watersheds and extracts hydrological data. The program allows users to visualize spatial information, document watershed characteristics and perform spatial analysis, and through its interfaces, menus, tools and buttons to help develop water resources in the region to prepare a model farms water investment method (see Figure 14).

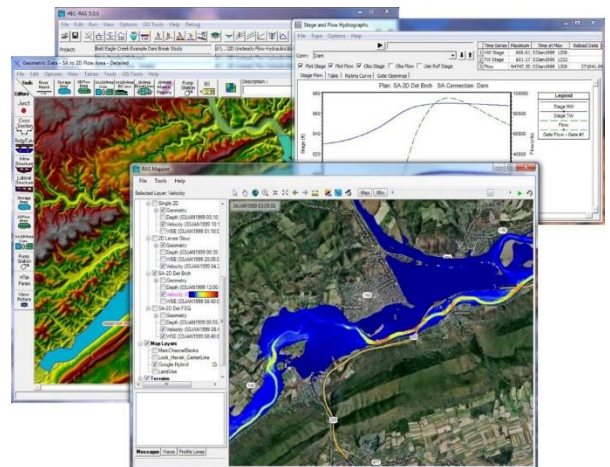


Figure 14. Use a program
Source: Elbarlament Organization [19].

Table 7. Physical and chemical characteristics of the study area

Site No.	Depth cm	Texture	Slope %	Carboate Mincrals (CaCO ₃)	Gypsum %	O.C%	PH	Ece ds.m ⁻¹	CEC Cmol.kg ⁻¹ soil	Drainage
1	100	L	<1	40	0.16	0.35		5.40	20.4	Moderately
2	100	sic	1	53	0.37	0.26	73	133	173	Moderately
3	100	L	<1	40	0.16	0.35	8	5.40	20.4	Moderately
4	100	SiCL	<1	13	1.26	0.55	715	6.34	25.1	Moderately
5	100	SiCL	<1	27	1.15	0.65	7.1	0.21	262	Moderately
6	100	SiC	1	53	0.37	0.26	7.3	13.3	17.3	Moderately
	100	SiL	<1	37	0.24	0.29	78	38	17	Moderately
	100	SiCL	<1	42.2	0.22	0.32		3.03	17	Moderately
9	100	SiCL	<1	23.2	0.17	0.17	78	31	21	Imperfect
10	100	SiCL	<1	422	0.22	0.32		3.03	17	Moderately
13	100	SiL	<1	29	1.01	0.33	8	38	212	Moderately
16	100	Sic	<1	28	0.19	0.45	1.6	46	213	Imperfect
17	100	SiCL	<1	27	0.28	0.21	77	143	22.1	Moderately
18	100	SiL	<1	18	0.46	0.55	7.2	0.54	22	Well drained
19	100	SiCL	<1	23.2	0.17	0.17	78	13.3	21	Moderately
20	100	SiCL	<1	34.1	0.33	0.45	7.6	38	18	Imperfect
21	100	SiC	<2	35	0.18	0.40	77	73	16	Imperfect
22	100	SiL	<1	40.37	0.14	0.59	74	2.04	20.2	Moderately
24	100	SiL	<1	29	1.01	0.33	8	18	21.2	Well drained
ae	1AA			A	aw	ie &	so	2%	211	Mannorataly

Source: Analysis of soil samples in the study area (engineering services laboratories) [13].

Table 8. Percentage of cultivation of lands in the study area

The Total	Al-Hei	Al-Ahrar	Kut	Badra	Nomania	Azizia	Essaouira	Province
5503	300	160	684	1650	949	560	1200	Number of palms

Source: Kilef Al-Huwais [14] and Dematté et al. [15].

5.4 Development of palm groves in Wasit Governorate

To develop the cultivation and production of palm trees and increase their production, it is important to use appropriate methods for cultivation and care. The chosen method depends on the nature of the soil. Therefore, methods of planting and propagating palm trees differ between countries due to weather conditions, such as high and low temperatures, the amount of rainfall, irrigation water, and the nature of the soil [18].

This is done by multiplying suitable, well-producing, genetically and genetically improved types and varieties of fruits and olives. It is one of the important programs implemented by the Ministry of Agriculture through the Horticulture Department. It began in 2019 and continues for five years. Its most important goals are to spread and develop palm trees in Iraq through a five-year plan prepared by the specialized technical staff. Increasing the residential area in the sites designated for establishing orchards, increasing factories according to an investment plan in the canning industry and molasses production, harvesting flood water in the north-eastern regions of Wasit Governorate, and exploiting water. Using modern methods to create model farms. It is possible to determine the appropriate areas for establishing model orchards in Badra district after relying on the data of the Ministry of Agriculture. Figure 15 shows qualifying those areas for economic investment Districts, then it becomes clear where the model farms are distributed to achieve the economic goal and obtain the best types of dates.

In light of the climatic and soil characteristics, which are compatible with the requirements of palm cultivation and development in the study area, investing in the lands in the eastern and north-eastern parts of the governorate, and increasing the agricultural area there through investing in groundwater and using water harvesting methods in this region, thus increasing human settlements, especially since the region. It suffers from a clear population imbalance, and this will lead to increased employment and investment opportunities through extending transportation routes, improving their performance, and building facilities that depend on date palm products. All of this will lead to the development of this region, which is devoid of population and has potential, making it an

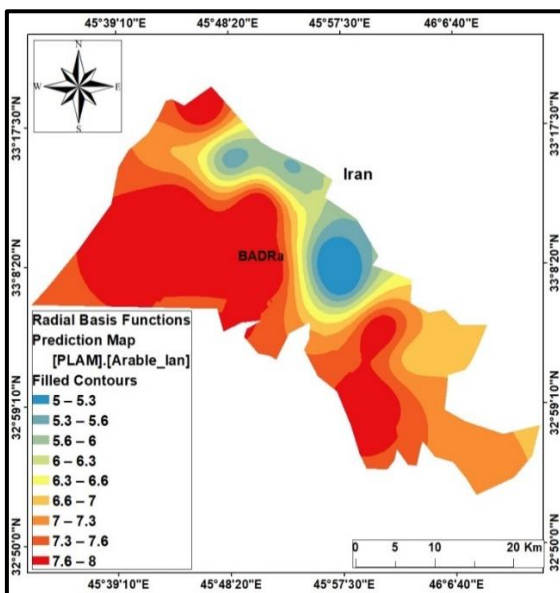


Figure 15. Model orchard establishment sites according to quality and area to produce dates in Badra and Zurbatih

important agricultural area for date palm production and other agricultural crops.

6. CONCLUSIONS

1-The study showed the possibility of cultivating and rehabilitating palm orchards in northeastern Wasit Governorate without seeking help and investing in them in the form of model farms instead of random cultivation in private farms.

2-Adapting palm cultivation to the climatic characteristics of the study area in terms of climatic elements (temperature, wind, humidity, evaporation, and rain).

4-Most of the good types of dates are found in Badra.

5-Predictive computer statistical operations were used to determine the best location for palm cultivation in arable land after knowing the physical and chemical characteristics of the soil based on the ARCMAP GIS program.

6-The Pearson correlation coefficient was relied upon to determine the continuous linear correlation of the two variables: temperature, humidity, rain, wind, water resources, and soil. The value of the correlation with palm production was (+1), which is the degree of perfection, while the result of the Pearson range correlation between evaporation and palm production was (0). If the relationship is weak Using a program SPSS.

7. RECOMMENDATIONS AND SUGGESTIONS

Overcoming financial challenges by relying on the private sector, Encouraging investment in date production Conducting applied research in the field of palm cultivation development Strengthening meteorological capabilities in the field of forecasting winds and frost waves witnessed in the study area. By expanding the field of water harvesting, using statistical and technical programs to produce and sign the map and find out the type of statistical relationships depending on programs Spss/arcmap/gis –HEC/HAS4, to grow improved varieties with good production for investment purposes.

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