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CRITERIA TO BE MET IN SELECTING THE OPTIMAL AREAS FOR GENERATING ALTERNATIVE ELECTRIC ENERGY FROM WIND

Nihad Khudair Kazem AL-KINANI[1]

Prof. Dr., University of Kufa, Iraq

Rfid Sabah Abd Al-Ridha AL-TAMIMI

Prof. Dr., University of Baghdad, Iraq

Helen Muhammad Abdul-Hussein AL-BADIRI

Asst.Prof., University of Kufa, Iraq

Abstract

The issue of renewable energy, an alternative to energy resulting from fossil fuels, is one of the most important topics that researchers have been interested in in recent years, due to its importance in reducing the effects of fossil fuels and the environmental pollution they cause, as well as being one of the important methods that reduce the depletion of large quantities of oil and gas in generating electrical energy from it.

The generation of alternative electric energy depends on a number of natural elements that are naturally available, permanent, and renewable, such as solar radiation energy, wind energy, as well as water energy and bioenergy resulting from the use of animal remains and the remains of various human uses. We will focus here in this research on wind energy as one of the most important energies used in the generation of clean, environmentally friendly electric power because of its characteristic of not leaving any environmental pollutants during its generation, as well as its other advantages. The generation of electric power from the wind needs to choose the optimal areas for generating it in a way that guarantees its continuity, and generating it in economic quantities that contribute to meeting the increasing needs of electricity in various human activities.

Therefore, the study of winds and knowledge of their characteristics, speed and directions are among the most important things concerned by those interested in climate affairs to ensure the continuity of their generation, whose speed should not be less than 3.6 m3 / second during the months of the year. And when choosing any area to generate electric power from wind and installing wind turbines in it, several important criteria must be

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[1] n_kinani@yahoo.com

available that must be available in the chosen area to ensure the success of the project of the stations built on it and ensure its continuity and in economic quantities, so we will focus in our research on those environmental and spatial criteria that must be available in choosing Areas of installation of electric power plants from wind, and we will take the western plateau region in Najaf province as a model for this study..

Key words: The Renewable Energy, Fossil Fuels, Solar Radiation Energy.

Research problem:

Is it possible to determine the optimal area for generating electrical energy from wind in the study area?

Research hypothesis:

It is possible to identify that area that is ideal for setting up wind turbines for the purpose of generating electrical energy from it.

Search objective:

The research aims to identify and analyze a set of criteria and determinants for the purpose of reaching the most suitable area for installing wind turbines and generating electric power from them. In order to fill the shortfall in electrical supply hours that the country's population in general and the governorate in particular suffer from.

Research Methodology:

In this study, reliance was made on the descriptive analytical approach with regard to defining and describing concepts. It also relied on a number of modern scientific geographic methods and techniques, such as the adoption of geographic information systems technology, through which maps were drawn and represented, as well as some modern methods such as the method of spatial interpolation and the method of line lines. Contour and a number of rates, sources and references related to the subject of our study were adopted.

The boundaries of the study area:

The study area is located in the southwestern part of Iraq within the western plateau region of Iraq, its borders do not exceed the borders of the administrative province of Najaf and occupies (90.0.6%) of the area of Najaf province which is (28824) square kilometers, as its area is (25960) square kilometers It is shaped like a rectangle whose short southern side represents Iraq's political borders with the Kingdom of Saudi Arabia, while it is bordered to the north by Karbala Governorate and to the west by Anbar Governorate. From the northeastern side, the study area connects with the western edge of the sedimentary plain (west of the Euphrates), and it is bordered by Al-Muthanna Governorate from The southeastern part. It is located within the subtropical latitudes in the southern part of the northern temperate zone. These latitudes are characterized by high temperatures in summer and warmth in winter. The study area is located between longitudes (42 44 45 44) east and latitudes 29 45 32 19 north. As for the temporal limits of our study, they were for the climatic data for the period 1989-2019 AD, and for the climatic stations (Najaf, Shabaka, Al-Mashkhab, Ain Al-Tamr, Karbala, Arar),

First: a geographical analysis of the standards required for establishing wind power stations in the study area

Here we discuss the most important determinants that have a significant impact on determining the most suitable sites for building and installing electric power plants from wind or what is called wind farms. Inadequacy in some areas, and this is due to the nature of the area in terms of topographical situation, bird tracks, road network, etc., and this is what we will study here as follows:

1- Characteristics of the height of the study area:

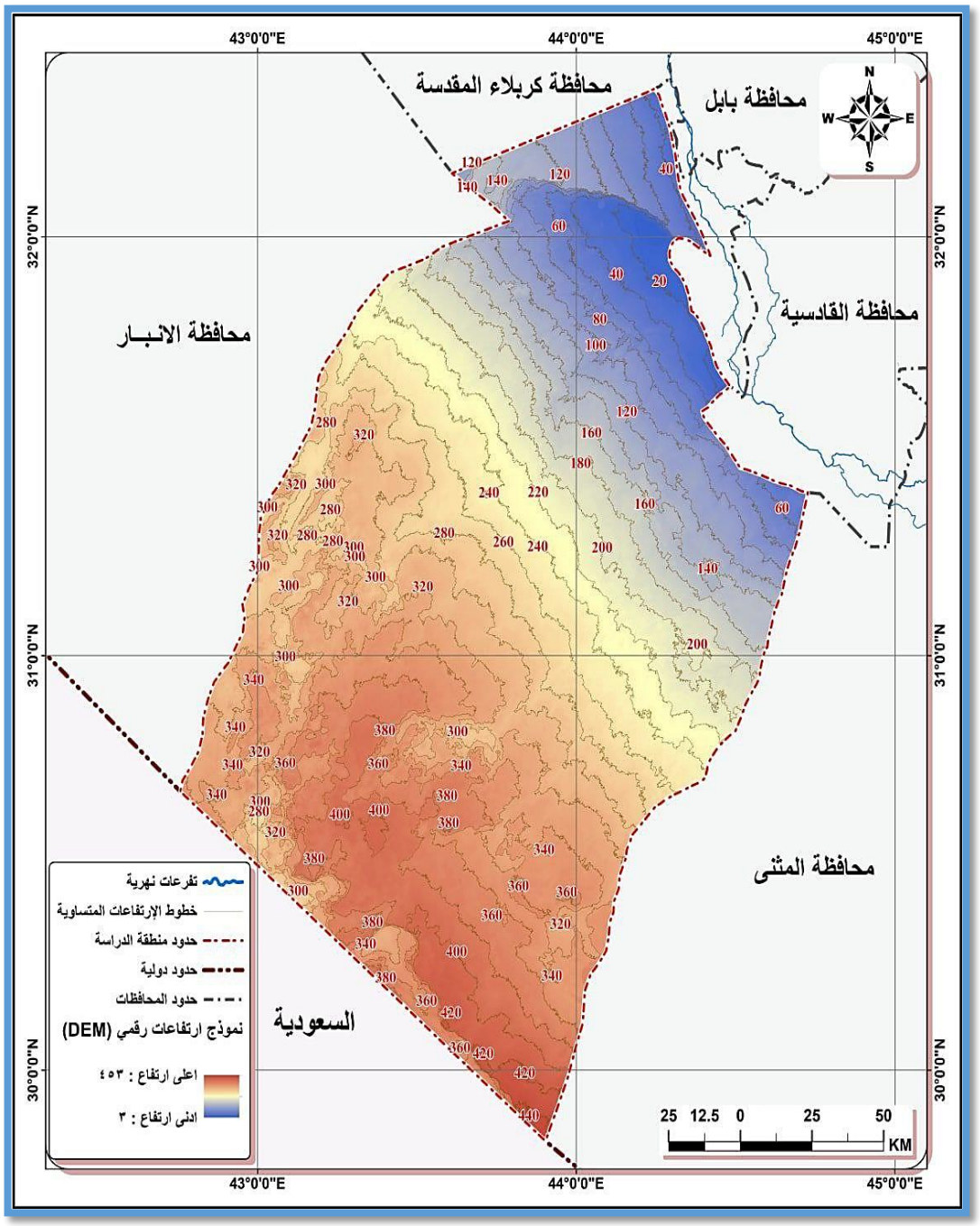
This factor has an important impact on the distribution of turbines in wind farms, as the flatter and cooler the site is, the more suitable it is for wind projects. with increasing surface roughness. The best surfaces ever are water surfaces, as the roughness is almost non-existent. The topography of the land is an important factor controlling the installation of turbines, and this control comes from its control over the wind speed and the nature of its direction, which is affected by the amount of the friction factor, so it is one of the most important factors that are taken into account by planners who seek to achieve the greatest benefit from their installation of wind turbines and long-term. It represents the roughness factor for the surface, as the greater the surface roughness, the greater the friction factor and vice versa.

Topographically, this region is part of the plateau of the northern Arabian Peninsula, with a wavy surface, in which elevations and depressions appear such as valleys and small hills. It is distinguished by its terrain diversity compared to the sedimentary plain region. And the factors of air erosion worked in it, which turned some of its parts into a rocky surface that has no soil above it. This plateau is crossed by a number of longitudinal valleys that take the same slope as the land. The western plateau constitutes most of the area of the governorate, and extends from the western edge of the sedimentary plain to the southwestern corner of the governorate. The surface of the study area is distinguished by its slope from the southwest towards the northeast, map (1), the highest height of which is about (452 m) above sea level at the political borders of Najaf Governorate with the Kingdom of Saudi Arabia, until it reaches its lowest in its northeastern outskirts, with a height ranging from about (20-40 m), and the height of the central parts of the study area ranges between (200-260 m), and thus, one of the most important things that wind farms look for when installing them is the flat plain areas that provide suitable wind speeds for carrying out wind farm projects.

2-Urban agglomerations:

Urban agglomerations are one of the most important results of urban planning and what is designed to build cities, dwellings, and agglomerations in various forms by those in charge of this planning. Planning often corresponds to areas that provide physiological comfort to residents and their basic needs, especially areas close to rivers or that enjoy fertile soil. This determinant is considered one of the most influential determinants in the installation of wind farms and the selection of optimal sites for them, as its effect appears in reducing the speed and change of its direction and reduce the amount of energy generated.

Map (1) Lines of equal elevations in the study area



Source: The General Establishment for Surveying, Baghdad, the administrative map of Iraq, 2020 AD.

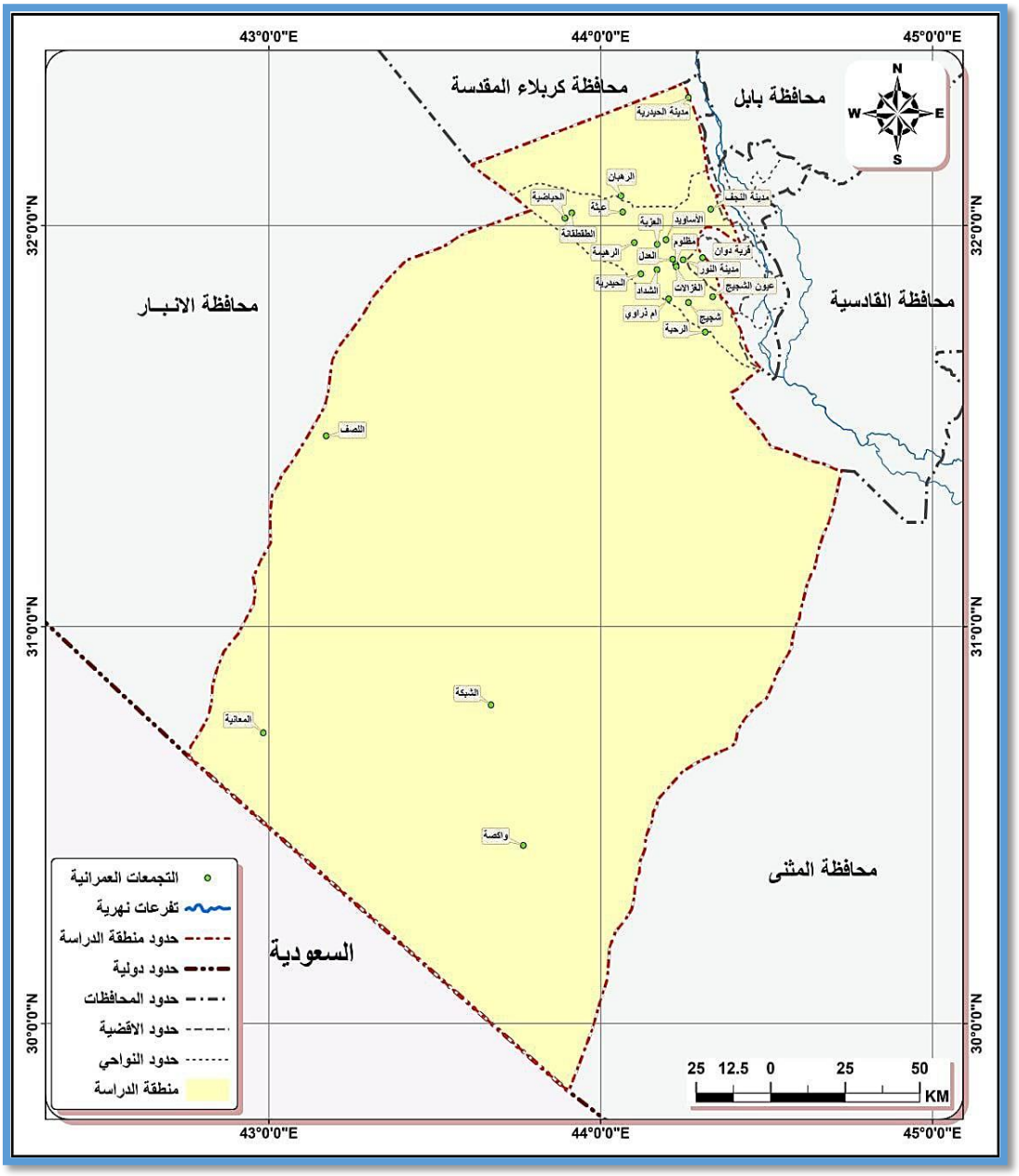
-The Iraqi Ministry of Planning, Directorate of Planning and Local and Regional Development in Al-Najaf Governorate, unadvised data, 2020AD. Using Arc GIS 10.8

is clear from map (2), that the most present human settlements are in the northern parts of the study area, and this corresponds to the availability of river courses and the nature of the soil as well as the relatively better climate than the southern and western parts of the plateau. Al-Asawid and others), and these urban communities have many activities that work to reduce wind speed and change its direction in a way that reduces the possibility of installing wind farms within these parts, while in the southern and western

sides, the presence of urban communities is reduced, which is limited to (Al-Shabaka, Waksa, Al-Ma'ani and Al-Saf), This group of gatherings enjoys high wind speeds because it is open and there are no beams that reduce its speed on the one hand, and on the other hand is the gradual slope of the height from the southwest to the northwest, which works on the flow of winds from the higher areas to the lower areas.

When a comparison is made between the two areas with large population centers that are concentrated in the northeastern side with the areas that are characterized by a scattered spread of residential areas in the southern and western parts, it becomes clear that the southern and central areas are the best in terms of investing in installing wind turbines in terms of the lack of symptoms that reduce the speed of wind turbines. Wind and encourage the installation of wind turbines or what is known as (wind farms).

Map(2) Distribution of urban communities within the study area



Source: The General Survey Establishment, Baghdad, Iraq Administrative Map, 2020 AD.

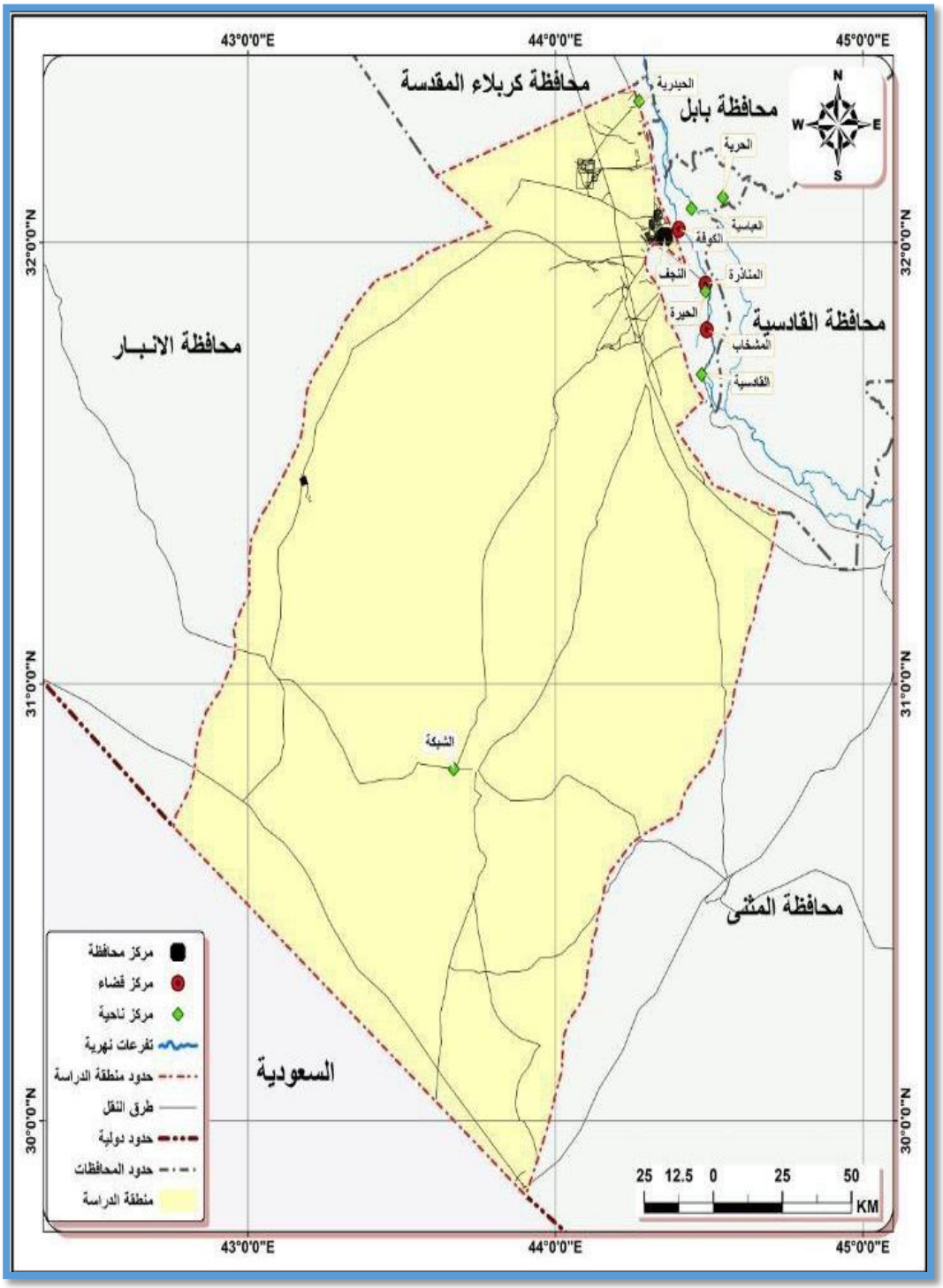
- Iraqi Ministry of Planning, Directorate of Planning and Local and Regional Development in Al-Najaf Governorate, unadvised data, 2020 AD - using the Arc gis 10.8 program

3_ road network:

The study area is one of the well-served areas through the main, secondary and even rural roads, and all administrative units that are located within the study area are surrounded on all four sides by a network of national roads. And the large weights that are used in wind farms and turbine installation, as well as the availability of huge mechanisms for installation and maintenance work. In addition to the possibility of access to the wind farm, and this is not achieved unless there is a road and a means of transportation linking the wind farm and the urban agglomeration areas that can provide the needs of the wind farm in terms of various tools. In many areas, it is not possible to install wind farms, due to the obstacles left by the road networks, so transporting wind turbine equipment needs a suitable and good road network that is able to bear the weight of the wind turbine equipment in order to avoid damage to the turbine components during the transportation process, as well as its capacity to avoid bottlenecks. Which is caused by the transfer of equipment and tools that can be used in the installation of wind farms, and this in turn imposes on the planners of installing wind farms an important hypothesis, which is (the transfer of turbines represents an important part of the wind farm development process).

Through map (3) it is clear that there is a network of dense roads near the areas where the urban agglomerations exist, and this is due to the large population within these areas, while in the central, southern and western parts, it is limited to roads that connect the districts, including the Najaf-Al-Shabaka road, which is 160 km long.) with a width of (5 m), the roads connecting the governorates that lie north and south of the study area, and finally the roads linking the study area with the Kingdom of Saudi Arabia. Thus, the length and width of the transportation routes within the study area should be increased, in order to be suitable for transporting wind turbine equipment and its various tools, which wind farms cannot dispense with or their arrival to the farm in poor condition, thus reducing their operational efficiency.

Map(3) transportation methods in the study area .



Source: The General Survey Establishment, Baghdad, Iraq Administrative Map, 2020 AD.

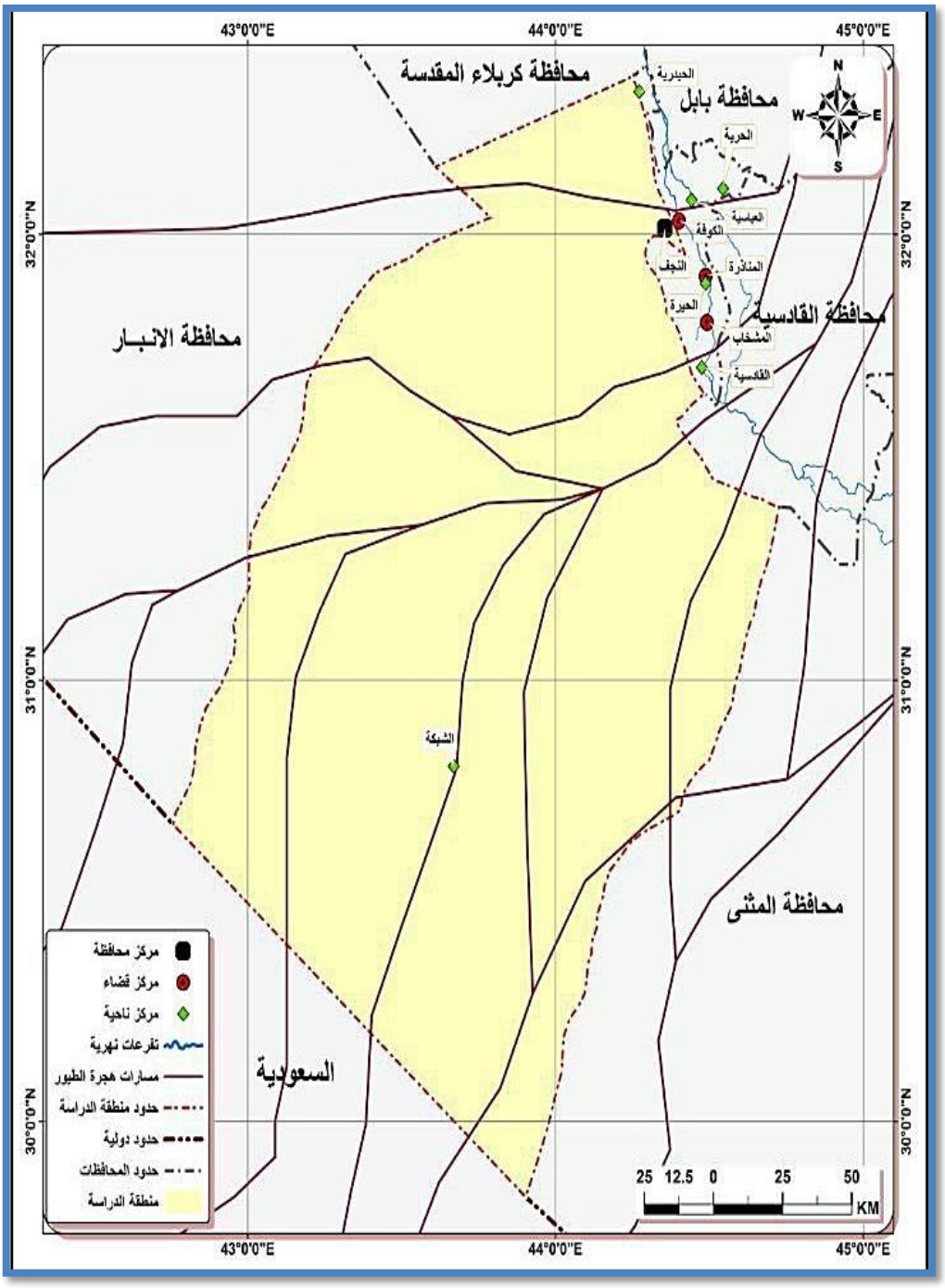
- Iraqi Ministry of Planning, Directorate of Planning and Local and Regional Development in Al-Najaf Governorate, unadvised data, 2020 AD - using the Arc gis 10.8 program.

4- Bird tracks:

The path of the bird can be defined as the path or path that the bird takes while moving from one place to another, and this path is affected by a group of factors, especially high windmills and high turbines. It affects many aspects. It is very important to study this aspect quantitatively and qualitatively throughout the year, in order to identify the nature of the impact of this aspect on the installation of wind stations. As the local birds within the study area originally learn after a while how to change their flight path and fly around or away from the wind turbines, as they can distinguish the rotor blades that rotate at relatively slow speeds for them, but the danger is to the lives of exotic birds or migratory birds that They often fly in groups at heights not less than (200 m), and these heights are not reached by the rotor blades, but some birds fly at lower altitudes, which endangers them. In European countries, this is one of the issues that causes widespread controversy. In Spain, large numbers of dead birds were found around wind turbines, and this may prevent these types of birds from returning to such areas in the future, and the danger lies in the case of farm areas.

The wind itself is a breeding ground for birds, which causes a problem in the extinction of some bird species. Therefore, many efforts have been made in western countries to prevent the establishment of wind farms on the same paths that migratory birds fly within. And it is clear from map (4) that all parts of the study area represent a path for birds except for parts of it, especially the northeastern parts that are not a path for birds, and this gives this part the possibility of establishing wind turbines, because this part does not affect the biological diversity of birds, while In other parts of the study area, a set of measures can be taken to protect the birds whose path corresponds to the location of the wind turbine station to be installed.

Map(4) Bird tracks within the study area



Source: The General Survey Establishment, Baghdad, Iraq Administrative Map, 2020 AD.

- Iraqi Ministry of Planning, Directorate of Planning and Local and Regional Development in Al-Najaf Governorate, unadvised data, 2020 AD - using the Arc gis 10.8 program.

5_ Proximity to the national

network This factor is of great importance in determining the location of the wind farm installation, and this is by its nature due to the fact that the wind turbines at the beginning of their work are like a motor, which is based on drawing electric current from the national grid, as well as alternating work between the national grid and the wind farms in terms of supplying consumers amount of energy, as there is often a malfunction in the national grid generation stations, which is compensated by the wind farm, and this is what prompts planners to connect wind turbines with the national grid. Map (5) indicates that the study area is almost free of high-pressure lines, except for the high-pressure line that penetrates the northeastern sides and exits from it at the center of Al-Najaf Governorate, and this is an obstacle to the possibility of installing wind farms. Wind power plants cannot be installed without their proximity to the national grid and high-voltage lines, as they provide the tools that are used in the maintenance and construction of wind farms as a source of energy for the start-up of the wind farm. 6- Ground cover It is one of the types of maps that shows the nature of the land in each region and the percentage of the fertile area that can be cultivated, and the arid and desert land and others, and it is derived from images taken through remote sensing, but it represents the shape of the biophysical cover that is monitored for the surface of the globe, and it transmits an external virtual image to the Earth's surface. The work of this type of map contributes to revealing the nature of the region and placing it in front of the planners to install wind farms, as they determine the best and good sites. It is clear from map (6) the following:

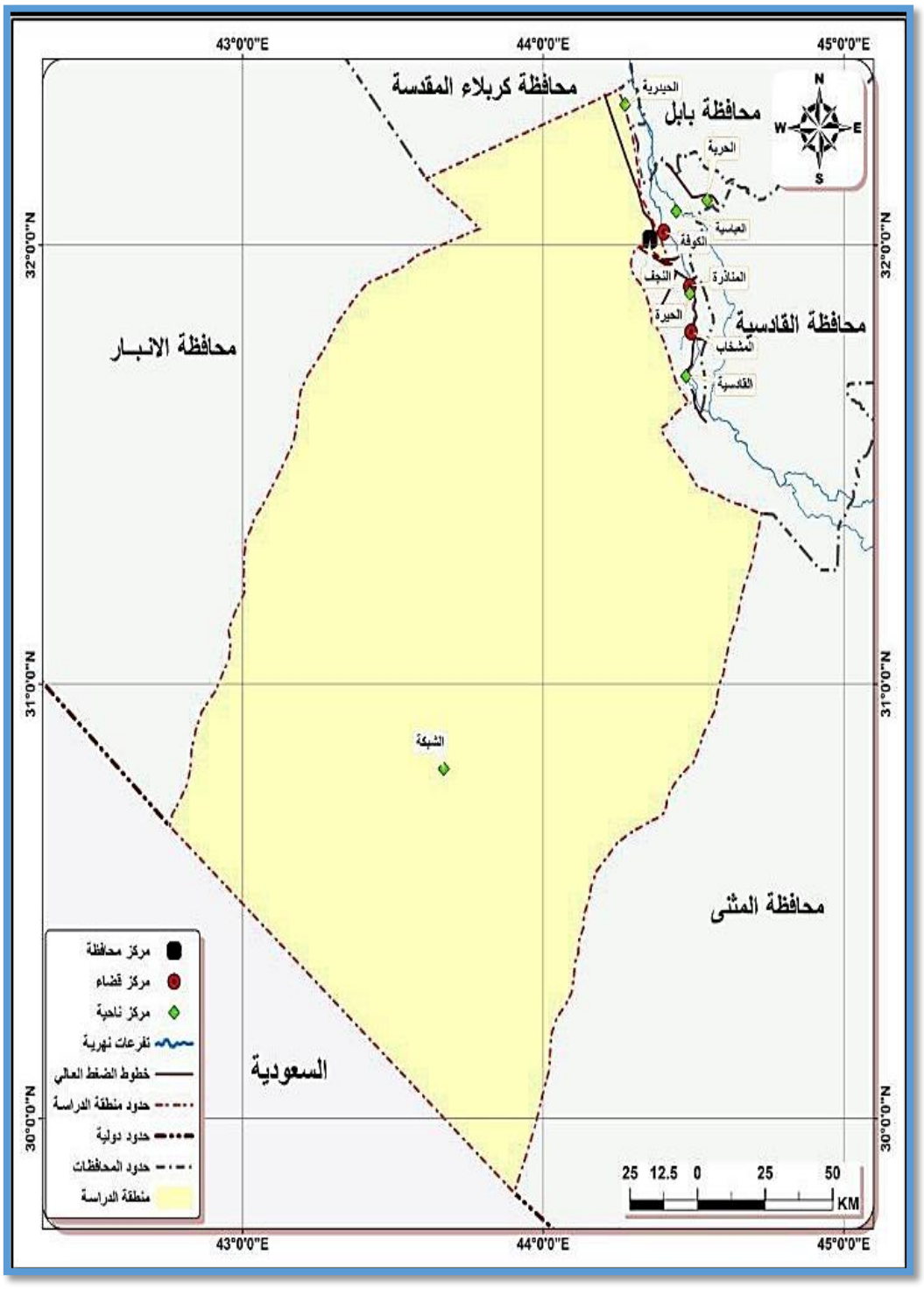
1_ The residential areas are concentrated in the northern parts of the study area, and this reduces the chances of installing wind farms within these parts, as they represent obstacles to the winds.

2_ The areas of sand dunes are located to the south of the first region, and this reduces the chances of installing wind farms because of having to close the turbines when strong sand storms blow.

3_ The oil sites are located in the far north of the study area, and this by its nature determines the investment of the areas covered by these sites as taboos.

4_ Whereas the eastern parts would be ideal regions, due to their enjoyment of agricultural lands, desert plants, and soil known as swamp soil, because these parts are flat and provide cooler air better than the rest of the regions.

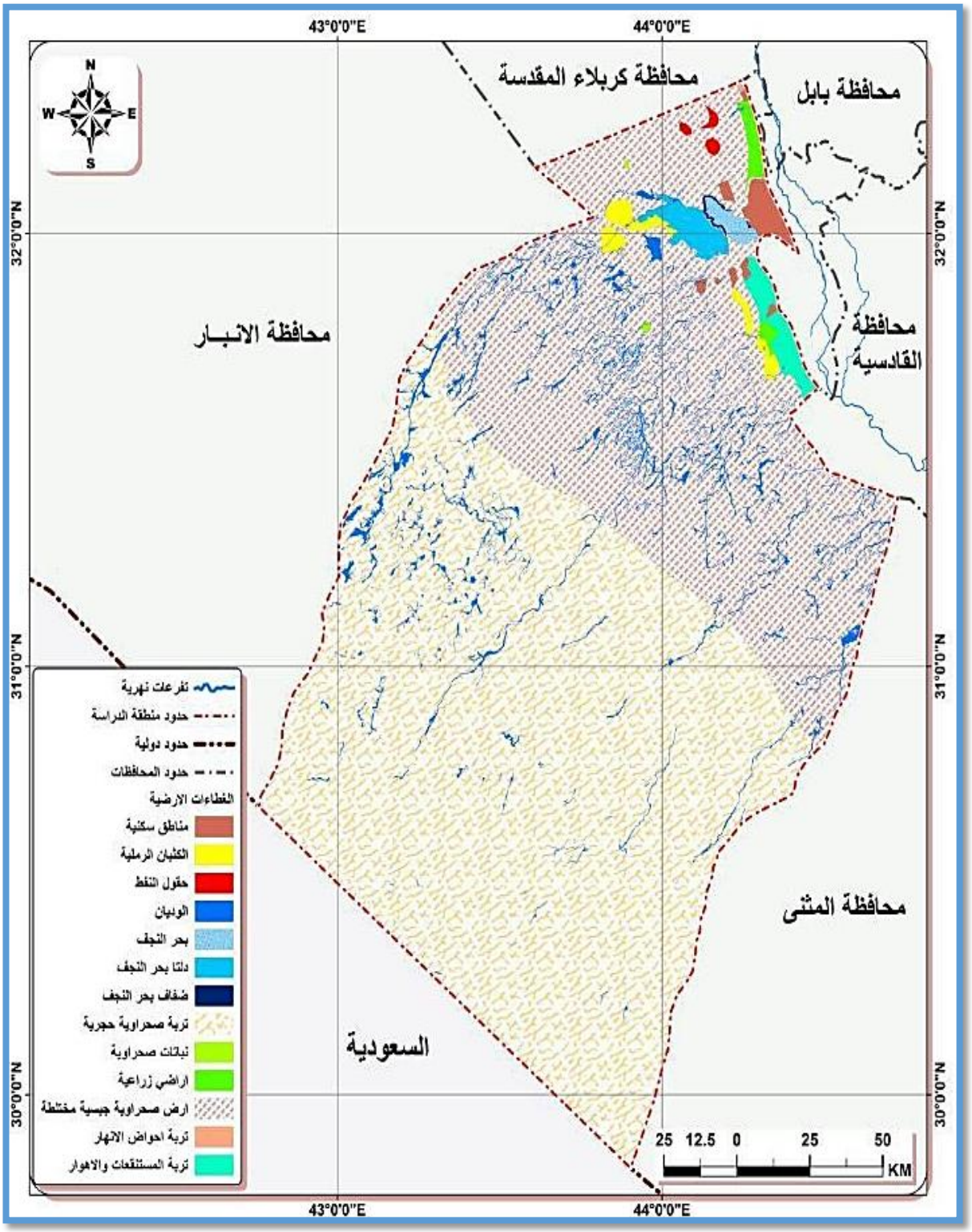
Map (5) Proximity to the national network



Source: The General Survey Establishment, Baghdad, Iraq Administrative Map, 2020 AD.

- Iraqi Ministry of Planning, Directorate of Planning and Local and Regional Development in Al-Najaf Governorate, unadvised data, 2020 AD. Using Arc GIS 10.8 .

Map (6) Land cover in the study area



Source: The General Survey Establishment, Baghdad, Iraq Administrative Map, 2020 AD.

- Iraqi Ministry of Planning, Directorate of Planning and Local and Regional Development in Al-Najaf Governorate, unadvised data, 2020 AD. Using Arc GIS 10.8

Second: a spatial determination of the areas most suitable for generating electric power in the study area

The interest in renewable energy generation, as mentioned, is one of the most important solutions to energy problems, especially energy from traditional sources, as well as its contribution to filling the shortage of equipped electric quotas in the region. Therefore, in this chapter, we will work on identifying the most suitable areas and locations for establishing and establishing stations to generate electric energy from wind in the study area by relying on what has been clarified of the standards and components that contribute to the establishment of environments to generate profitable electric energy in sufficient quantities economically and based on the GIS program And satellite visuals in a way that contributes to reaching models through which the most appropriate ones are determined from those areas. Through and in order to reach the existing results from the study, we carried out this work in several stages: -

1. Preparing the database (input): it is the entry of data on standards, statistics and constituents available in the study area (nature and human).

2. Conducting an exclusion form: that is, excluding areas that are not suitable for sites for constructing power generation stations, based on the criteria that must be met.

3. Defining variables, conducting and measuring spacing ranges, and developing a layer model for each variable and a standard that must be available to determine the generation areas and a used layer.

4. Giving ranks and weights to the layers used in preparing the model required to define the study target areas.

5. Converting spacing range maps, maps, and arguments of standards from linear form to digital form, and conducting a weighted match between the layers used in preparing the model, which is the last stage through which results are reached. The following will explain these stages and steps:

First: the first stage: (inputs) And the purpose of their use, and we will present below some of the required layers and the purpose of their use:

1. Wind speed layer: This layer is characterized by selecting sites that are characterized by suitable wind speeds that guarantee the generation of electric power in an economical manner.

2. The generated energy map layer: Through this layer, the locations from which economic electric energy was generated are selected based on the wind speed, and it represents the desired goal of the study.

3. The digital elevation model layer (contour lines): This layer contributes to the selection of flat sites that facilitate the construction and installation of turbines generating energy from wind in a way that guarantees their stability due to their large size and weight, in addition to the availability of safety rates for the station body and the system as a whole, and for the low cost of leveling the ground. In addition to the effect of the topography of the region on the distribution of fans inside a farm that was built with wind, the easier my distribution was.

4. The soil layer: During this layer, sites with cohesive soils are selected and away from fragile and sandy soils as much as possible to ensure the stability and stability of the wind turbines during the rotation of the blades, in addition to the low cost of soil stabilization.

5. Layer of faults and gulfs: Through the layer, all areas of rifts and gulfs existing in the study area are excluded because they do not provide safety rates for the station body and turbines when they are built over the rift or the rift meeting areas.

6. Ground Covers Layer: Through this layer, uninhabited and unused areas are selected, due to their low prices and wide area, and the exclusion of dry valley areas to mark torrents on the body of stations at times of rain and when those valleys are filled with water.

7. The layer of migratory birds' passage lines and paths: While the areas far from the migratory paths of birds that pass through the region are chosen, and their locations in order to avoid exposure to death when they collide with the blades of wind turbines, given that these birds are natural resources and wealth and the need to preserve them.

8. Layer of networks of electrical lines: choosing locations close to electrical networks, whether those closest to the city centers or to the districts located within the study area because of their importance with regard to linking the energy that is generated with the existing electrical network and solving the problem of the shortage in supplying shares of electricity for various uses in the region and its surroundings, As well as its contribution to solving the problem of storing electricity. 9. Transportation Roads Network Layer: Choosing locations close to transportation routes due to their importance in reaching the station and transporting rates and supplies during the construction phase and post-operation phase.

Second: the second stage

It is in which areas that are not suitable for preparing the steps of the model for determining the most suitable areas for power generation are excluded, as during this stage the following areas are excluded:

1-Areas in which the average wind speed is less than (3.6 m/s), which is the speed at which air turbines are likely to stop working, as the wind speed through which turbines can generate electric power ranges from (3.6-27). m3/sec. As it was mentioned previously ( ).

2-Excluding urban agglomeration areas by making (Multi Buffer)* for the urban communities layer with a distance, then choosing (Erase) management for the layer, with the same distance, as it is not possible to establish wind energy generating stations in populated areas to avoid the impact of buildings and facilities On wind speed, and in order not to affect the movement of turbine blades on the population, especially through audio and visual pollution.

3-Excluding the large dry valleys that are eligible for flooding: by choosing (Erase) for the layer of the valleys - this is because the study area is characterized by the presence of a number of dry valleys that are exposed to being filled with sudden torrents, especially during the winter season, whether from within the region or from Coming from the Saudi borders, which can affect the entire infrastructure and facilities of the station, as well as negatively affect the body of the turbines in the event of their abundance.

4-Excluding the faults layer by making (Buffer)□□□ for the faults layer, then choosing a management for the faults layer and its spatial sanctuary, as it is not possible to establish the station over a fault that may expose the station to insecurity as a result of ground vibrations resulting from wind speed or ground vibrations.

Third: the third stage

The intermediate map production stage is to produce a single map from a set of different maps. During this process, the type of maps and their classifications are unified through the work of divergence and convergence ranges, and the merging of these maps to facilitate the process of identifying the most suitable areas for wind power generation.

Fourth: the fourth stage

Determine the ranks and weights of the layers according to the importance of each layer in the parts of the model. At this stage, each layer is given a rank, and then a weight is determined on the basis of the layer according to its importance in the model. The higher the value of the rank, the greater the relative weight for it, as shown in the following table: -

Schedule (1) The relative weight of the layers used to determine the appropriate areas To generate profitable electrical energy in the study area

relative weight%	Rank	Conditions for selecting sites for wind power plants	
25.1	7	Wind speed Wind energy	
20.2	6	Surface slope (including the layer of faults and faults)	
20.1	5	Distance from populated areas and industrial activities	
13.8	4	Soil type	
9.8	3	The road network	
7.4	2	power lines	
3.6	1	Bird migration paths	

Source: From the researcher's work, based on the previous stages.

From the analysis of Table No. (1), it is clear that there is a difference in the relative weights of the specified layers, reflecting the importance of each of them in building and establishing profitable electric power stations. As it turns out that the highest ranks were for the wind speed layer and the energy layer that were generated in a previous chapter. Here, it was similar with a relative weight of (25.1%). The extracted energy values, which were projected on the visuals and maps, were dependent on the wind speed in the study area. The relative weight specified for each of them indicates their importance and that it is not possible to establish power generation stations if the appropriate speeds are not available through which electric power can be generated in economical quantities.

The second place in importance came to the surface slope layer, including the layers of faults and faults, which took a relative weight of (20.2%) because the nature of the surface and the presence of faults and faults has great importance in the cost of building stations, the percentage of safety in them, and the stability and stability of the turbine body. Then came the rank of the layer of distance from populated areas with a relative weight of (20.1%) because the nature of the surface and the presence of crack differences are of great importance in the cost of building stations, the percentage of safety in them, and the stability and stability of the turbine body. Then came the rank of distance from populated areas with a relative weight of (20.1%). It is also of great importance in planning for choosing the locations of the stations, because it is not possible to set up stations near populated areas, whether residential or industrial, as whenever there is a distance between power generation stations and those The more regions, the better, since those lands are relatively cheaper than them, and the possibility of expanding these stations in the future, as well as ensuring that there are no negative effects on the population due to the work of these stations and turbines. As for the fourth rank, it was for the type of soil with a relative weight of (13.8%). Its importance comes in choosing the type of soil that is the most

cohesive in the study area to avoid the occurrence of side effects for the station's facilities and its work.

It is clear from Table (1) that the road network layer in the study area came in the third place, because the existence of these roads saves a lot of costs in transporting and establishing stations and reduces the potential losses that may occur when transporting the equipment and equipment for the turbines because they are accurate and large in size in the event that these roads are far from the station sites. However, it came in this rank here because the costs of building roads are relatively inexpensive in the event that the rest of the requirements and conditions for establishing stations to generate economic energy from them are met. The second rank came to the power lines layer, with a relative weight of (7.4%), which is close to the weight of the road network. Because the storage process requires profitable electric batteries that are generated inside the stations. Because the storage process needs batteries, as mentioned previously, and power lines to transfer what is stored and generated energy to fill the shortage in the supplied quotas.

The seventh and last layer was for the paths of the bird's chamber, and it came with a relative weight of (3.6%). The second importance of this nature is that before establishing stations that meet the previous conditions, an environmental study must be carried out in the region to determine the paths of birds and determine their seasons. Which neglects in this aspect to preserve those birds from harm by avoiding building stations in the areas of those paths and by taking the necessary precautions in the event that a path of birds is expected to pass through the locations of those stations, which includes adding radar devices to the stations' facilities and using the mechanism to stop the operation of turbines during the possible passage for those birds to provide safe passage for them.

Fifth: the fifth stage

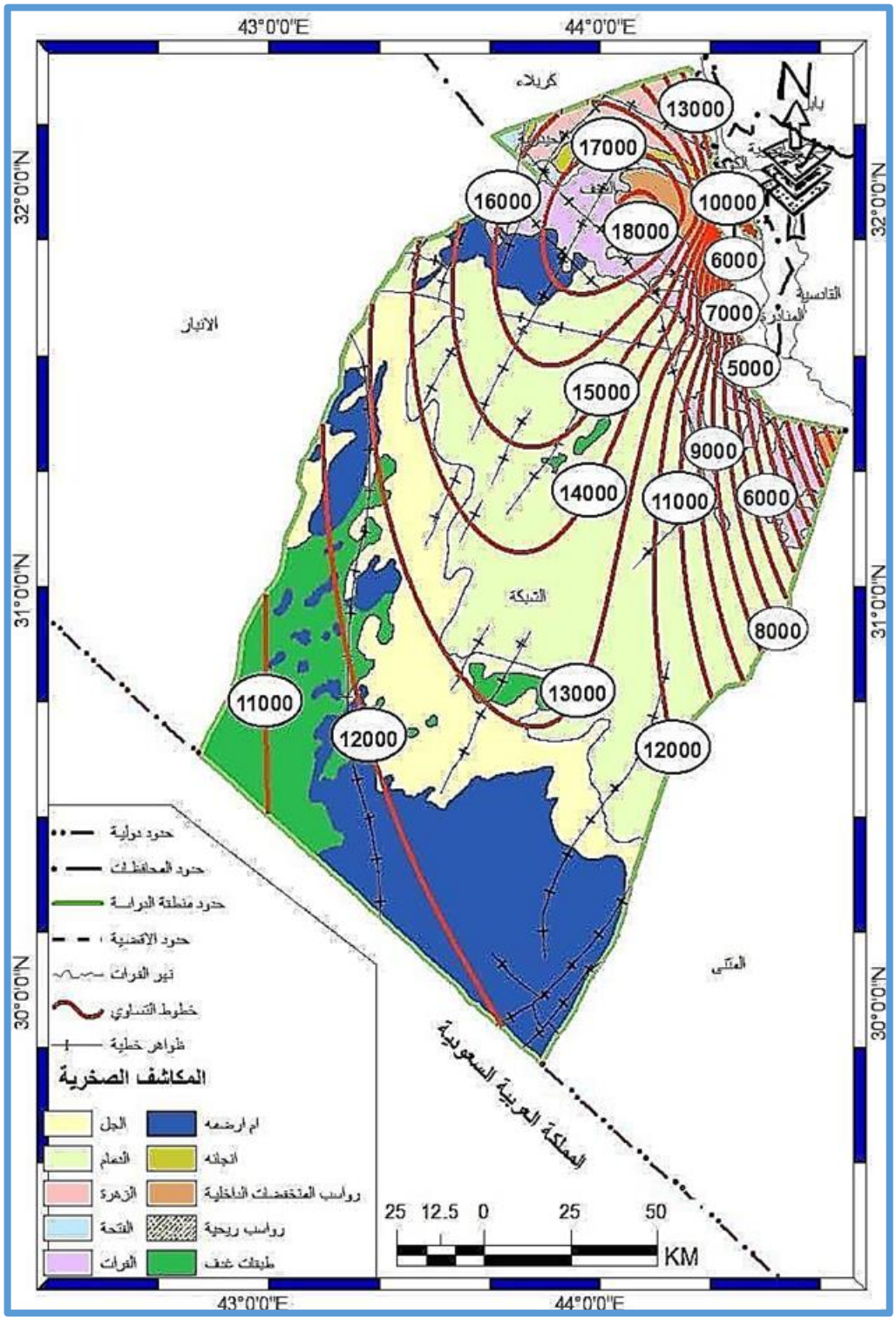
It is the stage of converting the selected layers and determining their relative weights from the linear pattern (Vector) to the grid pattern, which is (Raster). This stage includes two steps: 1. Converting all the used layers for which the spacing ranges have been determined for the criteria that must be available from linear data to networked digital data to unify the data that is dealt with during the work of the model for determining the most appropriate areas.

2. Conducting weighted matching operations between those layers used in the model according to the relative weight of each layer. In order to reach the identification of the most suitable areas for generating energy in the study area, maps were produced that correspond to the layer of the electrical energy map that was previously generated from the wind speed in the study area and at different heights, because the aim of our study here is to search for the possibility of generating economic energy in the region depending on What is available from the wind speed in it. Reliance has been made here on the generated energy at a height of (120 m) because the wind speed in Map (1) from which the energy was generated is typical in generating economical energy according to this height even in the case of cracks decreasing at that speed at certain times, in addition to that The energy that was generated was in abundant and economical quantities in a way that contributes to filling the local need for electricity, in addition to the possibility of storing the remaining energy until the times when the quantities of energy generated are less.

Due to the difficulty of creating a model for a single map that includes all the layers of criteria that must be available for establishing stations, those layers were divided into three groups and represented by maps with the generated energy layer at a height of (120 m) to give a clearer picture of that step and the rest of the identification of the most suitable areas as follows:

- Map No. (7) includes layers of energy generated at an altitude of (120 m) and layers of digital elevation, migration paths of birds, soil types.

Map (7) (First layer) Layers of energy generated at a height of (120) m



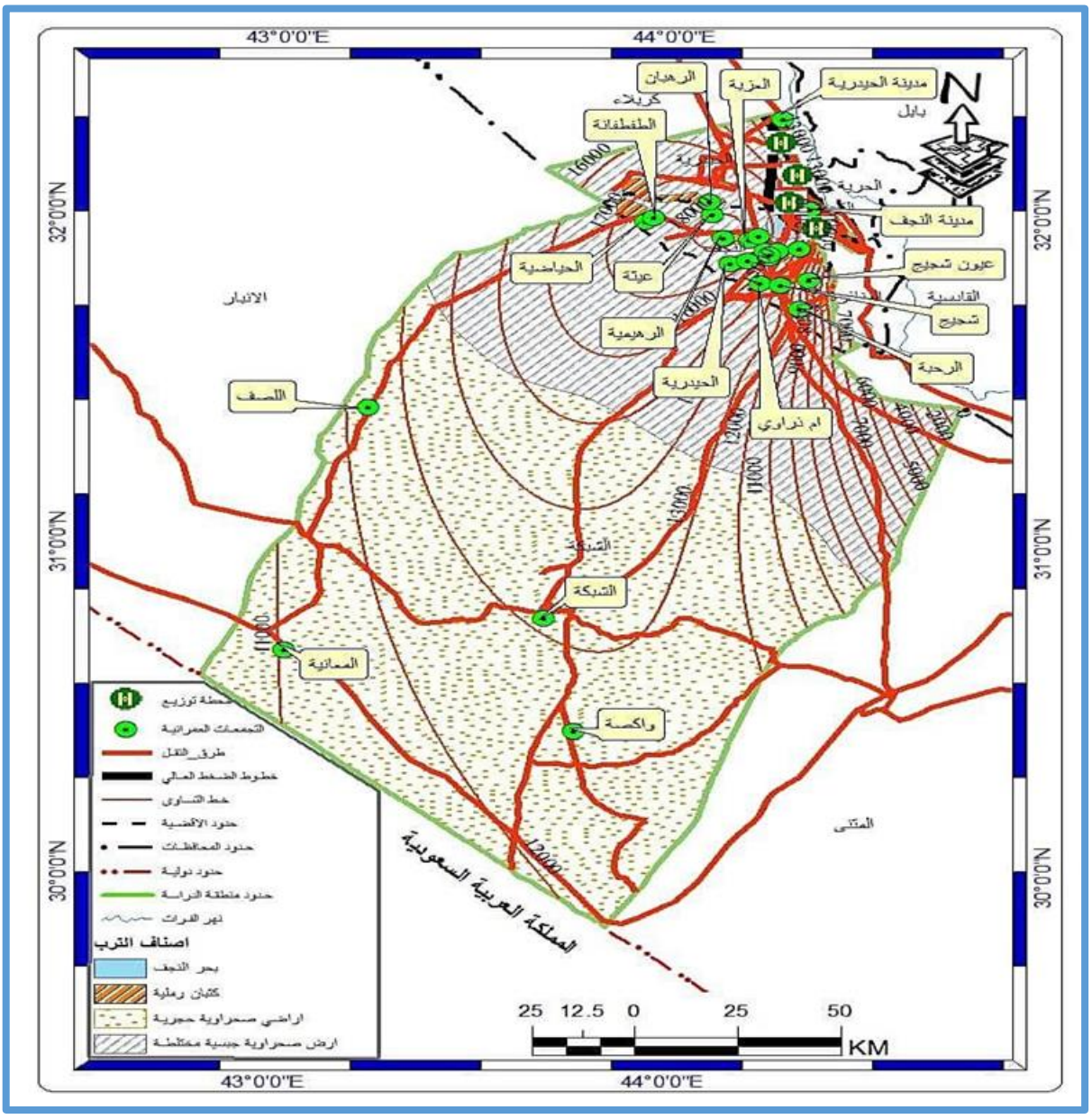
Source: The General Survey Establishment, Baghdad, Iraq Administrative Map, 2020 AD.

- The Iraqi Ministry of Planning, Directorate of Planning and Local and Regional Development in Al-Najaf Governorate, unadvised data, 2020 AD. Using Arc GIS 10.8

- Map of generated energy at an altitude of 120 m, map of migratory paths of birds, map of soil types, digital elevation map

What we notice from map (7) is that most of the urban agglomerations are located in the northern side of the study area. The clusters are abundant, which leads to the difficulty of setting up turbines. The presence of these clusters is less in the southern and western sides, especially the Shabaka, Al-Saf, Waksa, Al-Maa'inah, and Al-Tarat areas. We also notice from Map (7) that there is a dense network of transport roads located near the urban agglomeration areas, due to the large population of these Regions.

Map (8) (Second Layer) The layer of geological land formations



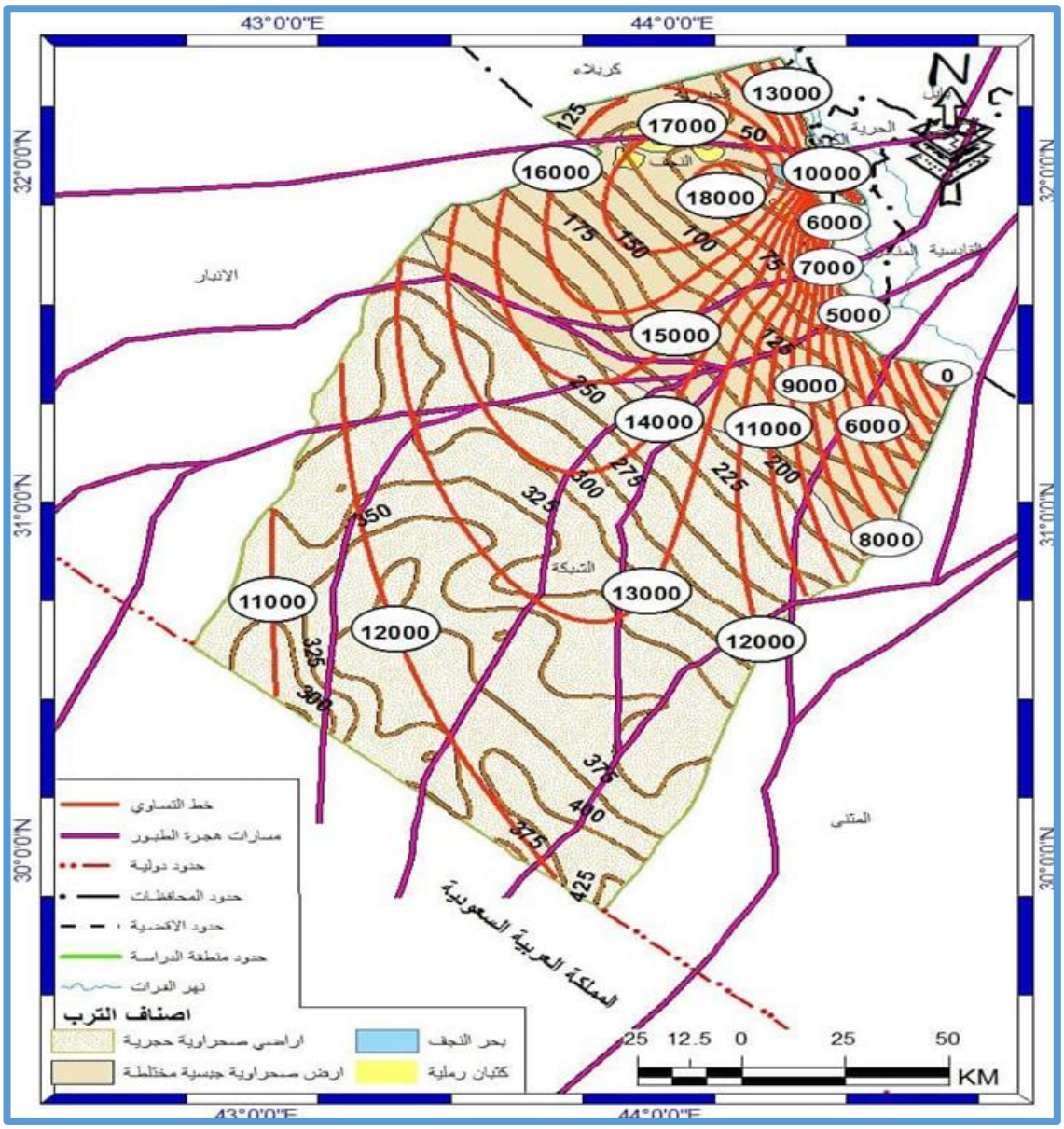
Source: The General Survey Establishment, Baghdad, Iraq Administrative Map, 2020 AD.

- The Iraqi Ministry of Planning, Directorate of Planning and Local and Regional Development in Al-Najaf Governorate, unadvised data, 2020 AD - using the Arc gis 10.8 program.

- Urban agglomerations map, transportation road network map, proximity map to the national network .

While we note that the transportation routes in the central, southern and western parts are limited to some roads that connect the districts, including the Najaf-Al Shabaka road, as well as the roads linking the governorates that lie north and south of the study area, as well as the roads that link the region with the Kingdom of Saudi Arabia, and this matter requires work to increase Lengths of roads located within the region in order to be suitable for the process of transporting wind turbine equipment, which our project cannot do without. It also appears through map (8) that the area is almost free of high-voltage lines, with the exception of the high-voltage line that passes through the northeastern sides and exits from it at the center of Najaf Governorate.

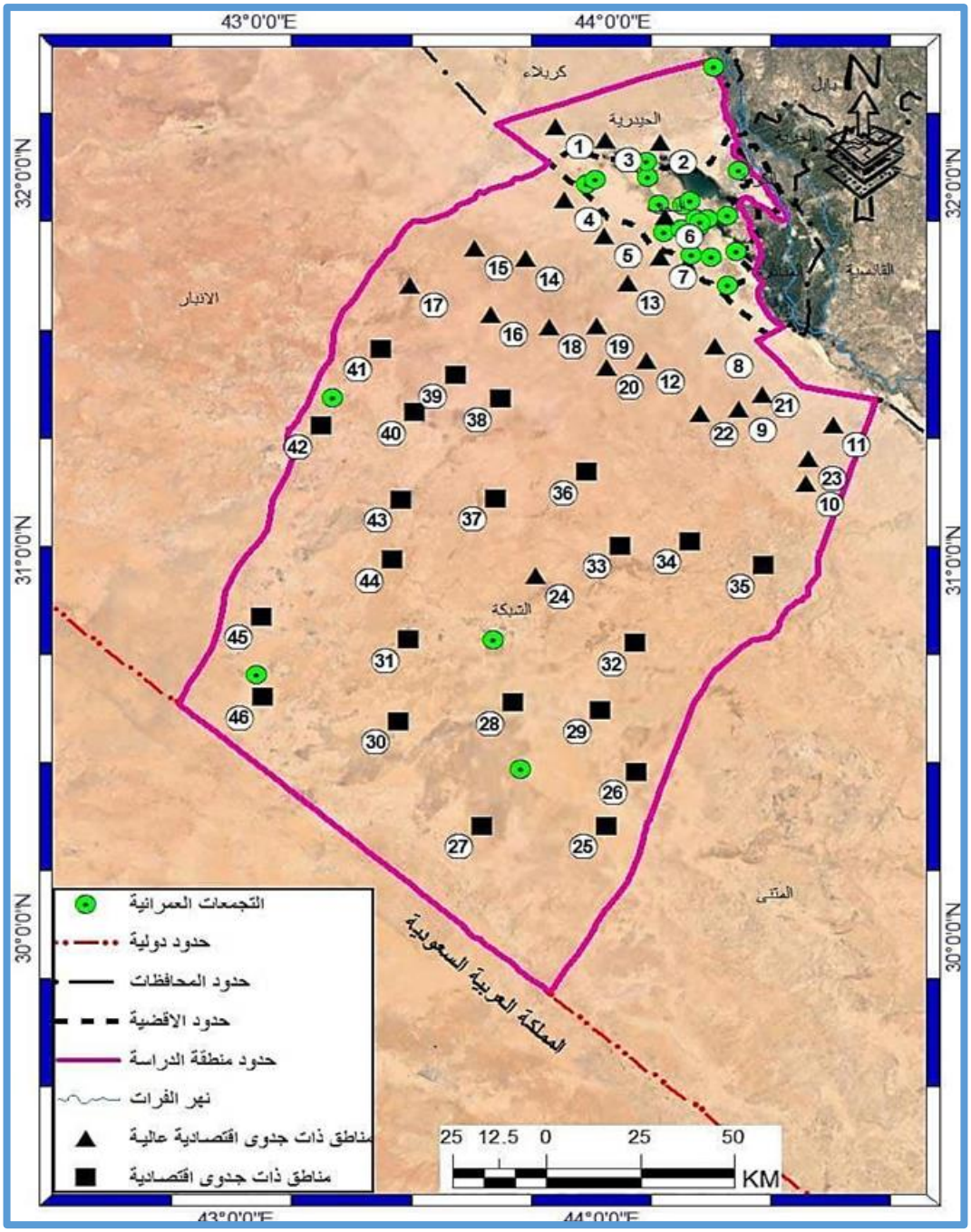
Map (9) (The third layer) The generated energy layer at a height of (120) m



Source: The General Survey Establishment, Baghdad, Iraq Administrative Map, 2020 AD.

- The Iraqi Ministry of Planning, Directorate of Planning and Local and Regional Development in Al-Najaf Governorate, unadvised data, 2020 AD. Using Arc GIS 10.8 - Equal altitude map, bird migration paths map, soil types map. We notice through the previous map that the surface of the study area is a wavy surface and manifestations of elevation and depression appear on it, such as hills and valleys. Finally, the nature of the surface plays an important role in the establishment of wind farm projects. The flatter the surface of the area where the turbines are to be installed and consists of hard rocks and few cracks, the more suitable it is for the establishment of wind farm projects. The roughness factor is considered to have a significant impact on wind speed, so the rougher the surface of the earth, the greater I said the speed of the wind passing over it. The surface of the region has a slope from the southwest towards the northeast, so its highest height is about (452 m) above sea level at the political borders of Najaf Governorate with the Kingdom of Saudi Arabia. And its lowest height is in the northeastern parts, with a height ranging from (20-40 m), while the middle parts have a height ranging from (26-200-m). Whenever that land is suitable for setting up and erecting turbines It also appears through the map that the study area in all its parts is crossed by paths for birds, with the exception of the northeastern parts. These paths must be avoided when selecting turbine installation areas. And based on the standards that must be met in the establishment of projects to generate electric power from wind, and after applying the aforementioned five stages, and relying on satellite visuals and the program (ARC GIS 10.3) and the satellite visualization processing program, a model was created through which we determined the most appropriate sites and areas for the establishment and establishment of power generation stations Electric winds in the western plateau of Najaf province, as shown in map (10).

Map (10) The locations of the most suitable areas for generating electric power in the study area



Source: - The General Survey Establishment, Baghdad, Iraq Administrative Map, 2020 AD.

- The Iraqi Ministry of Planning, Directorate of Planning and Local and Regional Development in Al-Najaf Governorate, unadvised data, 2020 AD.

Using Arc GIS 10.8 A map of the energy generated from the wind at an altitude of 120 m, a map of geological formations.

And through the application of the aforementioned stages, and after taking into account the ranks that have been determined for each layer of the criteria that must be available, and after taking into account the relative weights of each layer, then through the map model (10), determining the economic extent of those areas that were reached in this study. And give a number for each site and classify them into areas of economic feasibility,

and areas of high economic feasibility and the coordinates of each of those areas as in Table No. (2) We would like to point out here that it was found that there is an area in the study area with different characteristics in terms of geology, in terms of height, and in terms of distance from inhabited areas, and it is characterized by its proximity to transportation routes and electricity networks. It has solidity and stability that guarantees the safety of installing wind turbines at lower costs than what can be established in many specific areas, because this area is characterized by a height that contributes to reducing the length of the turbines proposed to be established in the area in a way that through the height of this area it is possible to make changes in the standard turbine columns Globally, this area is (Tar Al-Najaf). Map (11) Schedule .

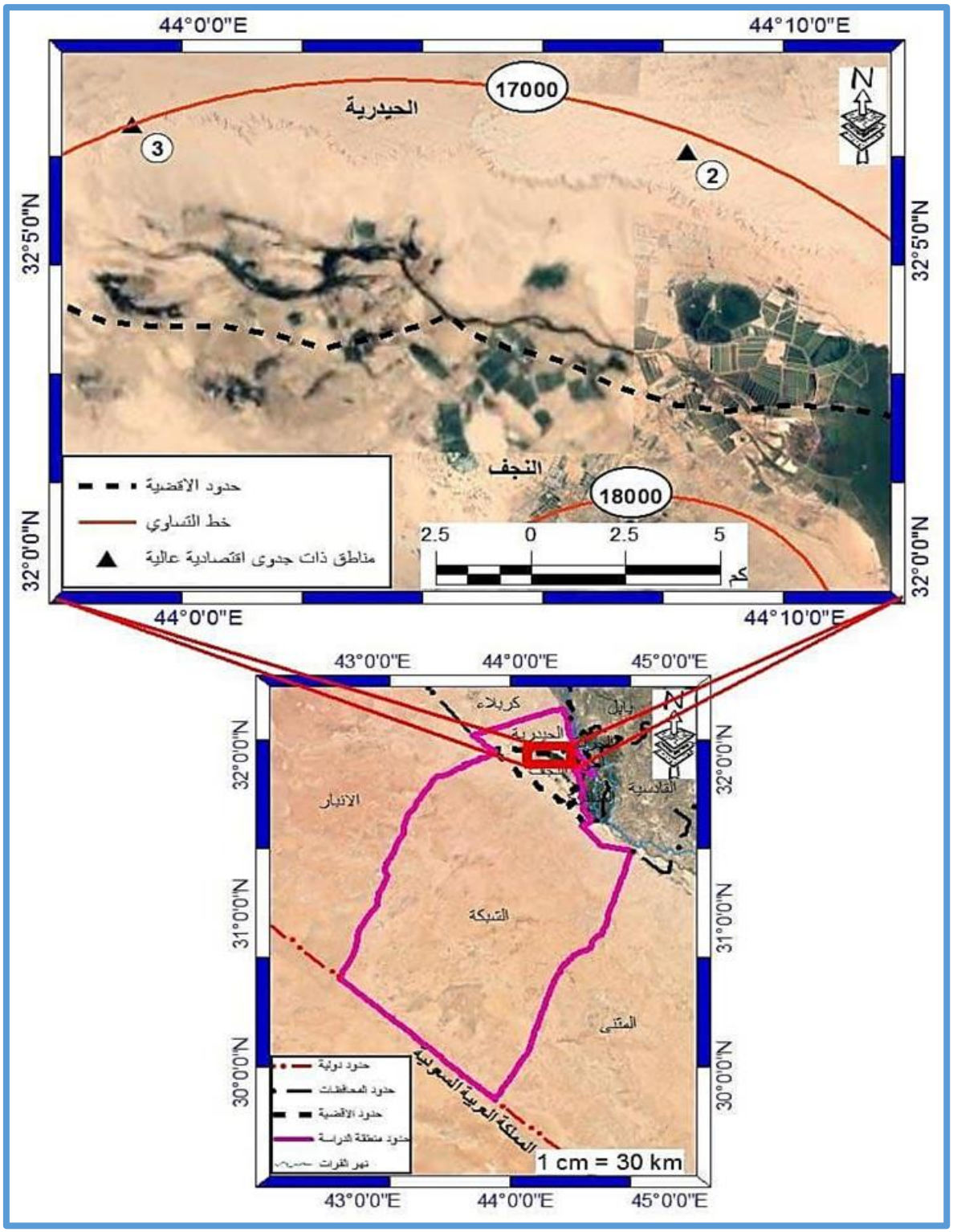
(2) The astronomical location of the most suitable areas for setting up wind turbines

Economic feasibility	latitude	Longitude astronomical location	point number
High economic feasibility	32 08 46N	043 50 30E	1
High economic feasibility	32 08 56N	044 12 24E	2
High economic feasibility	32 02 00N	043 56 16E	3
High economic feasibility	31 57 07N	043 52 09E	4
High economic feasibility	31 51 29N	043 58 53E	5
High economic feasibility	31 53 43N	044 11 22E	6
High economic feasibility	31 48 26N	044 10 35E	7
High economic feasibility	31 34 07N	044 17 41E	8
High economic feasibility	31 24 02N	044 21 45E	9
High economic feasibility	31 12 16N	044 33 05E	10
High economic feasibility	31 21 40N	044 37 31E	11
High economic feasibility	31 31 37N	044 06 15E	12
High economic feasibility	31 43 59N	044 02 48E	13
High economic feasibility	31 47 40N	043 45 46E	14
High economic feasibility	31 49 17N	043 37 05E	15
High economic feasibility	31 38 47N	043 39 54E	16
High economic feasibility	31 43 20N	043 26 21E	17
High economic feasibility	31 36 54N	043 49 44E	18
High economic feasibility	31 37 06N	043 57 43E	19
High economic feasibility	31 30 35N	043 59 27E	20
High economic feasibility	31 26 28N	044 25 33E	21
High economic feasibility	31 23 17N	044 15 17E	22
High economic feasibility	31 16 15N	044 33 24E	23
High economic feasibility	30 59 28N	043 48 04E	24
Economic feasibility	30 17 34N	044 00 09E	25
Economic feasibility	30 26 12N	044 05 05E	26
Economic feasibility	30 17 23N	043 39 37E	27
Economic feasibility	30 37 03N	043 44 32E	28

Economic feasibility	30 35 53N	043 58 55E	29
Economic feasibility	30 33 53N	043 25 38E	30
Economic feasibility	30 46 51N	043 26 54E	31
Economic feasibility	30 46 42N	044 04 36E	32
Economic feasibility	31 02 11N	044 02 04E	33
Economic feasibility	31 02 54N	044 13 40E	34
Economic feasibility	30 59 07N	044 25 54E	35
Economic feasibility	31 13 48N	043 56 17E	36
Economic feasibility	31 09 26N	043 41 08E	37
Economic feasibility	31 25 19N	043 41 49E	38
Economic feasibility	31 28 57N	043 34 17E	39
Economic feasibility	31 22 59N	043 27 22E	40
Economic feasibility	31 33 02N	043 21 39E	41
Economic feasibility	31 23 03N	043 13 01E	42
Economic feasibility	31 09 07N	043 25 21E	43
Economic feasibility	30 59 30N	043 24 10E	44
Economic feasibility	30 50 14N	043 02 30E	45
Economic feasibility	30 39 49N	043 01 31E	46

Source: using Arc GIS 10.8, map (20).

Map (11) Tar Al-Najaf area in the study area



Source: The General Survey Establishment, Baghdad, Iraq Administrative Map, 2020 AD.

- The Iraqi Ministry of Planning, Directorate of Planning and Local and Regional Development in Al-Najaf Governorate, unadvised data, 2020 AD - using the Arc gis 10.8 program.

Hence, it is necessary to give an explanation of the characteristics of this region and its importance: - Tar al-Najaf area: - Tartars constitute one of the natural phenomena of the city of Najaf and are located in the western and southwestern outskirts of the city, as the extension of the plateau suddenly breaks off forming a sharp rocky cliff known as sarcophagus. Najaf, heading west, and its length is about 65 km, and its highest point rises to about (176 m).). This area is located between the stable and unstable pavement. Formations with a marine environment are exposed in the area, such as the Dammam Formation, the Early Eocene, the Middle Miocene, and others.

It unfolds along the length of Tar Al-Najaf and Tar Al-Sayed. Sandy rocks to sandy pebbles, and they are gray, pink, and light gray to white. These sandy rocks consist of Heavy minerals average (10.12%) and consist of opaque minerals such as hodium oxides, celestite and metastable minerals, as the presence of these minerals reflects the igneous, acidic, metamorphic and re-deposited sedimentary origin of the source rocks. And through the procedures we have taken to determine the optimal areas for generating electric power from wind in the western plateau region of Najaf Governorate, which is the area of our study, it is an attempt by us to highlight the importance of this region of the province, which we explained through the study that it has most of the determinants that must be available in The installation and construction of electric power generation stations, which can fill the shortfall in the equipped quotas for the province of Najaf through what is generated from them and what is stored from them in times of low wind speed by means of batteries designated for this purpose, in addition to our study of this area that has not been previously studied for the purpose of generating electric power Wind is the basis that contributes to directing the interest of specialists in the generation of renewable energy to search for the selection of which types of turbines are most appropriate for this region and to determine the appropriate heights for them. We would like to clarify that the type of turbines that were nominated in our study for this area are vertical turbines connected to the electricity grid as mentioned previously. As the lengths of the blades in it have the greatest role in the energy that is produced, as the longer the length of the blade increases, the amount of energy generated increases, and as in Table (3), the dimensions and lengths of the turbines and the lengths of their blades can be chosen and modified by the parties that are contracted to build and establish such turbines In the study area by energy professionals. Schedule

(3) The proportion between the size of the rotor (feathers) and the maximum size of the energy produced

Rotor diameter (m)	Produced power (kW)
10	25
17	200
27	225
33	300
40	500
44	600
48	750
54	1000
64	1500
72	2000
80	2500

Source: Arkan Yaqoub Youssef, Wind Energy for Electricity Production, Southern Technical University / Basra, Technical Institute / Department of Electrical Technologies, 2020, p. 14.

Conclusions

1- There are a set of determinants that must be taken into consideration before establishing projects to exploit wind energy to generate electric power

2- Winds with a speed of less than 3.6 m/s have little or no effect on the process of moving the turbines.

3- We noticed through our study and the research phase that there is no real trend to exploit wind energy in the study area in particular and the country in general.

4- Limiting the use of alternative energy sources to solar energy in new and few attempts by the responsible authorities

5- The wind speed and directions in the study area are the result of a process of interaction of a group of fixed and moving factors, not only within the borders of the study area, but also extends to include areas outside its framework.

6- It turns out through the study that the Tar Al-Najaf area is the most suitable for the establishment of wind energy exploitation projects due to its location, height, surface nature, soil, etc., which are suitable for the establishment of such projects.

7- It is clear from the study that the selected area (Tar Al-Najaf) provides a height of approximately 50 meters above sea level, which means the possibility of installing a turbine with a height of 70 meters or more, because the height of 120 meters is the most suitable for the region.

Recommendations

In light of the research results, the study recommends the following:

1- Work to open centers specialized in research operations in the fields of renewable energy in general and wind energy in general.

2- Encouraging foreign investment in this field and benefiting from the experiences of leading countries

3- Providing devices and wind turbines in the local markets at reasonable prices that will be an encouraging factor for the purpose of purchasing them by those in charge of such projects.

4- Benefiting from our current study and other studies specialized in the optimal exploitation and investment of alternative energy sources, especially wind energy.

5- Dissemination and promotion of public culture on the importance of alternative energy

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