



Natural Development Pillars in the Holy Province of Karbala

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ABSTRACT

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The holy province of Karbala is one of the promising provinces to achieve sustainable spatial development, the research presented the natural development possibilities available to achieve this. To demonstrate the natural foundations and their developmental effects in achieving sustainable spatial development in the study area. A set of scientific approaches used in geographical studies were relied upon, namely: 1) Descriptive approach: Describing the natural foundations and their developmental effects in achieving sustainable spatial development. 2) Analytical method: Analysis of natural foundations and their developmental role in achieving sustainable spatial development. 3) Electronic programs that have strengthened the scientific method, namely: Geographic Information Systems (GIS) software for mapping that shows the distribution locations of phenomena. The geographical location of the study area provided the possibility of achieving spatial development, where easy communication with the rest of the governorates of Iraq, climatic conditions, the amount of solar radiation received and the prevailing winds, good development possibilities in the field of investment in providing clean and renewable alternative energy sources, especially temperatures for the cultivation of strategic crops, suitability of the prevailing climatic conditions for livestock breeding, diversity of geological structure accompanied by diversity of mineral wealth (metallic and nonmetallic), with the diversity of soils suitable for agricultural production, the availability of water resources (surface and groundwater) in terms of quantity and quality for the population to carry out various economic activities, which means that there are development possibilities that can be invested in enhancing the chances of achieving spatial development in the study area. Presentation and analysis of natural development pillars and the extent of their contributions to achieving comprehensive spatial development if appropriate development strategies are developed, in fact the situation indicates that the level of exploitation of these natural development pillars is not commensurate with what is available and with the requirements of achieving relatively balanced spatial development within the administrative units of the governorate.

1. INTRODUCTION

Identifying the natural development pillars available for the dissemination of investment projects and achieving sustainable spatial development. Within the region of the areas that the geography of development has been interested in, so this research included the presentation of the natural development pillars in the holy province of Karbala and the extent of their contribution to the development of spatial development levels, as there are large and differentiated development possibilities in terms of spatial distribution and quality, as the natural development pillars are one of the site-based requirements in the field of achieving comprehensive spatial development, within the regions of the various provinces of Karbala, the availability of great natural development capabilities can contribute to an effective role in the field of achieving spatial development if appropriate development strategies are developed, but the reality of the situation indicates that the level of exploitation of these natural

development pillars is still not commensurate with what is available and with the requirements of achieving relatively balanced spatial development within the administrative units of the province.

Research Problem: Investing the natural development potential in the holy province of Karbala is still below the required level and is not compatible with the directions of achieving relatively balanced sustainable spatial development within the administrative units of the province of Karbala.

Research Hypothesis: The Holy Province of Karbala has natural development potential in terms of quantity and quality that can be invested according to development strategies and the adoption of proper planning at the governorate level in order to achieve relatively balanced spatial development.

Research Objective: To determine the nature of the natural development possibilities available in the Holy Province of Karbala, and their importance in the field of publishing investment projects and achieving spatial development within the administrative units of the province.

Study Methodology: The study relied on a set of scientific approaches used in geographical studies, namely:

Descriptive approach: Accurately describe the natural developmental foundations in the holy province of Karbala.

Analytical method: Analyzing the reality of these pillars and their developmental effects in order to reach accurate results for the distribution of economic investments in the holy province of Karbala.

Quantitative method: The study used some statistical and mathematical techniques (arithmetic mean, percentages and some arithmetic operations).

Electronic programs that have strengthened the scientific method, namely:

- a) Geographic Information Systems (GIS) software for mapping that shows the distribution locations of phenomena.

Data Used: A set of data was relied on in order to complete the research, namely:

- 1) Library Resources and References: Reference has been made on the available frameworks, letters and books related to the topic.
- 2) The most important government sources: Studies available in state departments and the maps and data they contain:
 - a) Republic of Iraq, Ministry of Transport and Communications, General Authority for Meteorology and Seismic Monitoring, Climate Section, data (n.m.), for the period (1990-2023).
 - b) Iraqi Ministry of Water Resources, Public Authority for Groundwater, Groundwater Authority (Karbala Branch), unpublished data for 2023.
 - c) General Secretariat of the Holy Husseiniya Shrine, Department of Agricultural Development, 2023.
 - d) General Secretariat of the Holy Abbasid Shrine, Department of Agricultural Development, 2023.

2. THEORETICAL FRAMEWORK

- i. **Development:** Means making a quantitative and qualitative change of the economic, service and social reality of society in a region or an entire country during a specific period of time, so as to achieve a level of decent life in which the phenomenon of inequality between members of society decreases and the problems of unemployment, poverty, ignorance and disease gradually disappear, and in a way that contributes to granting a greater amount to invest human, material, economic and financial resources in order to achieve social, material, economic and financial well-being, which is the goal of development plans [1].
- ii. **Regional development:** The name of regional development is linked to the region as a geographical and economic concept, and then a spatial framework in which natural and human data interact to result in economic activities and urban centers of different sizes, morphology, functions, relationships and geographical distribution, and there is no doubt that market mechanisms and the free market economy system have worked to focus development in its various forms and forms in a region and specific regions within the same country, and this focus worked in one way or another to exploit the

capabilities and resources of other regions. And its attrition, which turned it into underdeveloped or deteriorating regions from an economic perspective, and the existing relations between the developed regions and the underdeveloped regions in the state have become relations of exploitation, domination and control, so some went to call this situation by the name of internal colonialism [2].

- iii. **Regional planning:** Planning programs prepared by the state and its planning bodies for a period ranging from 5 to 25 years aimed at achieving advanced economic growth after optimal investment of natural and human resources so as to help find a development balance between the parts of the region [3].

2.1 Regional development strategies

2.1.1 Balanced regional development strategy

It means the spatial distribution of investments, especially industrial investments within the region, and not limiting them to specific centers or regions, that is, the non-concentration of development projects, especially industrial projects, in specific areas, as achieving balanced regional development is done through the spatial distribution of economic activities in multiple places, the distribution of incomes, and reducing regional differences between the levels of economic, social and urban development between different regions or regions within the same region, but we find the effectiveness of the balanced spatial growth model is weak in the early stages. Due to the weak possibility of mobilizing economic savings and the high costs of infrastructure development, while it is more capable of achieving rates of economic development in the later stages, balanced spatial growth when adopted requires the following: large investments, investment capacity and high costs for the development of infrastructure.

Accepting non-high levels or rates of growth and thus achieving economic returns for limited regional development processes in the early stages.

Because of its importance in the possibility of contributing to the balanced regional distribution of investments, as its content is focused on encouraging the movement of industry and investments in the rest of the sectors, by directing them towards poor areas, as the pressure on resources is less, and the movement of industry is rapidly affected by the determinants of development in strong regions and by attracting financial incentives in poor areas, as it is the most appropriate in making the expelling regions attractive regions by providing job opportunities in them and encouraging new investors to go towards those poor regions where this is done by signing new investments in the region or transferring investments to it, as well as providing all appropriate and stimulating conditions to attract these investments to poor areas, such as the development of infrastructure and basic public services [4].

When this strategy is applied, it leads to the investment of previously uninvested resources, especially human resources, despite the varying productive efficiency of the labor force in poor areas, most of which are characterized by their lack of skill compared to workers in developed regions, and when they provide job opportunities in poor areas and employ unemployed workers who do not wish to emigrate, they lead to an increase in regional and national output and an increase in incomes, which represents the economic benefit for them, as for the social benefit of this strategy, it is to reduce

migration rates. And unemployment and raising living standards and social lifestyle in the region, following this strategy leads to finding a state of balance between poor areas and developed areas, as the benefit of surplus labor pushes to work on concentrating new economic activities in these areas, and encouraging capital owners to employ them in them to increase their attractiveness to economic activities, especially industrial activity, as this leads to low efficiency and low national economic growth, which leads to weak investment and lack of investment in territory is a balanced regional development strategy.

2.1.2 Unbalanced regional development strategy

It aims to concentrate investments in specific regions to increase production, revenues and incomes, as it represents the opposite of the content of the balanced growth strategy, as this strategy is concerned with focusing development factors in a specific number of selected growth centers that either exist and are considered natural, or are established, and in this case are artificial growth points by providing the necessary requirements required to distribute various economic activities, provide new job opportunities, develop infrastructure, services and external savings, which development needs in the region [5], includes from this strategy that the process of growth is achieved as a result of two groups of different forces, as the first exerts the effects of polarization, i.e., attracting other economic units to the center of growth due to the presence of economic and urban agglomeration savings, which leads growth to concentration in some centers and its decline in the surrounding areas.

As for the second group, which practices the effects of proliferation, as it is assumed that investments will be concentrated in a specific area, which will lead to the emergence of the effects of polarization and the agglomeration of external economic savings in the region in which investments were signed at the beginning of the development stages, but after a period of time after the emergence of polarizing factors, the effects of spread begin to appear, as they lead to the spread of the fruits of development from the center towards the surrounding areas, which achieves the development of those areas, the establishment of projects, especially the leading ones in a particular region. It constitutes a point of attraction or a center of growth, where the leading investment projects are considered the basic nucleus of development, as they have important and direct effects on other economic activities in the region, which generate the effects of attracting production units around them, as well as developing infrastructure and providing services, which enhances their economic, social and urban position in the region, while the effects of spreading or spreading the fruits of development on neighboring areas are within certain time ranges determined by the number of poles or growth centers in the region [6].

The development of the development pole for the presence of the appropriate industrial climate in the region makes this a strategy that takes its applied extent in a larger size within the regional development and overcoming the obstacles of its applications in some regions for reasons related to the size of the natural resource, for example, or the labor force, any pattern of industrial settlement can contribute to the formation of a growth pole, especially the pattern of industrial complexes that have a clear impact on achieving this, when the appropriate conditions are available for a particular industrial project and achieves great economic returns, that settlement

works on attracting other industrial projects that benefit from the products of that project or its economic and on-site returns.

3. RESEARCH STRUCTURE

It included the presentation and discussion of the following main axes: -

- a) Geographical location
- b) Climate
- c) Geological formation
- d) Features of the earth's surface
- e) Water resources.

3.1 Geographical location

Geographers have been interested in studying the geographical location due to its direct relationship to the following factors:

- 1) It makes a person choose this place and not others to settle and work in various economic activities, in terms of the ease of the region's communication process with other regions at the local and external levels, as well as the ease of going and returning to the sites of investment projects for the workforce.
- 2) The geographical location of any region plays a central role in the life of the inhabitant community, due to the climatic conditions imposed by this site that determine the general features of the region's atmosphere, whether dry or rainy, contributes to the diversity of agricultural production sources (plant and animal) that are raw materials for agricultural investment projects and even industrial projects through the establishment of agricultural industries that depend on the products of agricultural production sources.
- 3) In addition to the geological situation that reveals the poverty or richness of the region in natural resources, the variation of the components of the earth's surface plays its role in finding suitable opportunities to invest in these components of natural resources.

With regard to the province of Karbala located in the center of Iraq and to the western side of the sedimentary plain and to the east of the western plateau, the area of Karbala province (5034 km²), it represents (1.14%) of the area of Iraq (437072 km²), so its astronomical location is determined where it is located astronomically as shown in Figure 1, between longitudes (43°15'E - 44°30'E) and latitude (31°44'N - 32°45'N), its geographical location enhanced the opportunities to achieve and develop levels of spatial development within the administrative units of the governorate in accordance with the following developmental considerations:

1). In terms of geographical location, it is located southwest of the capital Baghdad at a distance of (105 km²), and is bordered to the north and northwest by Anbar Governorate, to the south and southwest by Najaf Governorate, and to the south and southeast of Babylon Governorate, has provided the possibility of finding suitable markets for the discharge of agricultural and industrial project products, in addition to providing the requirements of these projects of raw materials through the development of functional links and contributing to the development of spatial development levels in the province.

2). In terms of area, and in terms of planning and development, it can be said that the small area has two sides,

either a positive side in terms of ease of collecting and classifying data on the economic aspects of projects and investments and community represented by population and services, and thus obtaining information that bears a high percentage of accuracy, or a negative aspect, meaning that the small area makes the scheme specific to a small area of land and therefore, limits the freedom to sign investments and development projects planned within the governorate and the opportunities for the presence of natural resources, whether in the ground such as minerals and others or above ground such as water resources and arable land, were development directions by developing plans towards the western and southern regions.

3.2 Climate

Climate has a prominent role in the possibility of determining the quality of investment projects to be established, and then achieving spatial development in economically underdeveloped areas, and therefore the climate of the province is subject to the effects of Iraq's climate and will be clear through the presentation of the monthly rates of climate elements in the study area for the period (1990-2023), Table 1, which has a clear impact on the possibilities of investment and development of natural resources as follows.

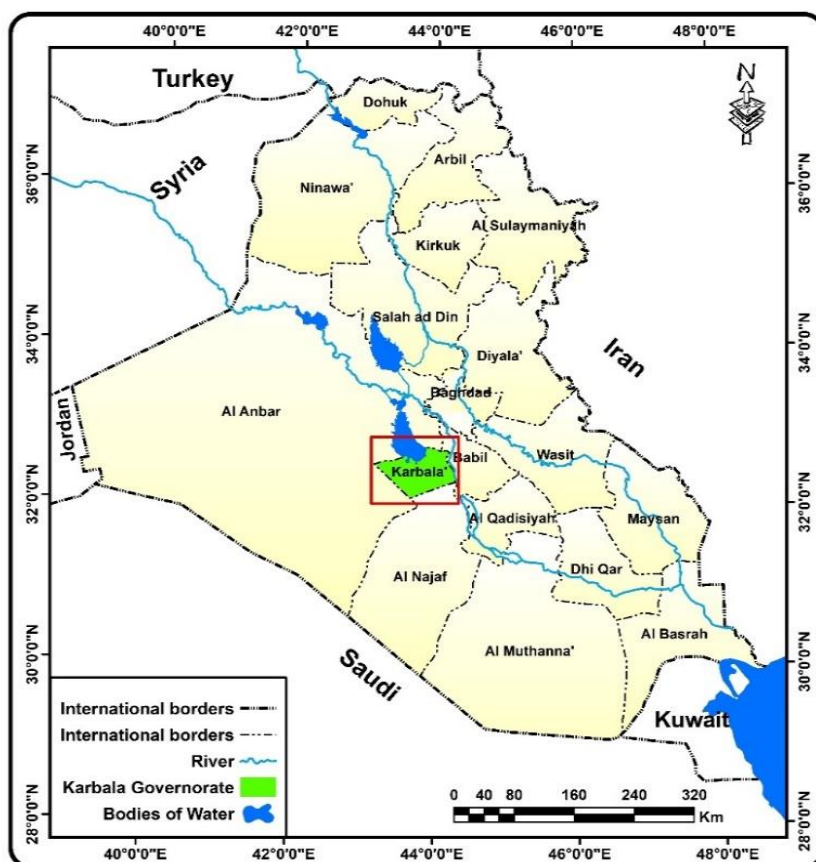


Figure 1. Location of Karbala province from Iraq and neighboring provinces

1. Ministry of Water Resources, General Authority for Survey, Map Production Section, Map of Iraq at a scale of 1:6000,000
2. Ministry of Water Resources, Public Authority for Survey, Map Production Section, Karbala Governorate Map, scale 1:500,000

Table 1. Monthly averages of climate elements in the study area for the period (1990-2023)

| Month | Solar Radiation Hour/Day | Temperatures Celsius (°C) | Wind Speed (m/s) | Amount of Precipitation (mm) | Relative Humidity (%) |
|-------------|-----------------------------|------------------------------|---------------------|---------------------------------|--------------------------|
| January | 6.3 | 10.7 | 2.4 | 17.7 | 75.1 |
| February | 7.3 | 13.2 | 2.6 | 12.6 | 60.7 |
| March | 7.8 | 17.6 | 3.2 | 16.1 | 52.2 |
| April | 8.4 | 24.3 | 3.1 | 11.8 | 42.7 |
| May | 8.9 | 30.1 | 2.9 | 3.22 | 33.8 |
| June | 11.2 | 34.3 | 4.1 | 0 | 28.9 |
| July | 10.9 | 36.8 | 3.8 | 0 | 30.7 |
| August | 10.8 | 36.4 | 2.9 | 0 | 32.6 |
| September | 10.1 | 32.6 | 2.4 | 0.33 | 36.7 |
| October | 8.2 | 26.4 | 2.1 | 4.3 | 46.1 |
| November | 6.9 | 17.9 | 1.9 | 10.7 | 61.9 |
| December | 6.3 | 12.4 | 2.3 | 14.5 | 73.2 |
| Annual rate | 8.6 | 24.4 | 2.8 | 7.6 | 47.9 |

Republic of Iraq, Ministry of Transport and Communications, General Authority for Meteorology and Seismic Monitoring, Climate Section, data (n.m.), for the period (1990-2023)

3.2.1 Solar radiation

The average annual sunshine hours in the province for the period (1990-2023) was about (8.6) hours / day, and this indicates that Karbala province gets sufficient amounts of sunshine hours.

3.2.2 Temperature

The general average temperature during the period (1990-2023) reached 24.4°C, and this led to the determination of two seasons for agriculture, the summer season and the winter season, if rain and water resources are available.

3.2.3 Wind

The winds are active in the seasons (spring and autumn) and their speed varies from month to month, and the highest average wind speed was during the summer, specifically the month of June (4.1 m/s).

3.2.4 Rain

The amounts of rain falling on the governorate fluctuate in three seasons (winter, spring and autumn), but they are more in the winter season by (17.7 mm) during the month of January, followed by December by (17.4 mm), while it is absent in the summer during (June, July and August), and the lowest rainfall rate is during the month of September by (0.33 mm), and in general, the annual average rainfall amounts for the period (1990-2023) was (7.6 mm).

Following:

- i. Climatic conditions in terms of prevailing winds and the amount of solar radiation received provide good development possibilities in the field of investment in providing clean and renewable alternative energy sources, as the investment of wind and solar energy can contribute to the establishment of electric power plants if appropriate plans are developed to achieve this, and (Al-Awali project) is the first experiment through which the Abbasid holy shrine began to invest alternative energy, (solar), to supply its major strategic projects with electricity, especially those through it, desert lands were invested and converted into green oases, to produce many types of important crops of national benefit,

through the establishment of systems based on solar energy through the expertise and competencies that exist in the queens of the Abbasid Holy Shrine [7].

- ii. The lack of falling airport quantities and the failure to properly invest the available groundwater with the help of other factors reflected on the nature of the spatial distribution of the population, through the presence of a large concentration of population near the Euphrates River and its streams to benefit from water and good soil, so the concentration of agricultural, industrial and service investment projects was (88%) in the eastern side, offset by the western side of population imbalance and weak dissemination of development investment projects.
- iii. Suitability of climatic conditions, especially temperatures, for the cultivation of industrial crops such as (wheat, barley, yellow corn, and other strategic crops) adding palm and fruit trees, and this means that there are development possibilities that can be invested in enhancing opportunities to achieve spatial development in the governorate if appropriate development strategies are developed to achieve optimal utilization of these development potentials, as well as the suitability of the prevailing climatic conditions with the other components of livestock breeding that the governorate is famous for sheep, goats, cows (whose products such as milk, wool, leather...) can constitute a major raw material for industrial projects if they are best exploited, such as the Sulaymaniyah Dairy Factories Group and Karbala Food Products Canning Factories.

3.3 Geological formation

The geological composition of the province is characterized by being uncomplicated, as limestone rocks appear over the western part, which is characterized by its hardness, and was not affected by the alpine movements that occurred in the third and fourth eras of the third time that the northern sections of Iraq were exposed to, while the rest of the plain area is covered by modern clay deposits [8], and accordingly the geological structure of Karbala Governorate can be divided into several sections (Figure 2).

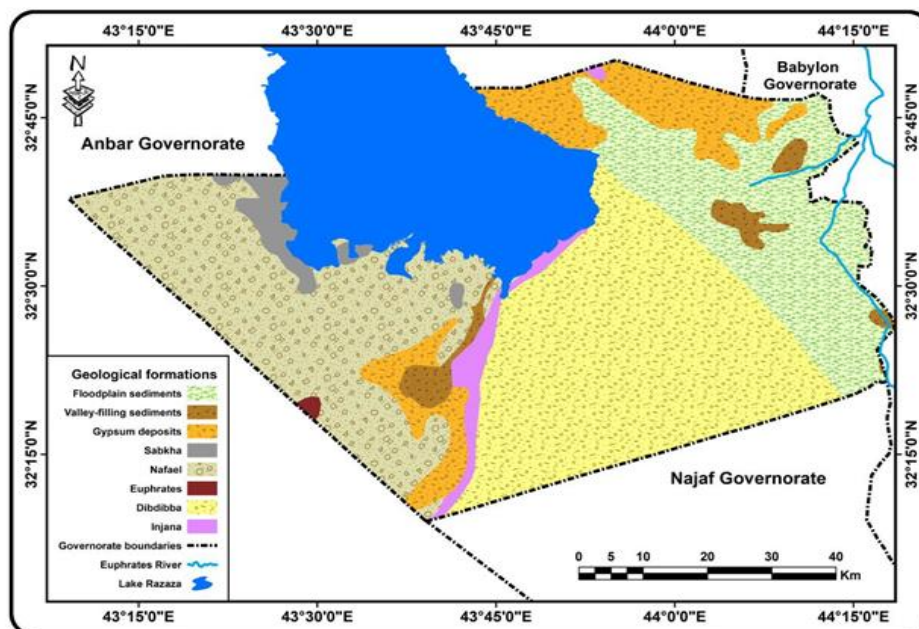


Figure 2. Geological composition of the Holy Province of Karbala

3.3.1 Formation of the calcareous Euphrates

This configuration covers the western region of Karbala Governorate, and its wide range is mainly represented in the administrative boundaries of the district of Ain al-Tamr, the area of Al-Akhaidir and the lower valleys, and it is one of the most widespread formations in the province, and the thickness of this formation ranges between (25-3) m², while the rock sections are thick ranging between (1-10) cm, and the holding material between those sections consists of calcareous materials, and the mineral content of these rocks is often from carbonate mixed with calcium and magnesium [9].

3.3.2 Composition of Anjana

One of the least geological formations within the governorate, as it is spread southeast of Lake Razzaza and separate parts of the south of Ain al-Tamr district, this formation consists of clay rocks, sandy and alluvial rocks of a partially greenish-red color and thin layers of thickness up to (0.3) m² of limestone and chalky, while the thickness of the entire formation reaches in some parts about (14) m² [10].

3.3.3 Aperture configuration

This formation appears in several sections in the form of small and scattered formations, the first south of Lake Razzaza and the other in the form of a narrow strip with the formations of the limestone Euphrates and Anjana, this composition contains lime and child rocks, with some of the fossil rocks such as anhdrite, gypsum, salt and clay stone and its thickness ranges between (60-50) m², in addition to the proportion of sulfur salts and gypsum.

3.3.4 Formation of floodplain sediments

This formation is the sediments of the Euphrates River and is geographically determined by the eastern outskirts of Karbala Governorate in the parts adjacent to the Euphrates River and its branches, as they appear in the stomachs of valleys and depressions, these sediments were formed from the sediments of the Euphrates River, its branches and irrigation channels, and are usually from clay and silt deposits, as for the

sediments that filled the depressions, they are from thin layers of sand and clay silt, and they are found in dry depressions most of the year, except for rainy periods where they are filled with water and sediments transported by rivers and riverbeds accumulate, and their thickness ranges between (3-40) m² [10].

3.3.5 Composition of the bear

It is represented in most parts of the governorate center and the adjacent land, and takes a triangular shape, its base represents the border between the provinces of Karbala and Najaf, and its head is at the southeastern end of Lake Razzaza, this formation extends towards the north in the form of a narrow strip parallel to the northern borders of the province, and it represents a cover for the sediments of the Injana formation and consists mainly of limestone, clay stone, limestone and red marl, and in addition to these rock components, it contains limestone fragments and sand and calcareous pools transported from the mother rocks or from river balconies, while the thickness of the bear layer ranges between (90-50) m² [10].

The diversity in geological formations has been positively reflected in terms of development in the diversity of mineral wealth (metallic and non-metallic) within the different regions of Karbala Governorate, as there are distinct mineral wealth in the province in terms of quantity and type, especially with regard to ores (limestone, clay stone, limestone, red marl stone and child with some of the fossil rocks such as anhydrite, gypsum and salt), which created an important development foundation that can contribute to enhancing opportunities for developing levels of spatial development within The different areas of the governorate if appropriate development strategies are developed to achieve this.

The researcher worked based on data from the US Geological Survey earthexplorer.usgs.gov, the Digital Elevation Model DEM, and the techniques of the Arc Map10.4.1 program.

3.4 Surface features

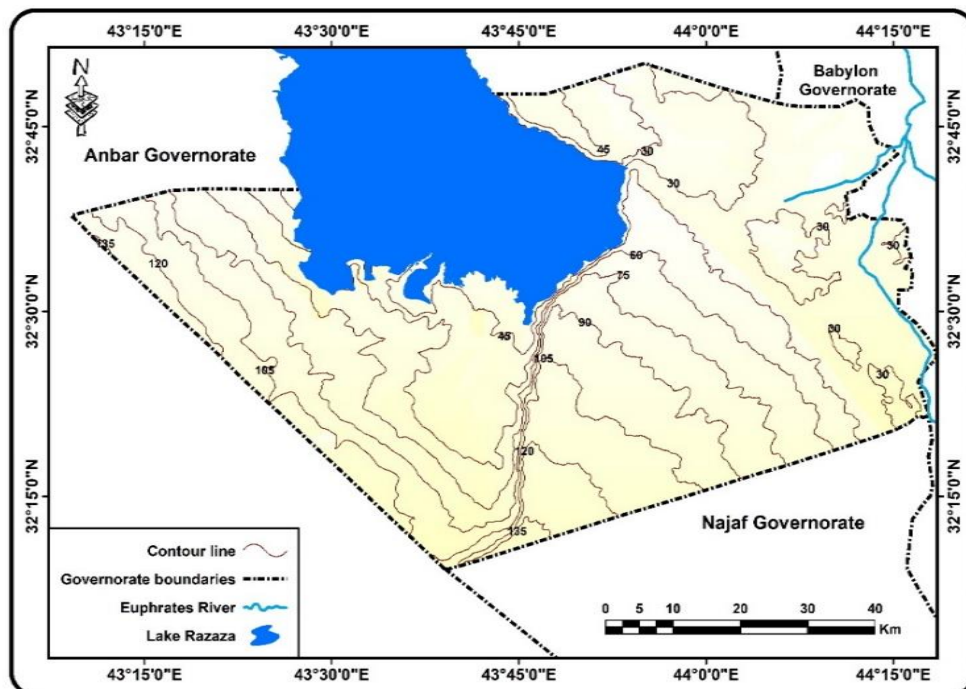


Figure 3. Altitude lines in the holy province of Karbala

The surface of Karbala province is almost devoid of prominent terrain forms, the land of the province is located north at the altitude line (30) m above sea level while it reaches (120) m above sea level in the south, noting that the eastern parts of it are less high than the western parts that contain in the north the Razzaza depression, and it seems that the surface of the province complicates terrain as we advance north and west towards Anbar province, as there are some low hills inside the Razzaza depression. It increases in height between (20-30) m above sea level, and the surface of the governorate shown in Figure 3 can be divided into several sections.

The researcher worked based on data from the US Geological Survey earthexplorer.usgs.gov, the Digital Elevation Model DEM, and the techniques of the Arc Map10.4.1 program.

3.4.1 Sedimentary plain area

These plains are characterized by being a flat plain land with a low slope and extend with the extension of the administrative borders of the province of Karbala with the province of Babylon, and it also forms a narrow range between it and the province of Najaf in its southeast, so it is a narrow strip that extends along the Indian Shatt, and it is difficult to distinguish between the sedimentary plain area and the plateau when they merge due to the flatness of the surface of the plateau in these areas, and the similarity of climatic conditions and natural plant species [11], and as long as the Euphrates River extends vertically from the north to the south of the governorate, the sedimentary plain is perpendicular to the banks of the river starting from its entry into the governorate and until it disappears within the borders of the southwestern governorate, and as shown in Figure 3, the possibilities enjoyed by the plains region reflected positively on its development compared to the rest of the governorate, which led to a disparity between the regions of the governorate in the levels of spatial development, and this is negatively reflected on the opportunities to achieve relatively balanced spatial development within the different areas of the governorate are evident through:

- i. The sedimentary plain areas represent the population concentration area, as (97%) of the total population of (1316750) people for the year 2023 are concentrated throughout the governorate, this means that the sedimentary plain area forms the basis for the concentration of the governorate's population and other service activities, especially those needed by investment projects (agricultural and industrial), to take advantage of the location advantages enjoyed by this area in terms of the availability of appropriate markets for the discharge of products in addition to the necessary manpower and the rest of the other services associated with the concentration of the population that investment projects need it to be established, on the other hand, the lack of the rest of the governorate, as is the case in the western plateau, to concentrate the population in a very limited way and within limited areas as well, such as the Ain al-Tamr district, which constitutes only (3%) of the total population of the governorate, with the lack of this area to the services it needs, which led to its lack of large investment projects that help develop the levels of spatial development and achieve spatial balance in

the distribution of the population between the different areas of the governorate.

- ii. It has agricultural development potential in terms of fertile soils, water resources, and this means that it constitutes development potential that can be invested economically to achieve spatial development, by relying on the establishment of projects based on agricultural production (plant and animal).
- iii. It has appropriate roads and means of transportation, which was reflected in the ease of movement, especially within the administrative units in which the main and secondary roads are available, such as the Karbala district, Husseiniya and the western stream, which led to the settlement of many investment projects to take advantage of the advantages of transportation appropriate to transport their products to local markets in addition to the markets of other governorates, especially the capital market (Baghdad), in addition to the transport of raw materials, so the availability of roads and means of transportation has reflected positively on the concentration of investment projects within these areas.

The researcher worked based on data from the US Geological Survey earthexplorer.usgs.gov, the Digital Elevation Model DEM, and the techniques of the Arc Map10.4.1 program.

3.4.2 Western Plateau

The widest area of the sedimentary plain area and gradually descends from the southwest towards the northeast, as shown in Figures 2 and 3, the plateau contains multiple manifestations such as depressions and hills, as well as geological processes in the ground that led to the rise of its eastern edge, and the decrease of its western parts represented in (Razzaza depression), the most important characteristic of this area is its flatness in general and with a rock formation of limestone and limestone with a few formations of clay and sand, and the lower valleys in the plateau are characterized by being shallow and short and filled with water when the rain falls that drains it towards Lake Razzaza with its silt, sand and gravel, its developmental importance is determined by: -

- i. The diversity of geological formations and this contributed to the diversity of mineral wealth that characterized the governorate in terms of quantity and quality.
- ii. The existence of agricultural development potential in terms of natural pastures, soil suitable for agricultural exploitation, in addition to existing groundwater reservoirs in terms of quantity and quality.
- iii. Supporting investment projects (industrial and agricultural) endemic in the governorate or that can be signed in the future in accordance with specific development strategies and goals to be achieved.
- iv. In terms of population stability, its investment may lead to a more regular redistribution of the population between the areas of the governorate, because the population is concentrated in the sedimentary plain, which led to leaving large areas of the western plateau depopulated, and this has a negative repercussion, especially in terms of border security.

3.5 Water resources

The importance of water resources is that it is an important factor in the settlement of various economic activities, especially agricultural and industrial activity, and this is important in the concentration of investment projects (industrial-agricultural) that depend on agricultural products (plant and animal) in their production processes, and with regard to determining the existing reality of the water resources available in the province of Karbala, and the extent to which they can contribute to enhancing opportunities for developing levels of spatial development within the different regions of the province, it can be shown through the classification of resources water in the province to the following:

3.5.1 Surface water

The Euphrates River and its sub-streams are the lifeline in Karbala Governorate, and Figure 4 shows the following:

- i. The Euphrates River (Shatt al-Hindiya): which branches from the Euphrates River in the northeastern section of the province into two branches, the first branch is the Shatt al-Hilla, which runs in the province of Babylon, while the Shatt al-Hindiya runs in the province of Karbala and the shape of its course is vertical, starting from its northeastern section and ending in its southeast, and takes its course to expand as we head south, because the area is located within the sedimentary plain, the length of its course is (67) km², within the study area and divides the Shatt al-Hindiya district Hindi into two parts:
 - a) The Great Greenhouse: which includes most of the area of the Hindiya district and its Khairat district.
 - b) Small greenhouses: which includes most of the countryside of the center of the Indian district.
- ii. Bani Hassan table: It is one of the important tables, as it penetrates the province from northeast to southwest, and runs along the Euphrates River, the course of this stream begins from the right side of the Euphrates River at the Indian dam of the province of Babylon, and its length is (66 km) of it (20 km) within the administrative boundaries of the province of Babylon and the rest within the province of Karbala, this table represents the main source of water for the lands in which its water flows, where it is watered with an area of (308) thousand acres in the district Indian, while relying on it completely in terms of bounties and the western table district, a set of sub-streams branch out from the table that contribute to the irrigation of the eastern regions of the study area, namely:
 - a) The drink is 10 km long, Abu Safin is 9 km, Duwayhiya is 5 km, Shattallah is 4 km long, Al-Ayouj is 7 km, um Al-Traid is 6 km long and Shatt Mullah is 6 km long.

In addition to these projects, a project located on the left side of the Euphrates River, the project (Hilla - Kifl), which covers an area of (14172) dunums in the Hindiya district, located to the left bank of the Euphrates River [12].

We note the strong correlation between the geographical distribution of the tables and the distribution of the population, especially as these projects have had a prominent impact on the concentration of population compared to other areas of the governorate, especially since most of the investment and economic projects are located in the east of the governorate.

- iii. Husseiniya stream: The stream of the Husseiniya stream begins from the right side of the Euphrates River at the

Indian dam and is (28 km) long and branches in its tail at the holy city of Karbala into two branches: -

- a) Rashidieh is located on the right bank of the Euphrates River and is (21) km long, and its course is directed towards the northwest and ends in the desert area near Lake Razzaza.
- b) Hunaidiya takes its waters from the left bank of the Euphrates River with a length of (17.5) km extending towards the southeast.

It should be noted that there are three branches (Al-Wand - Al-Kamaliya - Abi Zara) [13], branching from the Husseiniya table and the total length of (96 km), and these tables contribute to their sizes in irrigating approximately (94318) dunums, and for this it is one of the important tables, as the residents of the province depend on it in most economic and service activities, it has established on both sides and near it many development projects and residential complexes as is the case in the center of the province Al, Husseiniya District.

- iv. Sponsorship Schedule: This table is conducted from the front of the Indian dam in the north of the province of Babylon, and extends parallel to the Indian Shatt from the left side with a distance of no more than (1 km), and its length is (69) km and its course is between the provinces of Babylon and the holy city of Karbala and the residents of the center of the Indian district and its countryside depend on it to meet its water needs and other agricultural and service activities.

Directorate of Water Resources in the Holy Province of Karbala, Map of Water Resources in Karbala Governorate 2023.

- v. Lake Razzaza: It is a prominent body of water in the study area and represents the eastern part of a large closed basin as shown in Figure 5 expands as we head towards the west and southwest, and its area is (1501) km², either towards the east extends for a limited area does not exceed (5 km) east of the Razzaza depression, the area of the lake at the level of (30 m) above sea level (1700) km², and an area of (430) km² at sea level, flowing into Lake Razzaza a group of valleys: Temporary valley and Wadi Al-Ghaddaf, and the lake is fed in addition to that by the water of the springs of Ain al-Tamr, and thus it is an attractive site for tourism investment projects as a tourist interface, but it now suffers from drought due to the scarcity of rainwater and weather fluctuations and the lake is semi-salty and it is one of the dead lakes for water to enter it and not to exit and the percentage of salinity depends on the quantities of water that enter it and evaporate from it in addition to the absorption of the ground, the evaporation rate is about (2-1.5) meters deep during the year, especially the summer months, where evaporation is estimated at about (2) cm per day, as there are salty eyes inside the lake, especially the salt sea area [14], and one of the most important projects to be established, which is under study, is the project to develop the coast of Lake Razzaza, which belongs to the Department of Tourism of Holy Karbala, and it is possible to provide job opportunities up to (300-400) between a worker, employee and technician, as well as investment projects such as Fadak farm, which is located on Razzaza Road. It is one of the important strategic agricultural projects with an area of (2000 dunums) [15], located in the desert of the holy province of Karbala near Lake Razzaza, at a distance of (23 km) west of the city of Karbala.

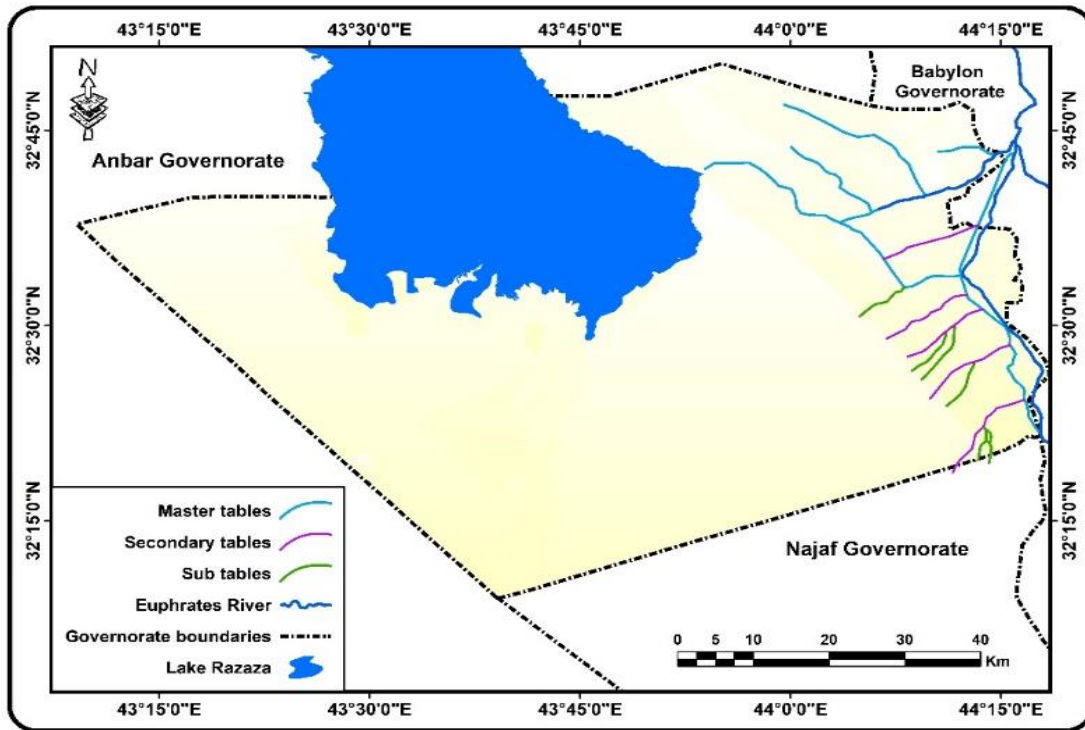


Figure 4. Surface water in the Holy Province of Karbala for 2023

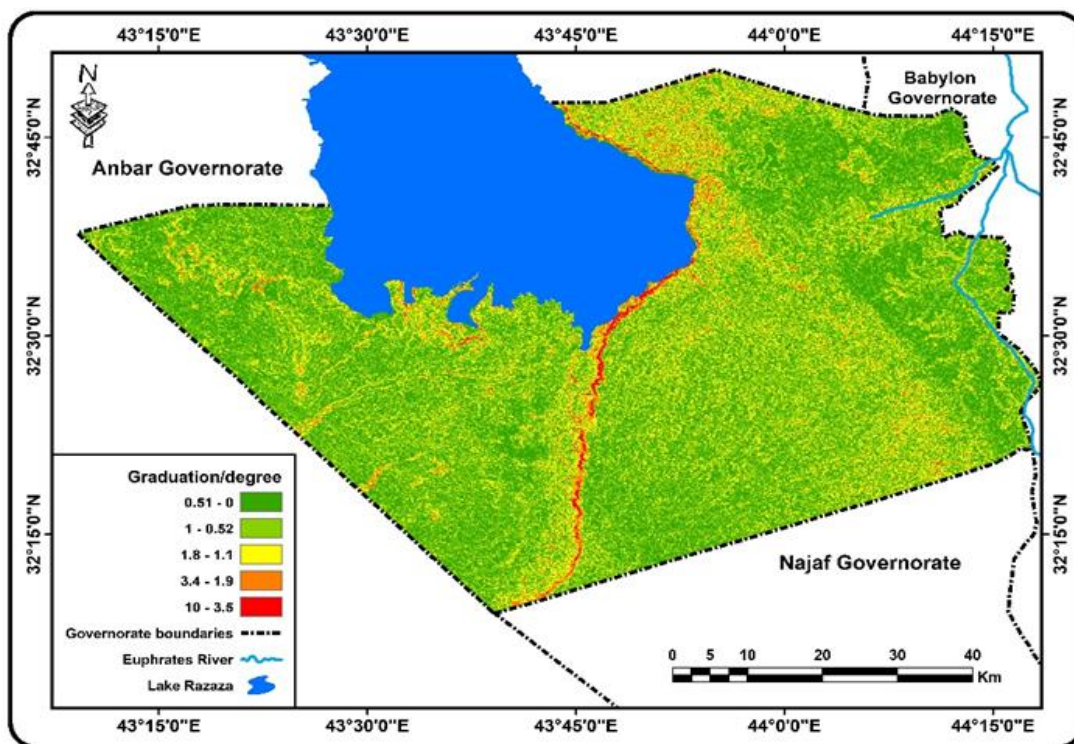


Figure 5. Modeling of classes of equal heights in the study area

3.5.2 Groundwater

It is one of the important water resources in arid and semi-arid areas, as it compensates for the shortage of surface water resources and rainfall, which is water filtered from the surface through the fragile soil layer into the formations of the earth's crust, which later became large reservoirs of groundwater [16]. The presence of potable and arable water in the western and northwestern sections of Karbala province is of great importance in the possibility of exploiting that water in the establishment of investment projects (agricultural and

industrial), as well as the possibility of exploiting that water in the stability of the population within those areas, which constitutes a geostrategic importance that can be positively reflected on the security of the province and the external borders of Iraq, groundwater appears on the surface of the earth in several forms, some of which are natural such as springs and some of which are artificial such as wells:

1) Wells

Groundwater is located in Karbala province in three

reservoirs, namely the reservoirs of the sedimentary plain, the formation of Al-Dabdeba and Dammam, distributed randomly depending on the availability of reservoir water, and it should be noted that these reservoirs are fed with water from rain and torrential valleys, and it is clear from Table 2 and Figure 6 that the number of wells drilled until (2023) totaled (2139) wells, and that the highest number of wells was in the district of the governorate center, as it reached a total of (573) wells, comes then the district of Ain al-Tamr (476) wells due to the lack of surface water sources, the lowest number of wells was in the district of Hindiya as it reached (15) wells due to the availability of surface water in the judiciary due to the

presence of Shatt Hindiya and streams branching from it that irrigate agricultural land and in general, these wells are productive and distributed over different areas of the province, used for irrigation purposes, and vary in geographical distribution between the northern and southern sides and the west side as well, according to the geological environment and the depth of layers. The depth of the wells in the Ain al-Tamr area is between (60-130) m below ground level, while the groundwater level between the city of Karbala and Ain al-Tamr is within (180-290) m and finally the Hindiya district and the Husseinia district, is limited between (12-15) m below ground level for each of them respectively [17].

Table 2. Geographical distribution of wells in the Holy Province of Karbala for 2023

| Administrative Units | Karbala District | Free Judiciary | Husseiniya District | Hindi District | Goodness District | Western Table District | Ain al-Tamr District | Total |
|----------------------|------------------|----------------|---------------------|----------------|-------------------|------------------------|----------------------|-------|
| Number of wells | 573 | 117 | 368 | 15 | 518 | 72 | 476 | 2139 |

Iraqi Ministry of Water Resources, Public Authority for Groundwater, Groundwater Authority (Karbala Branch), unpublished data for 2023

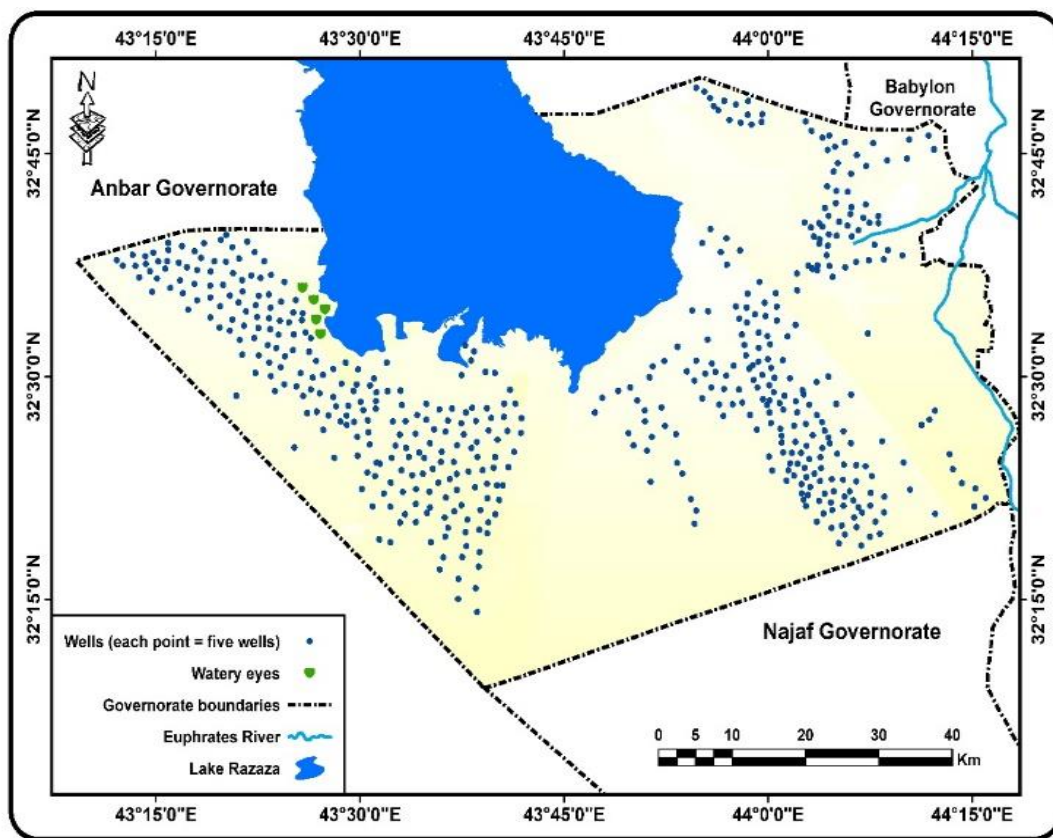


Figure 6. Wells and eyes in the Holy Province of Karbala for the year 2023
 Directorate of groundwater in the Holy Province of Karbala, Department of Geology and Drilling, 2023

2) Eyes

Spring water consists of rain and groundwater, where rainwater permeates the sandy ground into underground layers and passes on layers of different rocks, thus filtering and free of impurities, as well as gaining some salts of elements and mineral salts and giving the water a distinctive taste, and have a vital effect.

The eyes are concentrated in the province of Karbala in the district of Ain al-Tamr, as the arable land in which it depends on the water provided by these springs, the area of agricultural land irrigated from these springs is approximately (8000) dunums, there are in the province (4) eyes, all in Ain al-Tamr district, which is the blue eye, which was irrigating an agricultural area of (2600) dunums and a drainage rate of (650

liters / second), and the red eye, which was irrigating an agricultural area of (2000) dunums with a discharge rate of (500 liters / second), and Ain Seeb, which covered an agricultural area of up to (2600) dunums), and a discharge rate of (650 liters / second), while the latter is the eye of um al-Kawani, which was relied upon to water an agricultural area of up to (800) dunums), and a discharge rate of up to (200 liters / second), and it should be noted that there are eyes. Other secondary springs totaling up to (20) springs, most of which are located close to the main springs, but most of these springs have become depleted or unproductive, due to the drilling of many wells that were dug randomly by the residents of the district, which led to a decrease in the water level of the springs [18].

4. CONCLUSION

The geographical location provided the possibility of developing the levels of spatial development in the study area by creating suitable markets for the disposal of agricultural and industrial project products, in addition to providing the requirements of these projects of raw materials as a result of achieving functional coherence.

The small area of the study area in terms of planning and development makes the scheme limited to a small area of land and thus limits the freedom to sign investments and planned development projects and the opportunities for the presence of natural resources, whether in the ground such as minerals and others or above the ground such as water resources and arable land.

Climatic conditions in terms of prevailing winds and the amount of solar radiation received have good development potential in the field of investment in providing alternative clean and renewable energy sources, as the investment of wind and solar energy can contribute to the establishment of electric power plants.

Suitability of climatic conditions, especially temperatures, for the cultivation of crops such as (wheat, barley, yellow corn) and other strategic crops, adding palm and fruit trees, which means that there are development possibilities that can be invested in enhancing opportunities to achieve spatial development in the study area, adapting the prevailing climatic conditions with other components of livestock breeding that the governorate is famous for) sheep, goats, cows (whose products of) milk, wool, leather...) can constitute a major raw material for industrial projects.

The diversity in geological formations was positively reflected in terms of development in the diversity of mineral wealth (metallic and non-metallic) within the study area, as there are distinct mineral resources in the governorate in terms of quantity and type, especially with regard to ores (limestone, clay stone, limestone, red marl and child with some fossil rocks such as anhydrite, gypsum and salt), which created an important development foundation that can contribute to enhancing opportunities for developing spatial development levels.

The eastern parts are lower than the western parts, represented by the sedimentary plain area, the population concentration area, where (97%) of the total population, amounting to (1316750) people for the year 2023, are concentrated for the entire study area, this means that it forms the basis for population concentration and other service activities, especially those needed by investment projects (agricultural and industrial), offset by the western plateau region with a demographic dislocation such as the Ain al-Tamr district, which constitutes only (3%) of the total population, with this area lacking the services it needs, which led to its lack of large investment projects that help develop spatial development levels and achieve spatial balance in the distribution of population between different regions.

The western plateau region includes multiple manifestations such as depressions and hills, as well as geological processes in the ground that led to the height of its eastern edge, and the decrease of its western parts represented in (Razzaza depression), the most important characteristic of this area is its flatness in general and with a rock formation of limestone and limestone with a few formations of clay and sand, and the lower valleys in the plateau are characterized by being shallow and short and filled with water when the rain falls that drains

it towards Lake Razzaza with what is in it from silt, sand and gravel.

The diversity of geological formations and this contributed to the diversity of mineral wealth that characterized the study area in terms of quantity and type.

The existence of agricultural development potential in terms of natural pastures, soil suitable for agricultural exploitation, in addition to existing groundwater reservoirs in terms of quantity and quality.

The water resources available in the study area, and the extent to which they can contribute to enhancing opportunities for developing spatial development levels within the different regions, including the surface water represented by the Euphrates River and its branching streams, as well as Lake Razzaza, which is an attractive site for tourism investment projects as a tourist interface.

Groundwater appears on the surface of the earth in several forms in the western and northwestern sections, including what is suitable for drinking and agriculture, so it is natural such as springs or artificial such as wells.

5. RECOMMENDATIONS

Investing in natural development potential, climatic elements such as the prevailing winds and the amount of solar radiation received in the field of investing in providing clean and renewable alternative energy sources, with the need to invest the rest of the natural potential, especially the various mineral resources, through the deployment of industrial investment projects, especially administrative units rich in their poor development potential, such as Ain al-Tamr district.

The investment of arable land and the reclamation of reclaimable land, as it is still below the required level and is not at all compatible with the directions of achieving relatively balanced spatial development within the administrative units of the holy province of Karbala, which requires this in light of the formulation of future development directions.

The need to develop appropriate development plans and adopt sound plans in the process of investing these development potentials in order to contribute to achieving sustainable spatial development and thus enhancing opportunities for developing relatively balanced spatial development levels within the different regions of the governorate.

Supporting industrial and agricultural investment projects (economic) that can be signed in the future in accordance with specific sustainable development strategies and goals to be achieved.

Investing groundwater resources in a scientific and thoughtful manner, through the water resources directorates in Karbala from digging wells for farmers in a way that works to preserve the storage of groundwater, especially well water suitable for agricultural and industrial use and animal drinking purposes.

Work on the dissemination of agricultural investment projects in the region, in order to provide soils that encourage agricultural production by supporting the farmer in providing the needs of agriculture of fertilizers, pesticides and agricultural machinery, as well as drilling wells and adopting modern techniques in sprinkler and drip irrigation.

Work to encourage the dissemination of industrial investment projects and give greater opportunity for investors to enter the industrial sector, as it provides greater job

opportunities than the agricultural sector, as industrial resources are available in the region largely because of the clay and calcareous deposits that can be invested in the brick industry and the cement industry.

Paying attention to the tourism aspect and giving it the utmost importance by providing the requirements for the success of tourism through the establishment of modern roads for it, as well as hotels designated for tourists and providing support to the owners of investment projects that invest in the tourism side by giving them material and moral facilities, as well as providing media support for these areas and promoting them through advertising.

REFERENCES

- [1] Fatlawi, K.A., Allawi, F., Ghoneim, O.M. (2009). Principles of Economics (1st ed.). Dar Safaa for Publishing and Distribution.
- [2] Ghoneim, O.M. (2017). Spatial Development: A Study in Concept, Content and Theories (1st ed.). Dar Safaa for Publishing and Distribution.
- [3] Al-Ashry, H.D. (1979). Economic Development. Dar Al-Nahda Al-Arabiya for Printing and Publishing.
- [4] Nurkse, R. (1961). Problem of Capital Formation in Underdeveloped Countries. Oxford University Press.
- [5] Temple, J. (2005). Balanced growth. University of Bristol.
- [6] Shabaa, M.J.A. (2014). Industry and Its Impact on Regional Development in Najaf Governorate (1st ed.). Dar Al-Farahidi for Publishing and Distribution.
- [7] General Secretariat of the Holy Abbasid Shrine, Department of Agricultural Development. <https://alkafeel.net/projects/view.php?id=96>, accessed on Jul. 20, 2024.
- [8] Al-Taie, M.H. (1969). Determining the sections of the surface of Iraq. Journal of the Iraqi Geographical Society.
- [9] Hussein, Y.A. (1989). Water springs between kubaisa and samawa and its investments. Ph.D. dissertation. College of Arts, University of Baghdad.
- [10] Republic of Iraq, Ministry of Industry and Minerals. (1995). State Company for Geological Survey and Mining, according to the geological report Karbala plate, NI-38-14, miscellaneous, Baghdad. <https://industry.gov.iq/>.
- [11] Nasser, H.J., Khudair, N. (2012). Geographical analysis of food security in Karbala Governorate. Researcher Journal, University of Karbala, 1.
- [12] Al-Hamdani, A.F.A.H.M. (2011). The planning role of the local authority (Karbala Governorate case study). Master's thesis. University of Baghdad, Urban Planning.
- [13] Republic of Iraq, Ministry of Irrigation. (1998). Holy Karbala Irrigation Directorate, Design section of the Husseinia table for the year 1998, p. 6.
- [14] Sahab, M.F., Abdullah, M.H., Hammadi, G.A., Hamad, N.S., Abdulazez, A.A., Fayyadh, A.H., Ayed, D.J., Jala, A.D., Sayl, K.N., Ramal, M.M. (2024). Ground water quality evaluation for irrigation purpose: Case study Al-Wafaa area, western Iraq. International Journal of Design & Nature and Ecodynamics, 19(4): 1415-1424. <https://doi.org/10.18280/ijdne.190434>
- [15] General Secretariat of the Holy Husseinia Shrine, Department of Agricultural Development. (2023). <https://imamhussain.org/arabic/35345>.
- [16] Abu Sammour, H., I-Khatib, H. (1999). Geography of Water Resources (1st ed.). Dar Al-Safa for Publishing and Distribution.
- [17] Iraqi Ministry of Water Resources, Public Authority for Groundwater, Groundwater Authority (Holy Karbala Branch), for the year 2023. <https://mowr.gov.iq>.
- [18] Soren, D.D.L., Barman, J., Roy, K.C., Naskar, S., Biswas, B. (2023). Evaluation of groundwater quality of South Bengal, India. Journal of Earth System Science, 132(3): 130. <https://doi.org/10.1007/s12040-023-02152-8>