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Geographical Assessment of Natural Resources at Abu-Hadair Drainage Basin in Al-Salman Desert, Southern Iraq

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Abstract: The current research dealt with the most important natural resources available in Abu - Hadair drainage basin, one of the most prominent dry valleys in Al-Salman Desert in southern Iraq, including water resources, surface and groundwater, grazing and natural vegetation, as well as the most important mineral resources located in the area of study. Several ways have been discussed in which these resources could be invested by means of development projects for economic benefit, which represent a step towards the development of arid and semi-arid regions in Iraq, particularly in its southern deserts. The research showed that the basin is characterized by the existence of a proper water drainage network, thereby providing a sufficient amount of water to be invested in agriculture, in addition to the available groundwater reservoirs. The availability of such fertile soil leads to the growth of a wide range of natural vegetation, enabling large areas of the basin to be invested for grazing purposes. Rock diversity has proved to be significant in providing various minerals which could be invested in industry and construction.

Keywords: Economic development, Dry valleys, Drainage basin, Natural resources, Geospatial techniques

The human journey began by exploiting the environment and investing its natural resources since the earliest times, and since then many changes have occurred. The rates of population growth and civilization progress have increased, and the nature of their relationship and interaction with the environmental milieu in which they live has varied over the developmental stages through which humanity has been, attempting to make use of the natural resources available. This continuous journey enabled man to produce the materials and commodities he needs, yet the outcome was a range of environmental problems caused by humans. These problems have become the subject of global attention due to the imbalance they cause to the environmental equilibrium. Natural resources outcome of the many interacting forces and factors that are related to the surface of the earth, such as climatic conditions and the associated hydrological conditions and life forms (flora and fauna), the earth's crust and associated mineral resources. The immediate result that can be drawn from the formation conditions of these resources is that their existence is characterized by two main features, namely the variation in their geographical distribution, and their limited presence in nature. The present study is an attempt to understand the characteristics of the natural environment that caused the formation of the natural resources in the Abu Hadair basin, one of the dry valleys in Al-Salman desert, southern Iraq, as well as the characteristics of these resources and their most prominent types and investment possibilities in developing the southern desert of Iraq. The research hypothesis indicates that the natural environment, represented by the climate, soil, terrain, surface and underground water resources, rock structures and their mineral wealth, as well as vegetation, has a clear and distinctive role in the formation of natural resources that can be used as pillars of human development in the study area. The importance of the research lies in shedding light on the most prominent wealth and natural resources that can be invested in developing one of the desert areas with scattered settlements in southern Iraq, where no serious initiative has been made. The main objective of the research is to clarify the spatial relationship between the natural characteristics of the Wadi Abu Hadair Basin and the available natural resources, so as to invest them economically.

MATERIAL AND METHODS

The most important natural resources of the Wadi Abu Hadair basin were analyzed and interpreted through the use of several tools. A number of sources were relied upon, including analysis of aerial photographs, scale (1/50000), topographic maps of scale (1/25000), (1/50000) and (1/100000) and (1/250000) issued by the General Authority for Iraqi Survey, as well as geological maps of scale (1/250000). Additionally, the satellite visual of the American satellite (Landsat ETM + 8) for the year 2016 was relied upon, with the ability to distinguish (30) AD, and the radar board SRTM. These data were analyzed using the Arc GIS 10.8 program, in addition to relying on a number of field studies for the study area, as well as applying the Berkeley equation to know the expected annual flow:

$$R = (CIS)\ 1/2\ (W / L)\ 0.45$$

Where:

R = expected annual runoff volume (billion m^{-3}).

I = the expected annual rain volume (billion m^{-3}), calculated by multiplying the annual rain rate by the area of the basin and then dividing the result over 1,000,000.

S = slope rate (m/km), calculated as the difference between the maximum and minimum value in the basin height/basin length.

W = rate of duct width.

L = length of valley from upstream to downstream, measured with Arc Map 10.4.1 software.

C = a constant coefficient estimated in the southern desert, being (0.1).

Study area: Wadi Abu Hadair basin is located in the middle of Al Salman desert in the Governorate of Al-Muthanna, within the Lower Valleys region (Fig. 1). It is one of the largest dry valleys that flow into Al-Sulaibat. It is located within longitude and latitude (44°47′45″ - 45°14′4.1″E) and (30°59′49.1″ - 30°11′55.5″N), and it is 29 km away from the city of Al-Batha and 45 km from Ur, which implies that it extends for about one degree of width and about one degree of longitude. The Wadi Abu Hadair basin is bordered on the north side by the Al-Husam, Al-Dawudan, and Abu Muris valleys basins, whereas on the west side it is bordered by the valleys Al-Tayyar, Al-Hawaimi and Al-Faraj, and to the south it is bordered by the Wadi Al-Akarawi basin and its secondary valleys, whereas from the east it is bordered by the Al-Ashali, Al-Arjawi and Al-Kaseer valleys. The basin overlooks the Al-Sulaibat in its northern part through its flood stream.

RESULTS AND DISCUSSION

Water resources: The study area is classified within the hot dry areas, especially in terms of expanding settlement and economic exploitation, as based on agriculture and grazing. The sources can be divided into two types, namely surface water resources and groundwater. Since the annual amount of rain falling over the Wadi Abu Hadair basin is relatively small, changeable from one year to another, and its greater part is lost through evaporation, seepage and drainage towards the Sulaibat depression, no permanent surface water is considered in the area of study. This clarifies that when sudden rains fall with the cold fronts of the atmospheric depressions, the temporary surface water flows in the course of the valley basin and its tributaries in form of violent torrents, in which the water suddenly flows and causes flash floods. Many of these may continue to run in this way for several consecutive days and several times in all the years of relatively heavy rain. During periods of rain retention and after the surface water loses a large part of it through evaporation, leakage and drainage, running water could sometimes be observed in form of thin, threadlike surface water flowing in some of the secondary valleys in the basin. These weak water flows may continue to run for long periods of the year .

The occurrence of surface water was observed which flows over a distance of a few hundred meters in the form of weak runoff water with limited thickness in each of the valleys of the Wadi Abu Hadair Secondary Basin and Wadi Al-Theeb Basin (Fig. 2). Approximately (90%) of the average annual rainwater flowing in the Wadi Abu Hadair basin occurs during the main flood season (winter, from November to March). The study area is devoid of the availability of permanent surface water, except for some springs of limited spread. The valley overflows when the rains fall, and there is no hydrological station to measure the amount of water discharge.

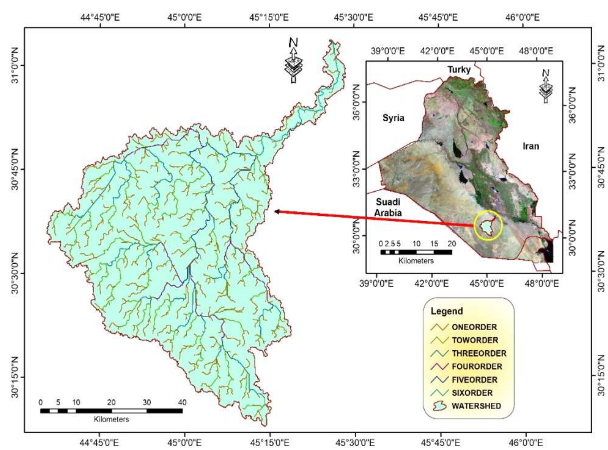

Fig. 1. Location of study area, Iraq

Fig. 2. Seasonal water flow in Wadi Abu Hadair secondary basin

The expected annual flow rate in the basin has reached (0.224) billion m^3 annually, while the secondary basins varied in the size of this revenue, being about (0.138) and (0.042) billion m^3 in Wadi Abu Hadair and Wadi Al-Akraa basins, respectively (Table 1). Despite the modest volume of surface water in the basin, some farmers have succeeded in exploiting it economically and erected deep circular pits in some parts of their farms for this surface water to collect inside them. The farms which were located at a level higher than the level of running water in the Wadi made use of pumps to rise these water so as to be used for irrigation and domestic purposes.

As for underground water resources, these contain water that is infiltrated from the surface through the fragile soil into the earth's crust formations, later to became larger groundwater reservoirs . In spite of the multiplicity of types of groundwater and the variation of its sources in the study area, the biggest source for it is rain precipitation. Despite its smallness, it takes a way towards the interior layers, and the bulk of this receding water settles between the folds of the rocks, filling the interstitial spaces and voids present in the sediments of the debris rocks, and settling in the pores of fused rocks and their joints and cracks, thereby forming the underground water reservoirs. Three reservoirs have been noted in the study area. Sedimentary layers or rock formations that contain this water are known as aquifers, and the availability of groundwater in these rocky areas depends on several natural characteristics, namely the degree of porosity and the degree of permeability .

The wells of the study area were used for human and animal purposes (Fig. 3), which made it a center for attracting population. Due to the decline of the study area towards the northeast towards the Sulaibat depression, large quantities of rainwater descend during its fall season. However, this quantity of water loses a large proportion of it due to evaporation and leakage into the soil, which is then considered wasted and is not used due to the long distance that it crossed to reach the depression. This is clearly visible in the secondary valleys of the basin, therefore, some natural dams can be constructed on the streams of these basins to benefit from the accumulated water to be used for grazing and agriculture purposes and reduce the depletion of well water, in addition to feeding the groundwater reservoirs with large quantities of water, especially since water reservoirs suffer from a lack of nutrition due to drought. The raw materials for creating dams include limestone, sand, gravel and boulders, which are all available in the region. A dam can be built on Wadi Abu Hadair secondary basin, particularly in the narrow area located to the south of the Abu Hadair flood, since the course in this area is characterized by its narrowness, along with the presence of rock cliffs that resist erosion processes. As for the Wadi Al-Theeb Basin, the best place to establish the dam is to the south. In the case of Abu Hadair main basin, the optimal places for constructing a dam is to the south of Ghadir (Lahuj) because of the hardness of the rocks and the narrowness of the valley (Fig. 4).

Grazing: This activity is widely practiced in the basin of Wadi Abu Hadair because it is an important resource in the population's economy, especially in the years of fertility or rain when the growth of woods and pastoral herbs is abundant. This drives the owners of livestock such as the shepherds of sheep, goats and camels to migrate to areas of

Fig. 3. Wells of study area

Table 1. Expected annual flow for the Abu Hadair Basin and its secondary ones

Name of Basin	Area (km^2)	Length (km)	Average width (km)	Average annual rainfall (mm)	Average slope (km/m)	Rain size (billion m^{-3})	Width /length	Expected annual flow (m^3)
Abu Hadair (secondary)	830,02	89,25	9,299	90	2,240	0,074	0,104	0,238
Al-Shikhia	676,68	53,25	12,70	90	1,877	0,060	0,238	0,044
Al-Theeb	1162,50	63,43	18,82	90	1,891	0,104	0,296	0,056
Al-Akraa	708,72	46,66	15,18	90	1,714	0,063	0,325	0,042
Abu Hadair (main)	3377,93	112	30,16	90	1,964	0,304	0,269	0.224

fertility. This activity mainly occurs during the rainy season, being from October to the end of May of each year. Due to the lack of rainfall and its insufficiency for practicing agricultural activity the lands south of the basin have become a major grazing area in which plants grow in the event of rain and include areas as Al-Shawiya, Trak Al Kulaib and Burbak, (Fig. 5). The importance of these areas is linked to the presence of various types of natural plants important for grazing, in addition to wells with potable water that enable the owners and their animals to survive in the area, and farmers may resort to planting some crops, especially fodder nearby.

As for the area to the north of the basin, it is a region with little grazing due to the lack of vegetation growth in it, so it is not considered a significant grazing area. The geographical distribution of livestock numbers indicates that they are mostly located in the southern parts of the basin, due to its many pastures. Yet, the actual numbers that exist within the region are much more, especially in rainy years, as the study area attracts huge herds of animals coming from surrounding areas. The grazing system in the study area is free grazing, as the herdsmen move with their flocks without restrictions, so many pastures in the study area suffer from stress, depletion of their plants and the inability to renew themselves in a way that guarantees them stability, as it is within the natural limits. In terms of exploitation, it takes the pasture to reproduce what it consumes as animal food for a year or less . Excessive grazing led to the disappearance of some of natural plants which are of importance for grazing and the replacement of unpalatable plants such as *(Prosopis farcta, Monotropa and Myrteae)*, and on the other hand it weakened the soil cohesion and exposed it to the risk of erosion and water or air erosion.

Natural vegetation: Natural plants of various kinds are spread throughout the study area, and it is one of the groups of desert plants that have adapted themselves to harsh environmental conditions, especially high temperatures, lack of rain and its fluctuation. The region has rich natural pastures due to its greater share of water and its suitable soil for the growth of herbs, so it is used by shepherds of sheep, camels and goats from many areas, especially from neighboring ones. In many ways, including the large underground root network and needle leaves, these shrubs provide important grazing plants in the summer, when green fodder is scarce, or in places that are not suitable for weeds, as they start to grow in summer and bloom and seed during fall. Among the types of these plants in the study area are *(Tamarix*, *Tamarix aphylla, Haloxylon ammodendron, Zizphus spina and Ranterium epapposum)* (Fig. 6). In addition, perennial weeds and herbs are characterized by their rapid response to the autumn rains, as they begin to

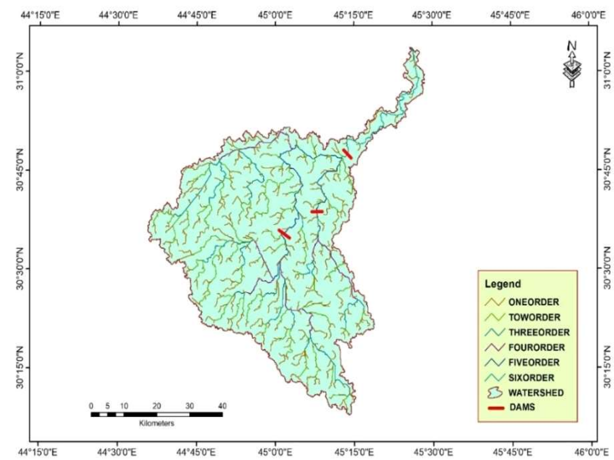

Fig. 4. Locations for the suggested dams within the area of study

Fig. 5. Grazing in the area of study

Fig. 6. Annual weeds in the area of study

form new growth and thus provide early grazing for animals, as well as their importance in preserving the soil from erosion, with their delicate and dense root network, and their types include *(Calligonum comosum, Achillea micrantha, Haloxylon salicornicum and Anabasis).* As for the second type of desert plants in the study area, annual weeds and herbs are characterized by their short life cycle, as they grow in the rainy season and end when the seeds are formed to re-grow after about a whole year. It has a great pastoral value for its palatability to animals, especially when it is green (Fig. 7).

In general, the study area is considered to be unable to support large numbers of animals that exceed the pastoral energy, which would damage and destroy the pastures and their plants, especially in depressions and valleys, characterized by the presence of many types of perennial plants. Therefore, an appropriate plan must be drawn up to proportion animals according to the amount of production of natural pasture plants, as well as the use of organized grazing in its various ways, such as periodic and postponed grazing, which preserves good and palatable plant species and prevents their extinction. Being one of the essential components of the ecosystem, yet the numbers of these organisms have decreased significantly due to natural factors, including climate change, water resources, and other human practices related to incorrect and negative human practices such as poaching and killing large numbers of them. This led to the extinction of a large number of animals, such as deer, falcons, bustards, partridges, and hares .

Minerals: The study area is rich in mineral resources, which have not been used in a thoughtful and planned manner due to the lack of technologies and research capabilities. Some of these resources are exposed, such as stones and building rocks (Fig. 8A), and some are in the form of sediments, most of which are concentrated in the stomachs of valleys and depressions (Fig. 8B), varying in thickness from one region to another, and consist of large boulders and pebbles that the running water cannot carry. It is transported though stumbling and rolling, which are controlled by several factors including the volume of water drainage, the speed of the water, the severity of the slope, and the distance traveled by the stream. These sediments are spread in multiple areas of the basin. Most of them are of local origin, indicated by their sharp corners and lack of roundness. They originate from the limestone, gypsum, marl, and flint rocks, and vary in size between several millimeters and large crushed stone blocks with sizes of more than 50 inches, which were swept by torrents to the bottom of the valley. These are not clearly separated but mixed with sand and mud due to the large number of sediments that are deposited with it through water erosion processes. The gravel is used in construction works, concrete and brick making, paving work, road and pavement construction, and other uses.

Fig. 7. Annual vegetation

Fig. 8. Types of rocks in the basin

CONCLUSIONS

Wadi Abu Hadair overflows through heavy rain storms which rarely occur in winter season, therefore groundwater is the mainstay of life in the study area. Grazing is widely practiced in the study area because it is an important resource in the population's economy. Different types of natural plants are spread throughout the study area, and it is one of the groups of desert plants that have adapted themselves to harsh environmental conditions, especially high temperatures and a lack of rain. Also, the study area is rich in mineral resources, some of these resources are exposed, such as stones and building rocks, and some are in the form of sediments, most of which are concentrated in the center of valleys and depressions, varying in thickness from one region to another.

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