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Morphometric characteristics of the Jabal Aqrah basins

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***Abstract*---**The study of river basins is one of the geomorphological studies that have received special attention by geomorphologists and hydrologists, as it represents an integrated geomorphological and hydrological unit in terms of the water network and its ranks, the speed of water flow and other characteristics between the geomorphological and geological characteristics of the water and its geological characteristics. The natural, which represents the natural medium that affects the drawing and defining of its dimensions and the characteristics of the flow in it. Today, morphometric studies take a special place because they combine geomorphological and hydrological studies. They are a link between them. They add accurate facts and information in the hydromorphological studies of water basins. Aqrah Mountain is located in Nineveh Governorate - Aqrah District - Nahla District and has two northern slopes and Jinan. And each of them has a network of water basins. The study targeted this basin area, which has an area of 809.4 km2.

***Keywords*---**morphometric, geomorphologists, hydromorphological.

The first topic
Cadastral characteristics of basins

The cadastral study of the basins is one of the studies of great importance in the geomorphological and hydrological studies, as it greatly affects the volume of water flow. It is natural that the areas of the water basins vary from one basin to another, depending on the variation of a number of natural factors affecting them such as climatic conditions, rock characteristics, movements The land, topography and vegetation cover, as well as the presence of the time factor [1] and other factors represented by human factors.

The water basins increase in their area with the increase of the water processes and the availability of suitable conditions and the presence of easy and salty rocks, as there is a direct relationship between the area and the drainage basin [2] Also, water erosion has a significant impact on the area of basins, as it increases with the increase in the activity of water erosion processes, and this is related to the increase in the presence of the geological structure with a fragile rocky structure that is easy to erode [3]

1- The pelvic area

The study area consists of three integrated basins of varying size, as follows:

- Basin (1)

The area of the basin is (311.07 km2), or 52.4% of the total area of the basins of the study area, and it is the largest basin in the area, as shown in Table (17). when

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([1]) Strahler,a,n, dimensional. Analysis to fluvial.Evaded land froms. Bulletin of geological of America, 51-69 1958. P.28.

([2]) Hassan Sayed Ahmed Labou El-Enein, The Origins of Geomorphology for the Study of the Landforms of the Earth's Surface, University Culture Foundation, Alexandria, 1986, p. 452.

([3]) Hassan Sayed Ahmed Labou El-Enein, same source, pg. 452.

The feet of Mount Aqrah, so the source of its water is from the slopes of Mount Aqrah, where waterfalls and melting snow run towards the basin.

- Basin (2), which is one of the basins with a large area (184.62) km2, or 31.1% of the total area of the basins of the study area.
- Basin (3), which is one of the small basins with an area of (98.01) km2, or 16.5% of the total area of the basins of the study area. The basin is located in the far northwest.

From the observation of map (12) it appears that the total area of the basins is (593,701) km2 of the total area of the study area, which is distributed over three main basins.

Table (17) areal characteristics of the Jabal Aqrah basins

basins			Properties
basin (3)	basin (2)	basin (1)	
98.012	184.623	311.065	Area/km2
16.5	31.1	52.4	area percentage
4.534	8.516	8.839	average pelvic width/km
24.656	27.356	40.850	real length/km
21.616	21.678	35.189	Ideal length / km
56.630	66.428	96.716	pelvic circumference/km
1.731	2.779	3.216	Relative circumference/km

Source: From the researcher's work based on the topographic maps of the study area and using the Arc Gis program

Dimensions of the basins
It includes the dimensions of the basins (length, width, perimeter, relative circumference) as follows:

A. The lengths of the basins

The length of the basin is one of the main dimensions through which some morphometric coefficients are calculated, whether it is to study the shapes of the basins or to clarify their topographical characteristics [4]

([4]) Gouda Hassanein Gouda, Mahmoud Muhammad Ashour, and others, Geomorphological Analysis Means, Edition 1, 1991, p. 290

sedimentary basin [5] The lengths of the basins vary according to the degree of slope and the severity of the sprocket, meaning that the areas of high sprockets with a large slope decrease the length of the pelvis and vice versa. Geomorphologists have developed an explanation for it, as the steep slope forces the water to tend to deepen, as it is more straight than the running water over the slopes of the few slopes, that the straight lines that meet between two points the distance is less and faster than the zigzag lines between the two points.

In addition, the length of the basin is affected by a set of other factors that control the length of the river basins, including the distance between the source and the estuary, which is the same that controls the distance of the basin, as it is considered part of the dimensions of the slope spread over the water network, in addition to the water sources of the water basins.

The lengths of the study area basins can be clarified as follows, Table (17):

- Basin (1), which is one of the basins of medium length. Its real length is 27,355 km, while its ideal length is (21.678) km. Map. It descends from the far north-east, i.e. from the area of the highest mountain of Aqrah, heading towards its lowest level at the Great Zab.

B. Width of the basins (breadth)

The width of the pelvis is the straight distance between the two farthest points on the perimeter of the pelvis [6] and the width of the pelvis is important in morphometric parameters in order to determine the shape of the pelvis, by knowing the ratio between length and width [7]

([5]) Ghazwan Salloum, Qandil Valley Basin, a morphometric study, Damascus University Journal, Volume 28, Number 1, 2012, p. 401.

([6]) Mahmoud Saeed Al-Salawi, Hydrology of Surface Water, Jamahiriya House for Publishing and Distribution, Libya, 1999, p. 102.

([7]) Muhammad Sabry Mahsoub, Geomorphology of Landforms, Dar Al-Fikr Al-Arabi for Printing and Publishing, Cairo, 1991, pg. 206.

The width of the basin affects the amount of water that the river basin can absorb, resulting from rainfall, and its impact is reflected on the surface runoff and patterns of runoff.[8]

The measurement of the basin's breadth can be found in several ways, including calculating the maximum breadth of the basin represented by the two farthest opposite points, or by dividing the basin area by the length of the basin. intersecting with the main stream, and then calculating the average sum of its lengths, which represents the breadth of the basin [9]

As for the basins of the study area, it was relied on the equation of the average width, due to the different shapes of the water basins and their meanders, as follows [10]

mean pelvic width = $\frac{\text{the aria of the besine 2 km}}{\text{the lingth of the besine 2 km}}$

After applying the above equation to the basins of the study area, the results appeared as shown in Table (17), and by noting the table, it appears that all the basins of the study area are longer than their width and that the breadth is small.

C. the perimeter of the basins

The basin's ocean represents the water dividing line between the basin and other basins adjacent to it [11] and it is used to show the extent of the basin's spread and breadth, as the greater the length of the basin, the greater its spread, expansion and geomorphological development [12] The ocean is of great importance as it is used to extract some morphometric parameters that show the shapes and topography of drainage basins.

([8]) Muhammad Sabry Mahsoub, Geomorphology of Landforms, previous source, pg. 206.

([9]) Ghazwan Salloum, Wadi al-Qandil Basin, previous source, p. 403.

([10]) Gregory K.j. and Walling, D.E, Draining Basin Erom and process Geomorphological approach, Edward Aronld, Lnoden, 1973 .p.50..

([11]) Ziyad Tariq Hussein, Morphometric Characteristics of the Sirat Kira Basin in Aqrah District, unpublished MA thesis, College of Education for Human Sciences - Ibn Rushd, University of Baghdad, 2018, pg. 67.

([12]) Yahya Ahmed Saeed Al-Arouji, Wadi Zabid Basin, a geomorphological study, a master's thesis (unpublished), Sana'a University, College of Arts, 1993, p. 91.

Significant as the coefficient of rotation and elongation. In order to know the hydrological and geomorphological conditions of the drainage basin, the two basin locations are related to many other morphometric characteristics and as a morphometric variable [13]

Pelvic circumference is measured in two ways:

- **The traditional direct method:**
  Through topographic maps and using a plyometric device.
- **The modern method:**
  Using the measurement tool in the (Arc Gis) program, which is the method used in the study.

D. relative circumference

It is to find the relationship between the area of the basin and its circumference, and this relationship is extracted according to the following equation [14]

Relative circumference= $\frac{\text{pelvic space}}{\text{pelvic circumference}}$

The second topic
terrain features

The study of the topographical characteristics of the water basins is of great geomorphological and hydrological importance, as through its results it is

possible to understand the topography of the basins and the nature of the landforms associated with them, as it has a clear role to know the geomorphological cycle that the basins go through. Determining the downstream phase that the river passes through, which has a significant impact on the water surface run-off, increasing its speed and the volume of discharge, and it depends on the steepness and its intensity.

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([13]) Muhammad Sabri Mahsoub, Geomorphology of Landforms, p. 207.
([14]) Horton. R.E, Erosional development of streams and their drainage density hydro-physical, approach to quantitative. Geomorphology. Geol, soc. No. 56, Amer, Bull, (1945).

From this, the topographic characteristics affect the morphometric characteristics, and this will be clarified in the basins of the study area and the topography in it that helped in the formation of its morphometric characteristics, as follows:

1. gear ratio

It is one of the important and simple morphometric measures for understanding the topographic features of an area. Its importance comes as through it it is possible to identify the activity of erosion processes, and for this it represents the sprocket of the basin by finding the ratio between the highest and lowest level in the basin and the length of the basin. Sedimentary transport, and that the transported sediments increase in proportion with the increase in the rate of erosion, which contributes to the formation of different geomorphological forms and their impact on the speed of arrival of the flood wave, and this is an indication of the increased risk of floods. It increases by increasing the values of the molar, which in turn leads to an increase in the effect of the effectiveness of the erosive activity of water, and this explains the increase in the transferred sediments [15]
The gear ratio is extracted by applying the following equation [16]
gear ratio=

$$\frac{\textit{The difference between the highest and lowest levels of the pelvis/km}}{\textit{The length of the basin is/ km}}$$

The values of this coefficient increase by increasing the difference between (the highest point and the lowest point) in the water basin, and by applying the above equation to the basins of the study area, it was found that there is a discrepancy in the ratios of the molars of the basins of the study area, which are shown in Table (22) between the highest value recorded by basin (2). At a rate of (51.89) m / km, and between the lowest value of (12.78) m / km at Basin (1), which are different values that indicate the geological difference and the topographic composition of the basins of the study area, as the values of the molars rise at Basin (2), which indicates a lack of The activity of salty operations due to running water, and that the basin formations are still undergoing geomorphological activity from

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([15]) Muhammad Abd al-Ridha Da'eef al-Shahili, Morphometric Characteristics of Wadi al-Zarka Basin in Dohuk Governorate, previous source, p. 81.
([16]) Stanely A Schumm. Evolut on of drainage systems slopes in bad_ land at perth Ambog, Newberys, Jor. Geo. V. 67. 1956. p612.

In order to achieve a balance in its streams. While the rate of tooth decay decreases at the basin (1). It is the largest basin.
This percentage comes as a reflection of the nature of the rocks and their qualitative composition, which is characterized by their low resistance to erosion processes, which affects the increase in the speed of water waves and the increase in the percentage of their load from the transported sediments, especially after raining operations. As for Basin (3), it was found that the trough ratio of the trough is (41.83) m / km, which was found on the ratio of the dentition and that the basin has a moderate relative slope due to the tectonic factor, which is an indicator with a significant impact in the study area. The values of the sprocket and its slope in addition to the type of rocks that make up it.
Geomorphological indications indicate that the increase in the values of the gears is important in increasing the effectiveness of the activity of erosion processes, as it has a major role in the development of the basin and the formation of geomorphological forms such as flood fans. resistance and slow gradient.

2. Extreme terrain

It is one of the simple morphometric parameters, which refer to the relationship between the highest and lowest altitudes in the levels of the water basins.
This coefficient is extracted through the following equation [17]

Max terrain = Maximum height of the basin (m) - Minimum height of the basin (m)

By applying the equation, it becomes clear that:
The average topography of the basins of the study area varies from one basin to another, and this is related to the rates of difference between the levels of the basins, as Basin (2) recorded the highest rate and reached (1125) m, and this indicates that the basin is relatively mutilated, while the average topography of the basin (1) and (3) it reached (450) (900) m, respectively.

([17]) Ali Abdul-Zahra Al-Waeli, Hydrology and Morphometric Science, House of Books and Documents, Iraq, Baghdad, 2012, p. 108.

This discrepancy is due to the difference between the maximum height at the sources and the minimum height at the estuaries, which is not a small difference.

3. Relative terrain

It is one of the important relative morphometric measures, representing the interrelationship between the topography of the basin and the basin circumference in the form of a ratio expressed by the following [18] equation

Relative terrain= $\frac{pelvic\ \ topography\ m}{pelvic\ circumference\ km}$

Terrain is related with the degree of rock resistance in an inverse relationship with the stability of climatic conditions. rocks for erosion. When applying the above equation to the basins of the study area, it was found that there is a discrepancy in the relative topography values between the basins, as the lowest value recorded at Basin (1) was (4.65 m/km) among the highest value recorded by Basin (3), which was (51.89) m/km. As shown in Table (22)
This discrepancy in the relative topography values indicates the difference in the topographical geological nature of the basins of the study area, and this can be clarified as follows:

Table (22) Topographic characteristics of the Jabal Aqrah basins

Pelvics			Feature name
Pelvic 3	Pelvic 2	Pelvic 1	
41.83	51.89	12.78	gear ratio
51.89	16.94	4.65	Relative terrain
1300	1500	800	The highest height of the basin m
400	375	350	Minimum height of the basin m
900	1125	450	extreme terrain
2.55	2.97	1.29	ruggedness ratio
0.11	0.16	0.69	Hypsometric integration
0.07	0.07	0.12	geometry number

Source: From the researcher's work based on topographic maps using the Arc Gis program.

([18]) Muhammad Magdy Trapp, Geomorphological Analysis of the Wadi Qusayb Basin in the Eastern Range of the Sinai Peninsula, Geographical Journal, No. 30, Egypt, 1997, p. 272.

Hypsometric parameter

It is a scale that shows the incipient stage of the water basins or any part of them [19] as it is considered a local scale that describes the morphology of the river basin at the present time. In the youth stage, and this was confirmed by (River), while the parts that are characterized by a little slope indicate that the region is in an advanced stage in the downstream [20] cycle, that is, it has reached the aging stage (2), and therefore the values of the Hypsometric coefficient are directly related With the period that the pelvis crossed in its temporal cycle and vice versa [21]
The Hypsometric parameter, in addition to being a quantitative and temporal measure of the attic stage reached by the water basin or any part of it, also indicates the amount of rocky materials that are still before geomorphological processes. If the Hypsometric curve is of a convex shape (curved upwards), then this means that the basin is still at the beginning of its pelvic cycle, that is, it is in its youthful stage. Aging), and this parameter is considered one of the best and most accurate quantitative parameters that shows the prevailing

geomorphological relationship represented by water erosion and saltwater by surface runoff.
Horton (1945) identified the downstream stages of the river basin into three stages [22], and accordingly, the values of this coefficient were divided into the following:

([19]) Hassan Ramadan Salama, Origins of Geomorphology, previous source, p. 193.
([20]) Ahmed Abdel-Sattar Al-Azzawi, a previous source, pg. 149.
([21]) Arthur Streller, Shapes of the Earth's Surface, a Geomorphological Study, translated by Wafik Al-Khashab, 1964, p. 207.
([22]) Saadi Abdul-Dulaimi, Hydromorphography of the Wadi Haqlan Basin in the Western Plateau, MA thesis (unpublished), University of Baghdad, College of Arts, 1994, p. 86.

- **Boyhood and youth stage**

If the bulk of the basin area is not eroded by more than (55%), then this stage is called the stage of imbalance due to the increase in the process of water urgency on the sediment, so the basin is in the stage of activity even and absolute erosion.

- **Maturity stage**

If the rocks of the basin are eroded by (45-55%), this means that the basin is going through a stage of maturity, where the basin is in a stage of equilibrium, meaning that the process of water urgency is relatively equal with the process of sedimentation.

- **Aging stage**

If the bulk of the area of the river basin is bare, and by more than (55%) of the total basin area, then the basin is going through an aging stage and that these rocks have been eroded due to their exposure to water erosion, which exceeded the sedimentation process on the two processes of erosion and erosion
The values of the hypometric coefficient can be extracted from the following equation [23]

$$\text{Hypsometric parameter} = \frac{\textit{Relative height}}{\textit{Relative area}}$$

As the relative height is extracted by applying the following equation [24]

$$\text{Relative height} = \frac{\textit{The height of any specific contour line}}{\textit{Max pelvic height}}$$

While the relative area is extracted by applying the following equation [25]

$$\text{Relative space} = \frac{\textit{The area between any contour line and the circumference of the pelvis}}{\textit{The total area of the pelvis}}$$

Each basin of the study area was divided into five areas of hypometric heights and based on the relative height of the basin and its relative area and through the application of the above mathematical equations for calculating the hypometric coefficient for each basin, the results were reached and as

([23]) Asbahiya Younis Al-Mohsen, Geomorphology of the Northern Part of Al-Jazirah Region in Iraq, Ph.D. thesis (unpublished), University of Baghdad, 1991, p. 144.
([24]) Strahar. A.N. Hypsometric (area-altitud) analysis of erosional to pography. Bulletin of the geological society of America, vol 63, 1952, p.1120.
([25]) Stahar, op, cit, p.1120

It is shown in Table (24) that the values of this coefficient for the basins of Jabal Aqrah ranged between (41.53)% in Basin (1) and (59.12)% in Basin (2), as follows:

- Pelvic (1)

The basin goes through the stage of youth, which is the stage of imbalance and according to the Horton division, as the bulk of the basin rocks were not affected by the various erosion processes and that 58.47 % of the total basin area is not eroded, while (41.53) % of its area has been exposed to erosion processes The water salinity is due to this tectonic factor in the region, which led to an increase in the upstream region and a decrease in the downstream region. The rocks play a great influence in the values of this coefficient, as its rocks are weakly resistant to geomorphological processes, and the amount of erosion in the basins depends on several factors represented by the steepness of the rocks, the hardness of the rocks and the time factor, in addition to the volume of water flow and the extent of its impact on the water basin. The results shown by the laboratories confirmed that the activity My salt was able to remove (41.53) % of the pelvic floor. It is a small percentage, and this explains that the rocks of the basin are rocks that are not affected by chemical processes such as oxidation, carbonation, hydration, and salty activity. geological weakness.

- Pelvic (2)

By observing the figure () the curve of the main basin shows that (59.12)% of the basin's rocks have been exposed to erosion, and that only (40.88%) of it is not eroded. Weak resistance to these processes, a stage in which the sedimentation process prevails over the processes of erosion and water erosion, and the high percentage of the area that has been exposed to erosion indicates a high proportion of geomorphological risks in the largest part of the basin, and that the basin is exposed to water erosion and is not free from the risks of flooding, especially in the areas the upper basin of the basin, and the decrease in these values indicates the basin's exposure to demolitions and the movement of materials that accompany severe slopes.

- Pelvic (3)

The value of the Hypsometric coefficient of the basin reached (48.28%), which represents the eroded part, and that (51.72%) of the basin rocks were not affected by the various erosion and erosion processes. Therefore, the basin is going through a stage of maturity, meaning that it is in a state of balance between erosion, erosion and sedimentation. The lower areas formed weak values amounting to (0.45)% at the lowest range (400 - 580) meters above sea level, while the largest value was at the highest point, which amounted to (34.84)% at the upper range of the basin (1120 - 1300) meters above sea level. As shown in Table (24), it can also be noted that the upper areas of the basin represented small areas that reached (2.81) km2 at the previously mentioned higher range, which represents rocky spaces with steep slopes, which is reflected in the increase in the speed of surface runoff in this range.

Conclusions

- By studying the morphometric characteristics, it is clear that the basins of the study area are close to the oval shape, and this is due to the fact that the basins are still passing through at the beginning of their end-cycle.
- The study showed that the study area suffers from the dangers of floods, and the degree of its danger varied from one basin to another. It is of high risk in Basin (1) and of medium risk in the basins of the other study area
- There are three types of drainage patterns, which are: (tree pattern), which is the most prevalent pattern in the study area (orthogonal pattern) (parallel pattern).

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