Geomorphometric Assessment of the Terrain Characteristics of Al-Sharhani Drainage Basin, Eastern of Misan Governorate, Iraq

Bashar F. Maaroof
Babylon Center for Civilization and Historical Studies (B.C.C.H.S), University of Babylon, Hillah, Babil 51001, IRAQ

ORCID: Bashar F. Maaroof (0000-0002-0859-1728) (orcid.org)

Correspondent Author Email: basharma@uobabylon.edu.iq

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Abstract:

In this paper, the terrain characteristics of Al-Sharhani drainage basin and its secondary basins were studied, which is located in the eastern parts of Misan Governorate in southern Iraq, within the eastern Tigris region. The study was conducted using 5 geomorphometric parameters listed in Table 1. with the use of the SRTM (Digital Elevation Model - DEM) and Landsat ETM+7 satellite image with a resolution of 30 m for the American satellite, as well as 1/50000 1/100000 topographic maps, and 1/250000 geological maps, the Spatial databases were created, using a GIS environment. The results showed that there is a direct influence of natural factors (surface, climate and geological structure) in the formation of the basin's topography features. The results also indicated that the relief ratio was 9.849 m/km, which is a low value that reflects the characteristics of the plateau in the region, and the relative relief value was 3.345 m/km, and the relationship was negative between the drainage basin area and the relative relief values. As well as the hypsometric integration value, which is 0.681 km2 /m, which is a low value because the basin is at the beginning of the geomorphological development stage, the ruggedness number was 0.415 which is a low value due to the low density of the discharge, while the texture ratio was 7.149 streams/km, this value indicates that the basin has a medium texture.

Introduction:

The geomorphometric analysis of river drainage basins include a wide range of geomorphological parameters and mathematical laws, which show the geometric and standard dimensions of the earth's surface shapes associated with river systems (Drăgut et al., 2011). To study the terrain characteristics of the river drainage basin, a set of mathematical equations is used, through which it is possible to measure the geometric dimensions of the landforms resulting from the river geomorphological processes (erosion, transport, and sedimentation), which in total formed the general characteristics of the shape of the drainage basin (Withanage et al., 2015). It reflects the extent of erosion development and its impact on shaping the surface of the earth within the boundaries of the basin and its chronological age, which reflects the severity of the destruction taking place in the river basins on the one hand (Kudnar & Rajasekhar, 2020), and its relationship to the water network and spatial characteristics by determining the amount of water discharge for each basin and the amount of sediments in it, on the other hand (Mahala, 2020), it is also a reflection of the impact of rock types and their structural characteristics, and a good indicator of the basin's evolution and its erosive cycle (Prakash et al., 2019).

The problem statement indicates that the river drainage basin is naturally composed of a varying terrain surface according to the location of the region and the age stage it is passing through, and the research questions revolve around; What are the nature and characteristics of this terrain, and what are the factors that affected it, and what are its standard dimensions? The hypothesis of the research indicates that the terrain of the Al-Sharhani drainage basin was formed during successive stages during the Pleistocene period, and there are geological and climatic factors directly or indirectly responsible for its formation. The research aims to study the terrain characteristics of the Al-Sharhani drainage basin and highlight its standard dimensions to identify the age stage that the basin is going through.

To study the terrain characteristics of the river drainage basins is of great importance from the geomorphological point of view, represented by knowing the standard properties of the terrain and the associated landforms, determining the geomorphological stage that the drainage basin passes through, and understanding the development of the river network of the drainage basins. The research aims to determine the water division line of Al-Sharhani drainage basin and its secondary basins, study the terrain characteristics, through the application of morphometric equations, and identify the natural factors (slope, climate, geological structure) that affected the formation of these characteristics.

Methodology:

Several scientific sources were relied upon to complete the research requirements, including the Landsat ETM+7 satellite image with a resolution of 30 m for the American satellite for the year 2020 issued by the US Department of Defense, and the DEM digital elevation model for the study area with a discrimination ability of 30 m, which was downloaded from the website of the US Geological Survey USGS and 1/50000 and 1/100000 scale topographic maps issued by the Iraqi General Survey Authority and the geological map of the Ali Al-Gharbi plate issued by the Iraqi Geological Survey.

In addition to using the maps of soil, water resources, and natural vegetation to display and explore the natural characteristics of the study area, and using the ARC GIS 10.8 software ARC MAP, basic maps were produced, such as a map of the river drainage network, a contour map, slope levels, a geological map, a cut-off for satellite image, as well as the production of maps of secondary basins, then a spatial match was made

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using the same application for all the above data, where the morphometric variables of the terrain characteristics were analyzed and interpreted after using quantitative methods and using the ARC SCENE application and Surfer V.21 software, a terrain stereogram was created, which had a great role in understanding the basin slopes and river valleys paths and their activity, the erosion, and sedimentation that formed the basin with its terrain characteristics. The spatial relations approach was followed by analyzing the spatial systems including independent or dependent elements and variables and analyzing their spatial connections that led to the formation of the topographical characteristics of the study area. The geomorphometric parameters of the topographic features are listed below:

Table 1. Geomorphometric parameters of the terrain features used in the research.

Parameters	Symbol	Formula	Description	Reference
Total Basin Relief	*(R)*	R = H – h	The vertical distance between the lowest and highest point of the watershed	(Schumm, 1956)
Relief Ratio	*(R_h)*	$R_h = H / L_b$	H: the difference between the highest and lowest levels in the drainage basin. L_b: length of the drainage basin.	(Schumm, 1956)
Relative Relief	*(R_r)*	$R_r = H / P$	P: The length of the perimeter of the drainage basin.	(Schumm, 1956)
Hypsometric Integration	*(H_i)*	$H_i = A / H$	A: Drainage basin area (km^2).	(Strahler, 1952)
Ruggedness Number	*(R_n)*	$R_n = H * D / 1000$	D: Drainage density.	(Strahler, 1957)
Texture Ratio	*(T)*	T = Nu / P	Nu: The number of tributaries in the drainage basin. P: The length of the perimeter of the drainage basin.	(Strahler, 1958)

In addition to the above-mentioned geomorphometric parameters, the Berkeley equation (Maaroof et al., 2021), was used to estimate the expected annual drainage volume for the Al-Sharhani drainage basin, to know the spatial relationship between the geomorphological work of the running surface water and the formation of geomorphometric characteristics and the terrain system in general. The equation is described as below:

$$\mathbf{R = (CIS)^{1/2}\,(W / L)^{0.45}}$$

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Where:

R: The amount of expected annual runoff in the drainage basin (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 by 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 the valley from upstream to downstream, measured with Arc Map 10.8 software.

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

Study Area:

Al-Sharhani drainage basin is located in the eastern part of Misan Governorate, within the (Al-Jazira Eastern Region). It is bordered on the north by the Iraqi-Iranian border, and on the south and east, it is bordered by the western parts of the Abu Ghraibat valley within the midst of Al-Zubaidat area, on the west side, it is bounded by the main course of the Al-Teeb River Basin, which flows into Al-Sanaf Marsh, noting that the Al-Teeb River is the main estuary of Al-Sharhani drainage basin, Al-Sharhani drainage basin is located within longitude (47°09′4.1″E – 47°18′43.9″E) and latitude (32°20′35.4″N – 32°29′47.3″N) (Fig. 1). Al-Sharhani drainage basin is one of the seasonal basins in the eastern Tigris region (Maaroof, 2017), it has an area of 129.41 km^2 and a perimeter of 56.79 km, with a slope rate of 2 m per 1 km, the total length of the basin reached 19.294 km, starting from its upper sources near the Iraqi-Iranian border and ending at its mouth in Al-Teeb river basin to the western part of the Al-Band hills, the highest elevation of the basin reached 240 m, and the lowest was 50 m above sea level (Fig. 2). The basin flows from the northeast towards the southwest and is characterized by drought at present, and the water does not flow into it except after rainfalls in the form of irregular torrential quantity that worked to form its geomorphological, hydrological, and geomorphometric characteristics.

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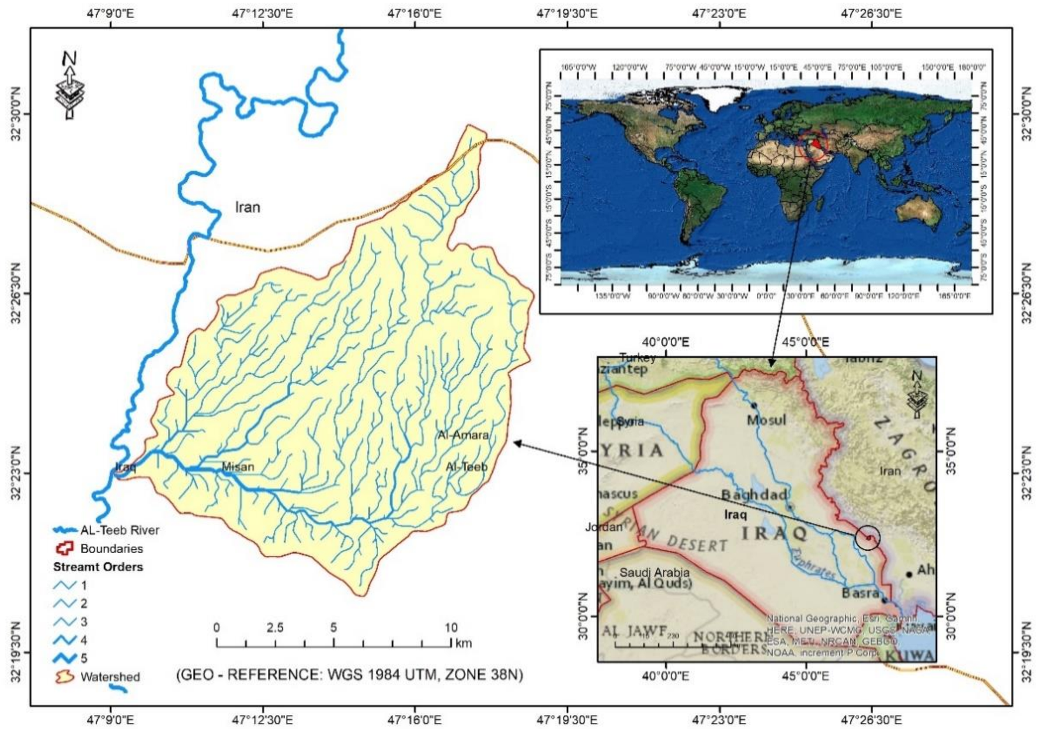

Figure 1. Al-Sharhani drainage basin site, eastern of Misan Governorate, Iraq.

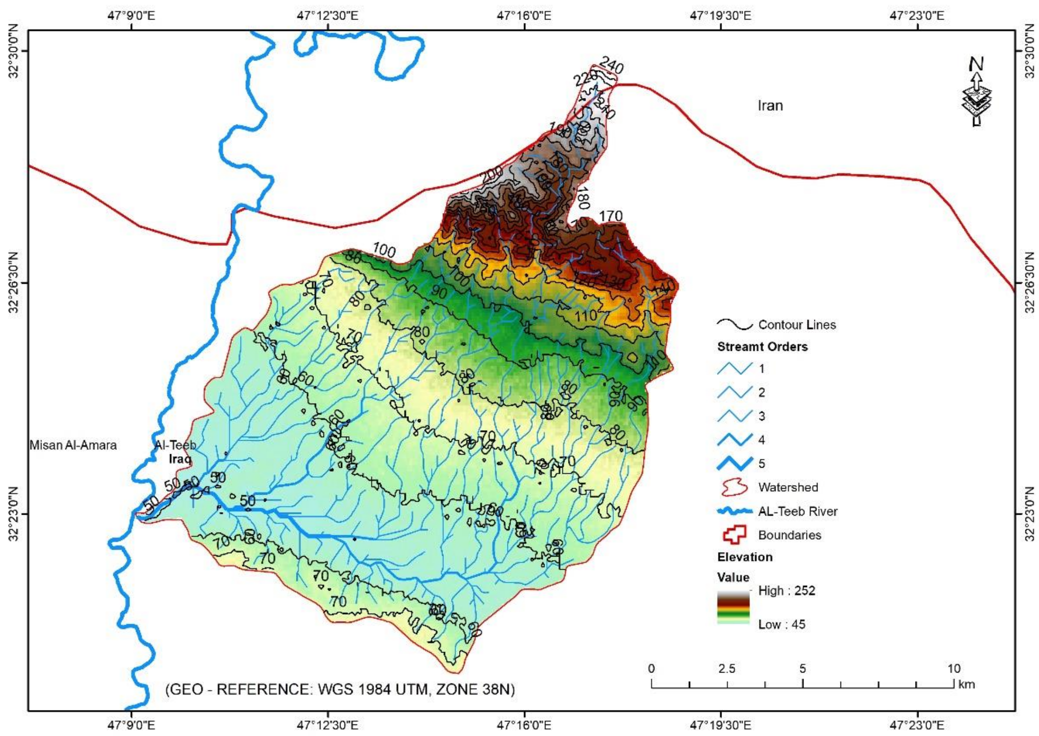

Figure 2. Contour lines of Al-Sharhani drainage basin.

Al-Sharhani drainage basin has been divided into three levels of slope in line with the geomorphological stage that the basin goes through in any of its parts, known as cycles (youth, maturity, and old age) according to the theory of William Morse Davis known as the geomorphological cycle, the first region, which represents the youth stage, is located between 240-140 m above sea level, and the second region, which represents the maturity stage, is located at an altitude ranging between 140-80 m above sea level, and as for the third region, which represents the aging stage, it is located at an altitude ranging between 80-50 m above sea level (Figures 3 and 4). Al-Sharhani drainage basin is characterized by being of a hilly character of moderate height, (Ibrahim, 2019), the basin was also distinguished by its different levels in its different parts, as for the levels in the central parts of the basin, they were also different, ranging from contour lines 100-65 m above sea level, The sections of the study area vary in height in all its parts, and the reason for this is due to factors related to the land structure and the quality of the rocks, as well as the great influence of the tectonic factor and climate.

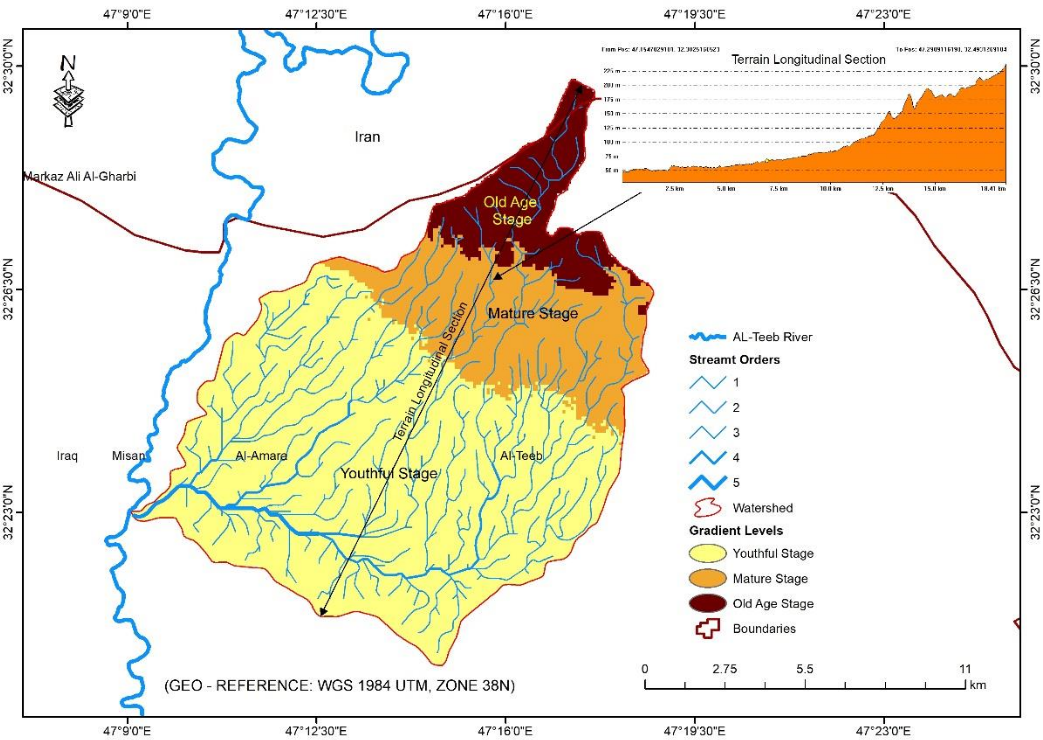

Figure 3. Terrain gradient levels of Al-Sharhani drainage basin.

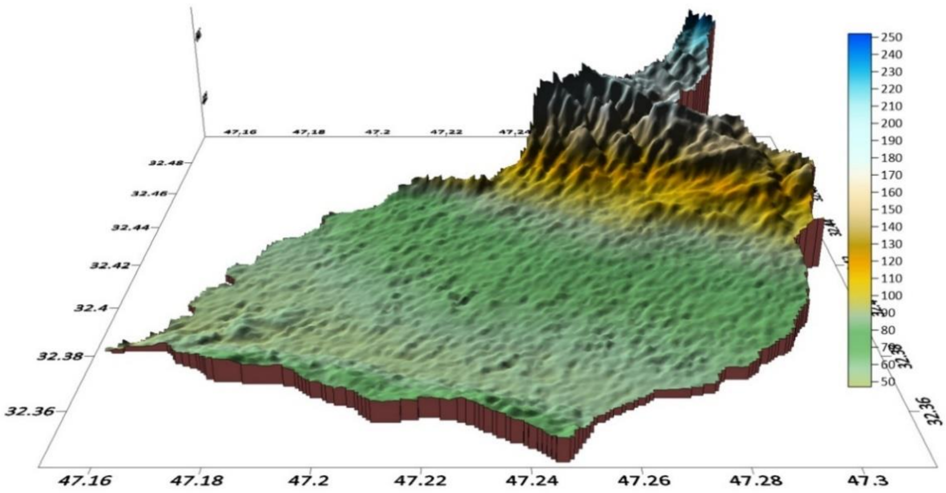

Figure 4. 3D terrain view of the Al-Sharhani drainage basin.

Al-Sharhani can be divided into a group of secondary basins:

1. Al-Sharhani Secondary Watershed (1) (W1): This basin is located in the western part of the study area, and its area is (21.681) km, while its perimeter reached 25.656 km and its maximum length was (9.876) km, (Table 2) and (Figure 5).

2. Al-Sharhani Secondary Watershed (2) (W2): This basin is located in the central parts of the study area, specifically to the east of the first secondary basin, and its area is 16.162 km, while its perimeter has reached 26.984 km, and its maximum length is It reached 11.320 km.

3. Al-Sharhani Secondary Watershed (3) (W3): This basin is located in the central parts of the study area, specifically to the east of the second secondary basin, and its area is 14.372 km, while its perimeter has reached (27) km, and the maximum length is It has reached 11.421 km.

4. Al-Sharhani Secondary Watershed (4) (W4): This basin is located in the eastern parts of the study area, and its area is 63.494 km, while its perimeter is reached 50.069 km and its maximum length was 18.423 km.

5. Al-Sharhani Secondary Watershed (5) (W5): This basin is located in the southern and southwestern parts of the study area, and its area is 13.72 km, while its perimeter has reached 29.534 km, and its maximum length has reached 9.906 km.

Table 2. The area, perimeter, and length of Al-Sharhani drainage basin and its secondary basins.

The name of the watershed	Area (km^2)	Perimeter (km)	Length (km)
Al-Sharhani Secondary Watershed (1) (W1)	21.681	25.656	9.876
Al-Sharhani Secondary Watershed (2) (W2)	16.162	26.984	11.320
Al-Sharhani Secondary Watershed (3) (W3)	14.372	27	11.421
Al-Sharhani Secondary Watershed (4) (W4)	63.494	50.069	18.423
Al-Sharhani Secondary Watershed (5) (W5)	13.72	29.534	9.906
Al-Sharhani total catchment area	129.41	56.79	19.294

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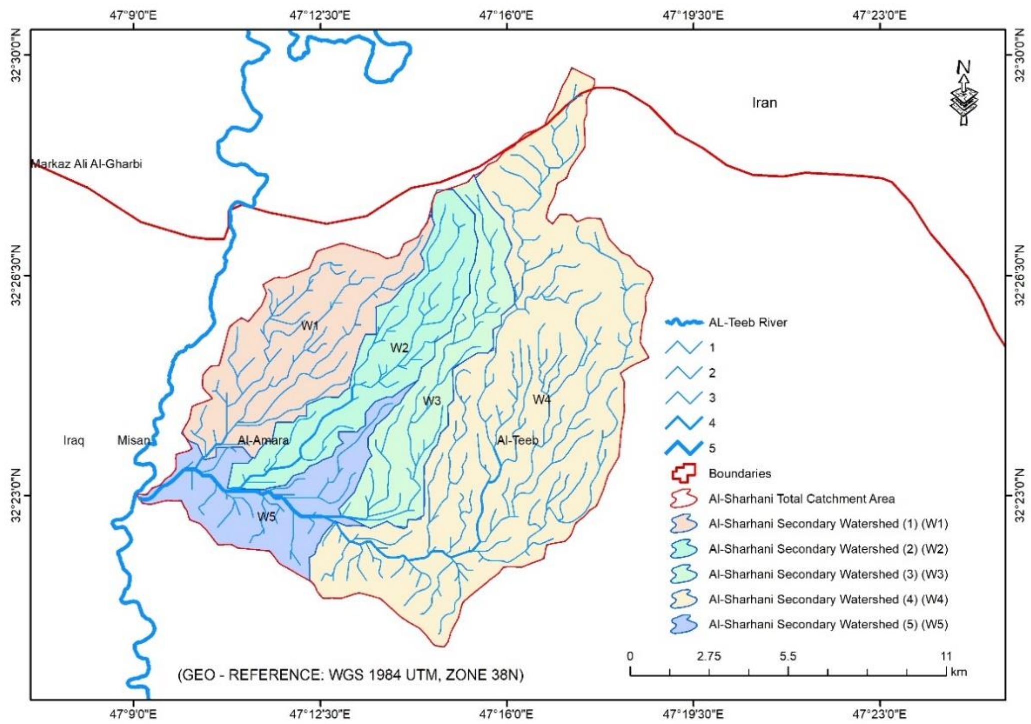

Figure 5. Al-Sharhani main drainage basin and its secondary basins.

Climate is one of the geomorphological factors affecting the formation of the terrain characteristics of the river drainage basins, and this is evident by understanding the influence of the main elements of climate (temperature, rain, and wind) (Maaroof, 2022), as these elements affect the rates of weathering, erosion, receding slopes, changing river channels and their development to higher levels (Prakash et al., 2016). It also affects the processes of erosion and river sedimentation, and its difference in time and space, in addition to the influence of other natural factors, results in different river basins in their landforms and geomorphometric characteristics (Maaroof & Kareem, 2020).

The data in Table 3 indicate that the temperature in the study area increases in the summer months (June, July, and August) and reaches its highest rate in July, reaching 47.2 m. As for the winter season, it is characterized by relative moderation in temperature with Its tendency is declining, as it ranges in this season (December, January, and February) between 20.1 m, 16.2 m, and 19.5 m, respectively. The rain is also characterized by being seasonal and fluctuating, as it begins to fall in October and continues until May when it reached 5.7, 14.5, 19.7, 34.5, 22.6, 31.7, 13.3, and 2.1 mm respectively, and their annual total is 142 mm. As for the winds, they do not differ in anything from the wind blowing over the central and southern regions of Iraq, where its annual rate reached (3.6) m/s, and its speed increases in the summer months, reaching in the months (June, July, and August) (5), (4), (5.4) and (4.7) m/s, respectively. Its average decreases in the winter months (November, December, and January) to reach (2.8), (2.7), and (2.5) m/s, respectively.

Table 3. Data of climatic elements (temperature, rain, wind) recorded in Al-Amarah Climatic Station for the period 1980-2009.

Months	temperature (°C)	Rainfall (mm)	wind (m/s)
January	16.2	34.5	2.5
February	19.5	22.6	2.7
March	24.2	31.7	2.7
April	30.9	13.3	3.4
May	40.7	2.1	4.5
June	45.7	–	5.4
July	47.2	–	5.4
August	45.2	–	4.7
September	42.1	–	3.7
October	35.2	5.7	3.1
November	25.7	14.5	2.8
December	20.1	19.7	2.7
Average	32.7	11.8	3.6

The area in which Al-Sharhani drainage basin is located is characterized by being semi-dry, which led to the basin relying on rainwater sources that are characterized by seasonality and fluctuation, as precipitation usually starts from October to May, as the water flows in the basin if the rain continues for a long time and was rainstorm covers all parts of the basin. To find out the expected annual runoff in the basin, the Berkeley equation, which depends on the elements of climate and terrain, was used. Through the data contained in Table (4), it is clear that the expected annual drainage of the Al-Sharhani drainage basin has reached (0.0028) billion m3 annually, and the secondary basins varied slightly in the volume of water drainage, and this depends on the amount of rainfall and the variance in the area, the rate of the width of the stream and the rate of regression, that is, the equation is direct, the more the values of these variables increase the annual flow rate and vice versa. While the Al-Sharhani drainage basin 1 reached (0.0014) billion m3 annually, the Al-Sharhani drainage basin 2 reached (0.0012) billion m3 annually.

Table 4. The expected annual flow volume of Al-Sharhani drainage basin and its secondary basins.

Name of the watershed	Area (km2)	Length (km)	Width (km)	Annual rainfall (mm)	slope (m/km)	Rain amount (billion /m^3)	Width /Length (m)	Expected annual flow (m^3)
Al-Sharhani Secondary Watershed (1) (W1)	21.68	9.87	3.54	142	0.607	0.003	2.78	0.0014
Al-Sharhani Secondary Watershed (2) (W2)	16.16	11.32	2.05	142	0.848	0.002	5.51	0.0012
Al-Sharhani Secondary Watershed (3) (W3)	14.37	11.42	1.18	142	0.735	0.002	9.63	0.0013
Al-Sharhani Secondary Watershed (4) (W4)	63.49	18.42	5.50	142	0.553	0.009	3.34	0.0013
Al-Sharhani Secondary Watershed (5) (W5)	13.72	9.90	2.98	142	0.151	0.001	3.34	0.0013
Al-Sharhani total catchment area	129.41	19.29	11.52	142	0.590	0.018	1.67	0.0028

Geological studies indicate that the study area is located within the unstable pavement, and is completely located within the eastern parts of the Mesopotamian region (Sissakian & Fouad, 2015). Several geological formations are spread in it, the most important of which are the Muqdadiyah and Bay Hassan formations, this formation is spread in the northern and northeastern parts, its formation dates back to the Lower Pleistocene era (Figure 6). It may be within a riverine sedimentation environment similar to the deposition environment of the Bai Hassan Formation, and it includes well-sorted sediments that were formed as a result of the area's elevation and the continued effectiveness of erosion agents (Hatem K.S. Al-Jiburi, 2005). The sand cover deposits are also spread to the south and southeast of the first formation in the form of thin, intermittent sand sheets that are collected over the sediments of the floodplain, and the types of dunes in it vary according to the factors of their formation, including the dunes (barchan, longitudinal and transverse) (Fadhil Kassim Al-Kaabi, 2009). As well as the sediments of the flood plain, which spread in the form of a longitudinal strip that extends northwest to southeast, and is located to the south and southwest of the previous formation, and this formation dates back to the Holocene era, and its most important components are sand, silt, and alluvial clay (Maitham Ali Al-Ghanmi, 2015).

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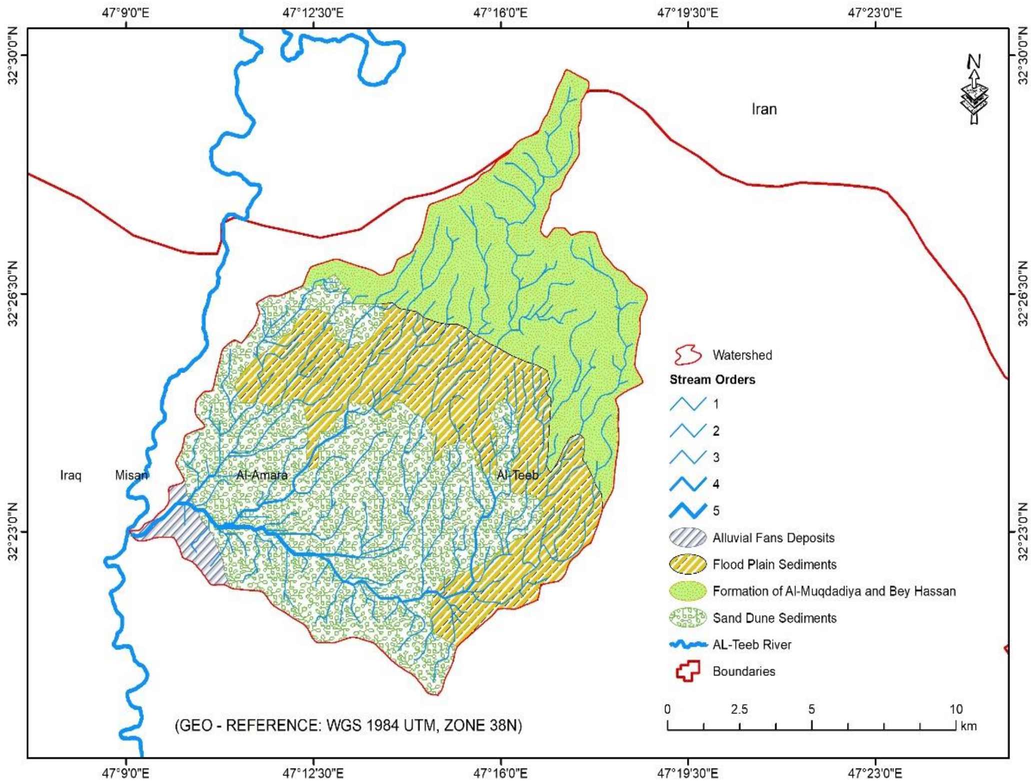

Figure 6. Geological map of Al-Sharhani drainage basin.

Results and Discussion:

1. Relief Ratio: Using this factor, a measure of the slope of the main basin is obtained, which is obtained by dividing the topography of the basin by the height difference between the highest and lowest points of the basin (Yunus et al., 2014). The length of the basin, which is proportional to the value of the terrain, is also a good indicator of the amount of sediment transported (Enea et al., 2014). The higher the slope rate, the activity, and speed of the erosion process will lead to the formation of multiple landforms (Rama, 2014). The decrease indicates that the activity of the water erosion process is insufficient and the wind erosion process is increased (Aadil Hamid, 2013).

The data contained in Table 5 indicate that the relief ratio of Al-Sharhani total catchment area reached 9.849 m/km, which is a high percentage that reflects the characteristics of the plateau region as it represents one of the areas of the edges of the Iranian plateau, it is considered a high percentage compared to other basins in the dry areas. The proportions of this coefficient varied in the secondary watersheds, reaching 14.134 m/km in Al-Sharhani secondary watershed (2) (W2) which is the highest value, and it reached 2.525 m/km in Al-Sharhani secondary watershed (5) (W5), which is the lowest value. The remaining values in other secondary watersheds differed from that, as the secondary drainage basins (W1, W3, and W4) have reached their values from this parameter (10.131, 12.259, and 9.229 m/km) for each of them, respectively (Figures 7 – 11).

The high value of relief ratio of Al-Sharhani drainage basin, due to the increase in the difference between the level of the highest point and the lowest point in the basin, which reached 100 m, and the small area of 129.41 km, and the variation of geological conditions and rocky diversity in all parts of the river drainage basin, as indicated by the increased activity the geomorphology of the basin, the retraction of the dividing line of water. The variation in the areas of the secondary drainage basins of Al-Sharhani, affected the variation in relief ratio, basins with large areas have low ratios of this coefficient and vice versa. The geological structure also affected the variation in the ratios of this factor, as the basins that have a high rate of erosion are characterized by solid rocks that are resistant to various erosion processes.

Table 5. General terrain characteristics of Al-Sharhani drainage basin and its secondary basins.

Name of the watershed	Length of Watershed (km)	The highest point (m)	The lowest point (m)	Total Basin Relief (m)	Relief Ratio (m/km)	Gradient (m/km)	Drainage Density (km/km2)	Numbers of Valleys
Al-Sharhani Secondary Watershed (1) (W1)	9.87	150	50	100	10.131	0.607	2.222	68
Al-Sharhani Secondary Watershed (2) (W2)	11.32	210	50	160	14.134	0.848	2.166	50
Al-Sharhani Secondary Watershed (3) (W3)	11.42	200	50	140	12.259	0.735	2.242	45
Al-Sharhani Secondary Watershed (4) (W4)	18.42	240	70	170	9.229	0.553	2.183	192
Al-Sharhani Secondary Watershed (5) (W5)	9.90	75	50	25	2.525	0.151	2.129	51
Al-Sharhani total catchment area	19.29	240	50	190	9.849	0.590	2.188	406

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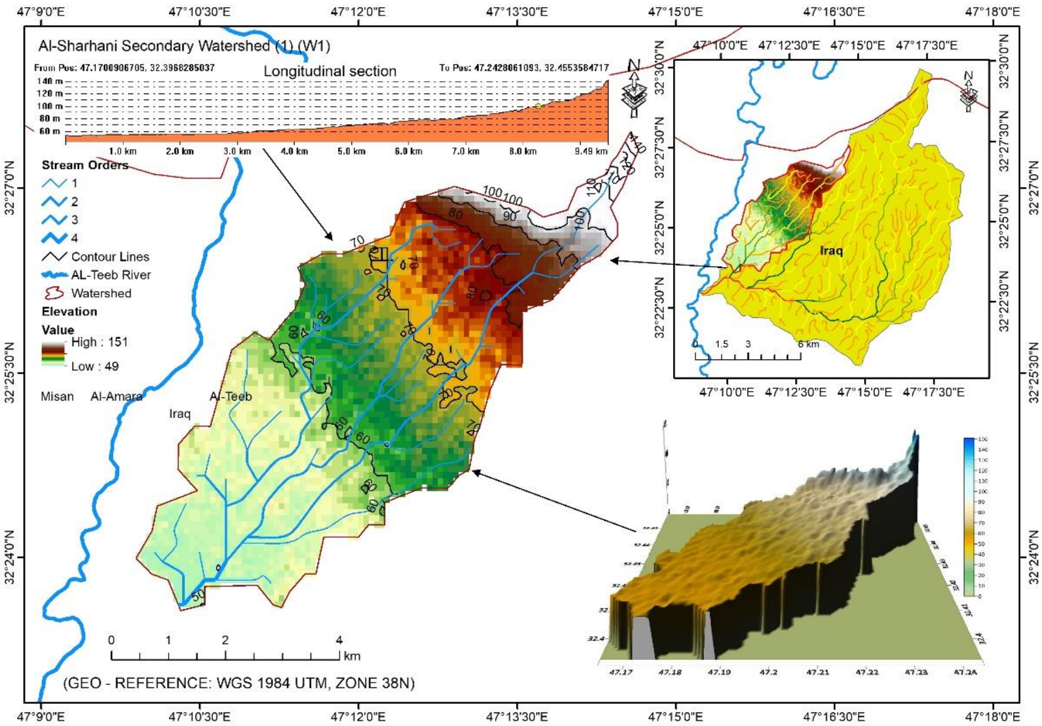

Figure 7. Terrain dimensions of Al-Sharhani secondary watershed (1) (W1).

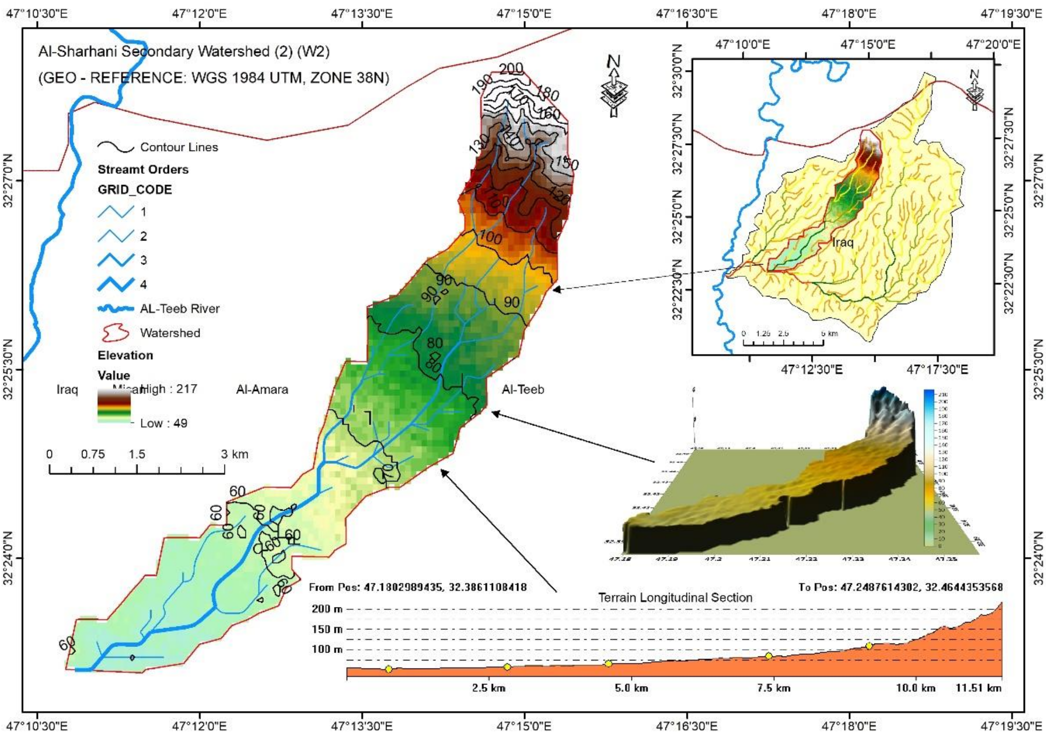

Figure 8. Terrain dimensions of Al-Sharhani secondary watershed (2) (W2).

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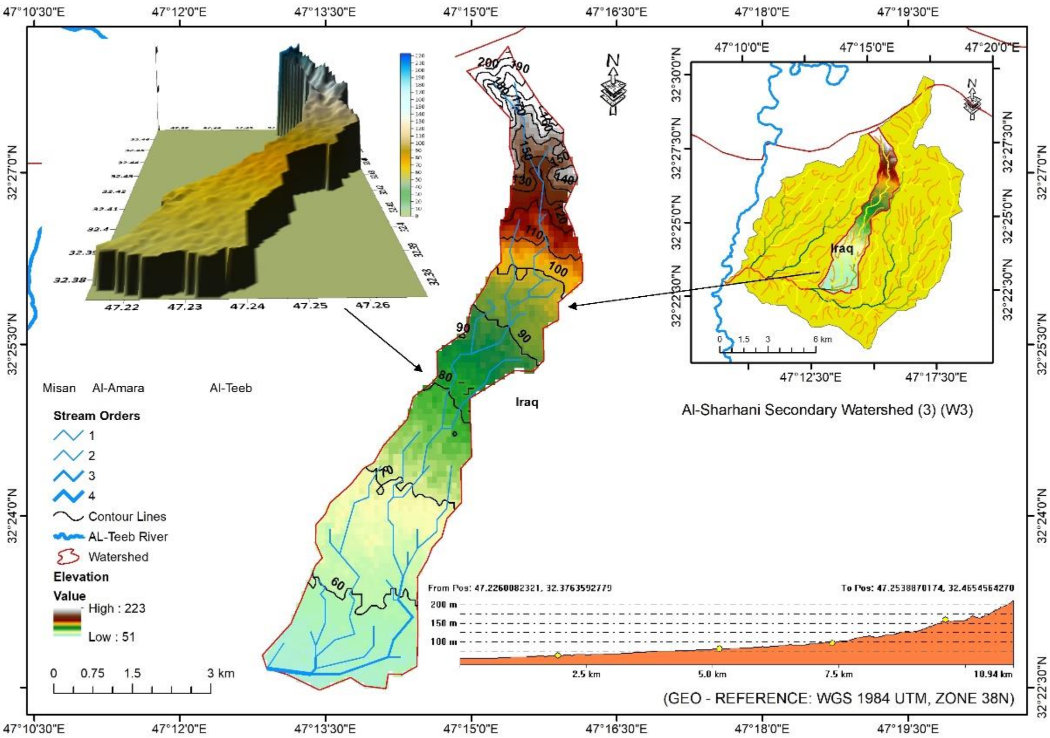

Figure 9. Terrain dimensions of Al-Sharhani secondary watershed (3) (W3).

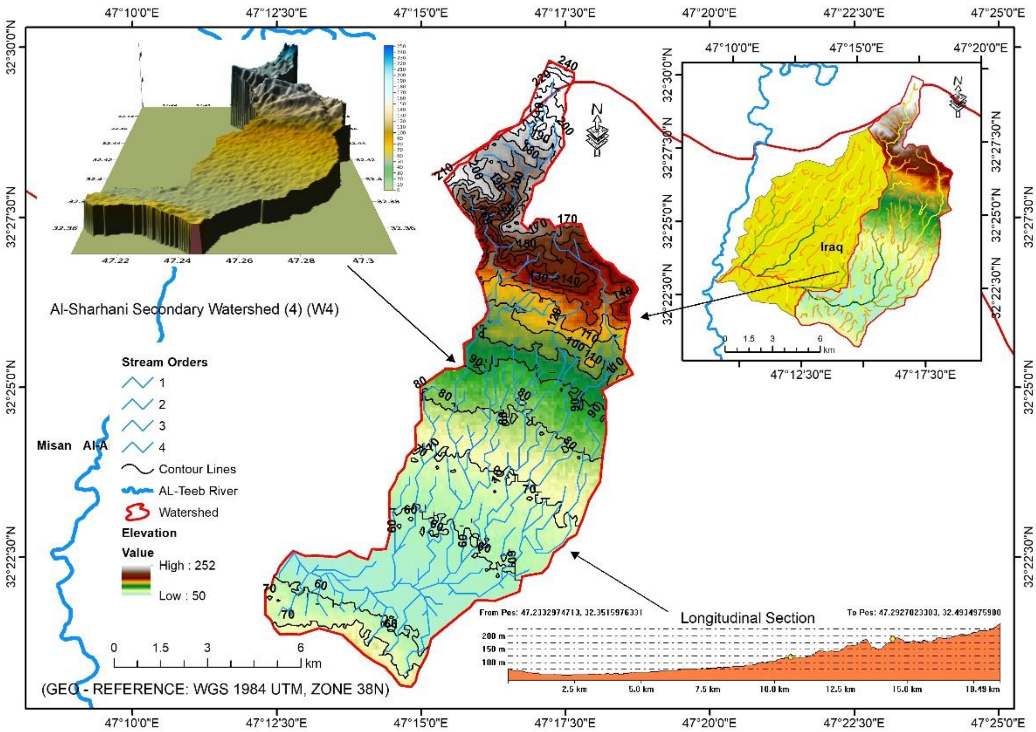

Figure 10. Terrain dimensions of Al-Sharhani secondary watershed (4) (W4).

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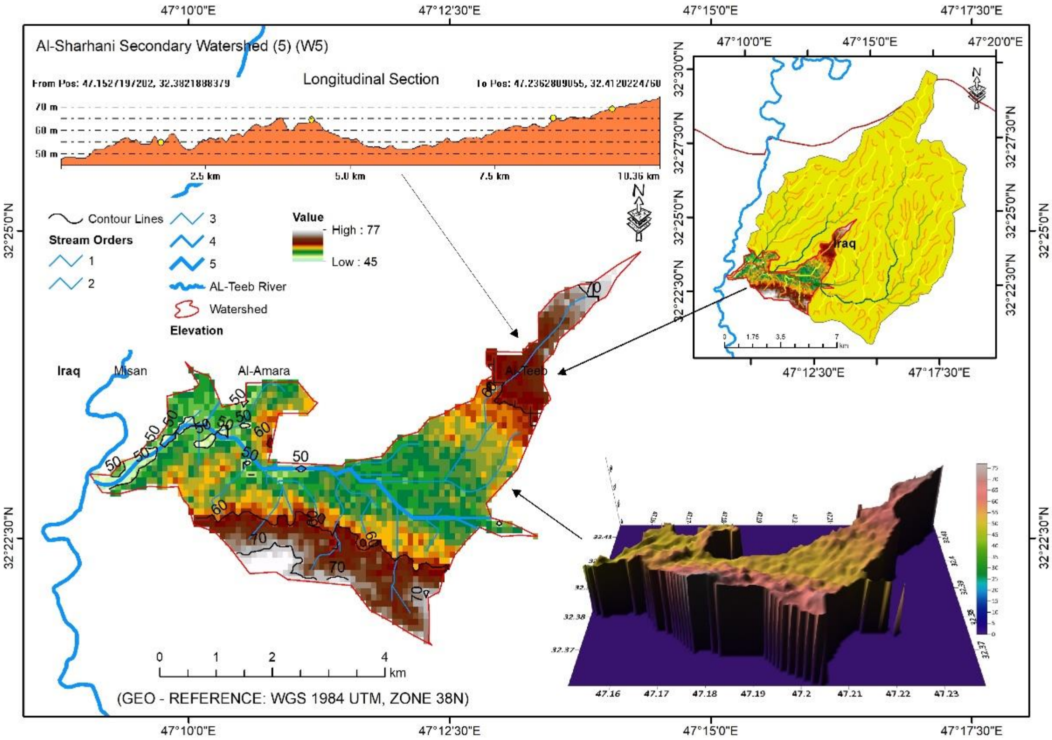

Figure 11. Terrain dimensions of Al-Sharhani Secondary Watershed (5) (W5).

2. <u>Relative Relief</u>: This parameter shows the relationship between the topographic extent (the difference between the highest and lowest point inside the drainage basin), and the extent of the drainage basin perimeter. In the case of constant climatic conditions (Rai et al., 2014), we find a negative correlation between the values of this coefficient and the degree of rock resistance to erosion processes.

The data presented in Figure 12 indicate that the relative relief value of the total Al-Sharhani drainage basin was 3.345 m/km, with the values converging for the secondary Al-Sharhani drainage basins 1 and 3 reaching 3.897 and 3.395 m/km, respectively. While the value increased in the secondary drainage basin of Al-Sharhani 2 to reach 6.262 m/km. Then comes the second order for high values, the secondary drainage basin of Al-Sharhani 3, with a relative relief value of 5.185 m/km. But in the last order comes Al-Sharhani drainage basin 5, where its value from this coefficient is 0.846 m/km. There is a negative relationship between the area of the drainage basin and the relative relief values, where small basins recorded a high theme of this coefficient, and the opposite is true for large area basins that worked to adjust the slopes of their surface and reduce the terrain range, because they made a great way in the stage of river erosion. The reason for the high value of this coefficient in the secondary drainage basin of Al-Sharhani 2 is mainly due to the high degree of resistance of the rocks to erosion processes. It should be noted that the rates of erosion to which the total drainage basin was exposed in its various parts were relatively different between the source and the estuary according to the variation of the rocky nature, which led to a variation in the basin areas, and consequently the variation in the values of this coefficient in all secondary basins.

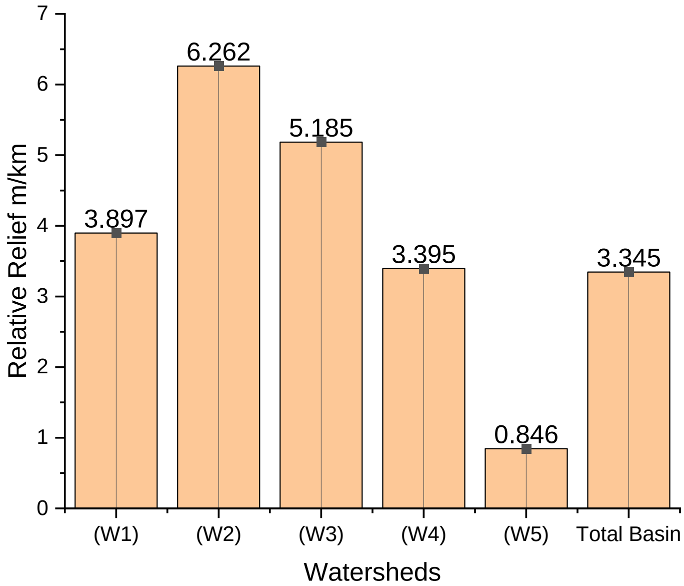

Figure 12. Relative relief of Al-Sharhani drainage basin and its secondary basins.

3. <u>Hypsometric Integration</u>: Using this parameter, it is possible to know the topography of the surface of the drainage basin, in addition to the possibility of determining the time taken by the basin from the Davis erosion cycle (Strahler, 1954). The high values of this coefficient indicate an increase in the area of the drainage basins, and a decrease in their terrain range, which indicates the age of these basins (Yunus et al., 2014), there is a direct relationship between the values of this coefficient and the period of time that the basin traveled from the erosion cycle, and vice versa (Strahler, 1952).

The value of the hypsometric integration of Al-Sharhani drainage basin was 0.681 km^2/m (Fig. 13), which is an average indicator indicating the relative expansion of the drainage basin and its progression in the erosion cycle. The secondary drainage basins varied in the values of this coefficient, it reached 0.548 km^2/m in the secondary drainage basin of Al-Sharhani 5, which is the highest value recorded for the secondary drainage basins. It also amounted to 0.101 km^2/m in Al-Sharhani secondary drainage basin 2, which is the lowest value at the level of all secondary drainage basins. As for the rest of the secondary basins, they varied in the values of this coefficient and ranged between high and low values.

The above results indicated that there is a variation in the values of the hypsometric integration of the secondary drainage basins of Al-Sharhani, as the decrease in the values of this coefficient in some basins indicates that they are newly formed valleys of small area, and they are at the beginning of the geomorphological development stage, as the drought conditions realized them before the progress in erosion cycle. While the high values of this coefficient in some basins indicate the expansion of their areas and their progress in the erosion cycle.

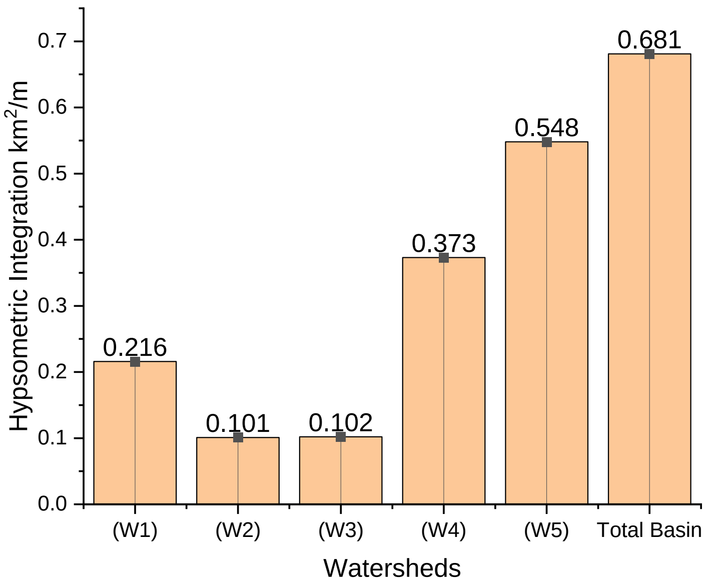

Figure 13. Hypsometric integration of Al-Sharhani drainage basin and its secondary basins.

Strahler has indicated that the value of the hypsometric integration is high during the young phase of the geomorphological cycle, ranging from 0.6 - 0.8 where the valley sides are steep. In the maturity stage, the value of this coefficient ranges between 0.4 - 0.6, as a result of the occurrence of terrain settlement processes of the valley surface and the removal of isolated blocks. Hypsometric integration values decrease in the aging stage to reach 0.125, where the terrain range is large at this stage. By analyzing the data contained in Figure 13, it is clear that Al-Sharhani drainage basin is going through the youth stage, and is on its way to entering the stage of maturity. Several factors have controlled this, including the nature of the terrain, the size of the river basin, the density of drainage, the climatic conditions, and the type of rock.

4. Ruggedness Number: Using this parameter, it is possible to know the relationship between the topography of the drainage basin and its longitudinal drainage density (Rama, 2014). The values of this parameter vary during the phases of the geomorphological cycle, as its values decrease at the beginning of the cycle, then begin to gradually increase until they reach their maximum at the beginning of the stage of maturity, and then decrease again at the stage of aging and the end of the dead cycle (Mahala, 2020). Strahler (1952), indicated that the values of this coefficient vary between 0.06 for the basins of low terrain and more than one true for the basins of high terrain.

The degree of ruggedness of the main Al-Sharhani drainage basin was 0.415, which is an average percentage indicating that the length of the basin's courses increased despite the increase in its area. As for the secondary drainage basins, they varied in the values of this coefficient, while it reached 0.371 in the secondary Al-Sharhani drainage basin (4) which is the highest value, and it reached 0.053 in the secondary Al-Sharhani drainage basin (5) which is the lowest value. The values of the rest of the secondary basins varied from this range, reaching 0.222, 0.346 and 0.313 for the secondary drainage basins of Al-Sharhani (1), (2) and (3), respectively (Figure 14).

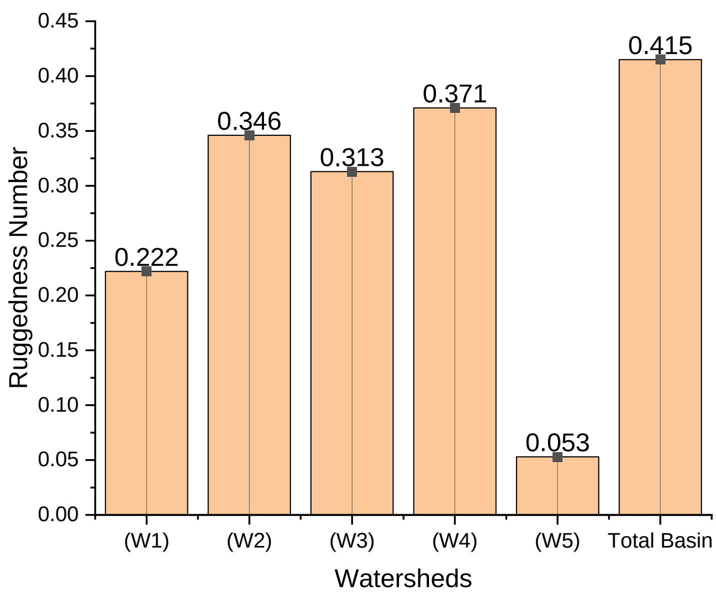

Figure 14. Ruggedness number of Al-Sharhani drainage basin and its secondary basins.

The above results indicate a relative decrease in the roughness values of the Al-Sharhani drainage basin and its secondary basins, due to the low density of river drainage resulting from the small number of waterways and the small area, as well as the occurrence of the drainage basin at the beginning of its geomorphological cycle. The ruggedness number increase with the increase in the terrain of the basin, in addition to the increase in the lengths of the river courses at the expense of the area of the drainage basin, and those all-secondary drainage basins have lower roughness values than the roughness of the main drainage basin, due to the increase in the terrain range, as no secondary basin can reach this number.

5. <u>Texture Ratio</u>: Using this parameter, it is possible to know the degree of intersection of the surface of the drainage basin by the river drainage network streams. In other words, knowing how close or farther the streams of the river drainage network are from each other, regardless of their lengths. The texture ratio is affected by a number of natural factors, including: climate, rocky structure, soil type, and vegetation cover (Magesh et al., 2011). Class (Smith, 1950) the texture ratio to four types: (0-4) coarse, (4-10) medium, (10-15) fine, (greater than 15) very fine.

Al-Sharhani drainage basin has a texture ratio of 7.149 streams/km, and thus it is classified in the medium category. The secondary basins varied from this value, as it reached 3.834 stream/km for the secondary Al-Sharhani drainage basin 4, which is the highest value, and 1,666 stream/km for the secondary Al-Sharhani drainage basin 3, which is the lowest value.

Through the above results, it is clear that the secondary drainage basins of Al-Sharhani are classified under the coarse texture ratio category, due to the small number of 406 tributaries, and the increase in the length of the drainage basin perimeter, as they pass at the beginning of the geomorphological stage. This is a clear indication of the similar geological and climatic conditions of the secondary drainage basins.

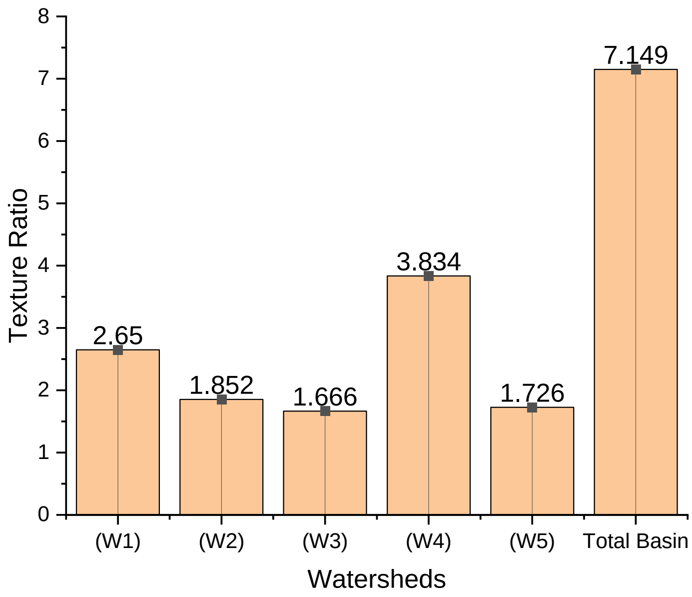

Figure 15. Texture Ratio of Al-Sharhani drainage basin and its secondary basins.

<u>Conclusions</u>:

Al-Sharhani drainage basin is one of the seasonal river basins in the East Tigris region, east of Misan Governorate in southern Iraq. It is characterized by relatively similar climatic and geological conditions, which affected the formation of its terrain characteristics. The relief ratio of the main Al-Sharhani drainage basin reached 9.849 m/km, which is a low rate because the basin is located within a hilly region extending from the Iranian plateau to the east. While the secondary basins varied in the values of this coefficient and ranged between 14.134 m/km for Al-Sharhani drainage basin 2 which is the highest value, and 2.525 m/km for the secondary Al-Sharhani drainage basin 5 which is the lowest value, as the area as a factor affecting this variation, as well as the impact of the geological structure and climate.

The relative relief values varied at the level of the secondary basins between high and low. The secondary drainage basin of Al-Sharhani 2 recorded a rate of 6.262 m/km, which is the highest value, while the value of this parameter was 0.846 m/km in the secondary Al-Sharhani basin 5, which is the lowest value.

The hypsometric integration value was 0.681 km2/m for the total Al-Sharhani drainage basin, which is an average value, indicating the slight progress in the erosion cycle. The values of the secondary basins varied from that, reaching 0.548 km2/m2 for Al-Sharhani Basin Secondary 5, which is the highest value, while it reached 0.101 km2/m2 for Al-

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Sharhani Secondary Basin 2 which is the lowest value. As the smallness of the area and the modernity of the formation led to a decrease in the values of this coefficient in some basins.

The ruggedness number reached 0.415 for the total Al-Sharhani drainage basin, which is an average value indicating an increase in the number of water courses relative to the area, and there was a variance in the values of this coefficient for the secondary basins, it reached 0.371 for the secondary Al-Sharhani basin 4, which is the highest value, while it reached 0.053 for the secondary Al-Sharhani basin 5, which is the lowest, the low density of drainage and the small area are what are behind the low values of some secondary basins.

The texture ratio was 7.149 streams/km for the total Al-Sharhani drainage basin, which is an average. The secondary basins differed from that, as it reached 3.834 stream/km for the secondary Al-Sharhani basin 4, which is the highest value, while it reached 1,666 stream/km for the secondary Al-Sharhani basin 3, which is the lowest value. The secondary basins of Al-Sharhani are classified under the coarse texture, due to the small number of 406 tributaries, and the increase in the length of the perimeter of the drainage basin.

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References

Aadil Hamid, R. A. H. (2013). Application of Morphometric Analysis for Geo-Hydrological Studies Using Geo-Spatial Technology –A Case Study of Vishav Drainage Basin. *Journal of Waste Water Treatment & Analysis*, *04*(03). https://doi.org/10.4172/2157-7587.1000157

ARTHUR N. S. (1958). DIMENSIONAL ANALYSIS APPLIED TO FLUVIALLY ERODED LANDFORMS. *BULLETIN OF THE GEOLOGICAL SOCIETY OF AMERICA*, *69*(7), 279–300. https://doi.org/10.1130/0016-7606(1958)69

Drăgut, L., Eisank, C., & Strasser, T. (2011). Local variance for multi-scale analysis in geomorphometry. *Geomorphology*, *130*(3–4), 162–172. https://doi.org/10.1016/j.geomorph.2011.03.011

Enea, A., Romanescu, G., Iosub, M., Stoleriu, C. C., & Hapciuc, O.-E. (2014). The relation between the morphometric characteristics and river network of the Tazlău basin, hierarchised according to the Horton-Strahler system. *2nd International Conference - Water Resources and Wetlands*, 59–66.

Fadhil Kassim Al-Kaabi. (2009). *Hydrogeochemistry and evaluation some Selected wells,NorthEast Misan Governorate*. University of Basrah.

Hatem K.S. Al-Jiburi. (2005). *Hydrogeological and Hydrochemical Study of Al-Amara Quadrangle* (p. 33). State Company of Geological Survey and Mining.

Ibrahim, S. A. R. (2019). MORPHOMETRIC ANALYSIS OF THE AL-TEEB RIVER BASIN, SE IRAQ, USING DIGITAL ELEVATION MODEL AND GIS. *Iraqi Bulletin of Geology and Mining*, *15*(1), 59–69.

Kudnar, N. S., & Rajasekhar, M. (2020). A study of the morphometric analysis and cycle of erosion in Waingangā Basin, India. *Modeling Earth Systems and Environment*, *6*(1), 311–327. https://doi.org/10.1007/s40808-019-00680-1

Maaroof, B. F. (2017). Geomorphological characteristics of the eastern region of the Tigris between the Shihabi and the Hawizah marsh in southeastern Iraq. *Journal of Misan Researches*, *13*(26), 366–390.

Maaroof, B. F. (2022). GEOMORPHOMETRIC ASSESSMENT OF THE RIVER DRAINAGE NETWORK AT AL-SHAKAK BASIN (IRAQ). *Journal of the Geographical Institute "Jovan Cvijić" SASA*, *72*(1), 1–13. https://doi.org/https://doi.org/10.2298/IJGI2201001M

Maaroof, B. F., Al-abdan, R. H., & Kareem, H. H. (2021). Geographical Assessment of Natural Resources at Abu-Hadair Drainage Basin in Al-Salman Desert, Southern Iraq. *Indian Journal of Ecology*, *48*(3), 797–802.

Maaroof, B. F., & Kareem, H. H. (2020). Water erosion of the slopes of tayyar drainage Basin in the desert of Muthanna in Southern Iraq. *Indian Journal of Ecology*, *47*(3), 638–644.

Magesh, N. S., Chandrasekar, N., & Soundranayagam, J. P. (2011). Morphometric evaluation of Papanasam and Manimuthar watersheds, parts of Western Ghats, Tirunelveli district, Tamil Nadu, India: a GIS approach. *Environmental Earth Sciences*, *64*(2), 373–381.

Mahala, A. (2020). The significance of morphometric analysis to understand the hydrological and morphological characteristics in two different morpho-climatic settings. *Applied Water Science*, *10*(1), 1–16. https://doi.org/10.1007/s13201-019-1118-2

Maitham Ali Al-Ghanmi. (2015). *Hydrogeological Assessment Study of Al-Teeb Basin, East of Misan Governorate* (p. 54). Ministry of Water Resources.

Prakash, K., Mohanty, T., Singh, S., Chaubey, K., & Prakash, P. (2016). Drainage morphometry of the Dhasan river basin, Bundelkhand craton, central India using remote sensing and GIS techniques. *Journal of Geomatics*, *10*(2), 121–132.

Prakash, K., Rawat, D., Singh, S., Chaubey, K., Kanhaiya, S., & Mohanty, T. (2019). Morphometric analysis using SRTM and GIS in synergy with depiction: a case study of the Karmanasa River basin, North central India. *Applied Water Science*, *9*(1), 1–10. https://doi.org/10.1007/s13201-018-0887-3

Rai, P. K., Mohan, K., Mishra, S., Ahmad, A., & Mishra, V. N. (2014). A GIS-based approach in drainage morphometric analysis of Kanhar River Basin, India. *Applied Water Science*, *7*(1), 217–232. https://doi.org/10.1007/s13201-014-0238-y

Rama, V. A. (2014). Drainage basin analysis for characterization of 3 rd order watersheds using Geographic Information System (GIS) and ASTER data. *Journal of Geomatics*, *8*(2), 200–210.

Schumm, S. A. (1956). EVOLUTION OF DRAINAGE SYSTEMS AND SLOPES IN BADLANDS AT PERTH AMBOY, NEW JERSEY. *BULLETIN OF THE GEOLOGICAL SOCIETY OF AMERICA*, *67*(6), 597–646. https://doi.org/10.1130/0016-7606(1956)67

Sissakian, V. K., & Fouad, S. F. A. (2015). Geological map of Iraq, scale 1: 1000 000, 2012. *Iraqi Bulletin of Geology and Mining*, *11*(1), 9–16.
Smith, K. G. (1950). Standards for grading texture of erosional topography. *American Journal of Science*, *248*(9), 655–668.

Strahler, A. N. (1952). HYPSOMETRIC (AREA-ALTITUDE) ANALYSIS OP EROSIONAL TOPOG- RAPHY. *Geological Society of America Bulletin*, *63*(11), 1117–1142. https://doi.org/10.1130/0016-7606(1952)63

Strahler, A. N. (1954). Statistical Analysis in Geomorphic Research. *The Journal of Geology*, *62*(1), 1–25. https://doi.org/10.1086/626131

Strahler, A. N. (1957). Quantitative analysis of watershed geomorphology. *Eos, Transactions American Geophysical Union*, *38*(6), 913–920. https://doi.org/10.1029/TR038i006p00913

Withanage, N. S., Dayawansa, N. D. K., & De Silva, R. P. (2015). Morphometric analysis of the Gal Oya river basin using spatial data derived from GIS. *Tropical Agricultural Research*, *26*(1), 175. https://doi.org/10.4038/tar.v26i1.8082

Yunus, A. P., Oguchi, T., & Hayakawa, Y. S. (2014). Morphometric Analysis of Drainage Basins in the Western Arabian Peninsula Using Multivariate Statistics. *International Journal of Geosciences*, *05*(05), 527–539. https://doi.org/10.4236/ijg.2014.55049