

Simplify Equation to Calculate Elongation River Basin Proposed by Schumm (1956)

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ABSTRACT

Since of twentieth century, Schumm (1956) suggested equation known "Elongation Measuring River Basin:

$$R = 2 \times \sqrt{(A / \pi)} / L$$

Where R= Elongation Ratio.

A = Area of the basin(km²).

π = 3.14.

L = Basin length(km).

Up to know this equation still gaining attention by many researchers around the world. Schumms equation faced many difficulties from graduate student, researchers and during its application. So we tried to make this equation simple and easy to use with simply application:

$$R = A \times \sqrt{B} / C$$

Where . R= Elongation Ratio.

A = Fixed factor (1.1282).

B = Area of the Basin / km².

C = Along the Basin/km.

This simplified equation was implement to basin of Djaal Valley in Iraq and it gave the same results as schumm equation.

Introducation

Occupied studies Applied geomorphology and hydrological basins of water of great importance by the researchers because of their great importance in human life, plant, animal, especially as recent trends stresses on the importance of fields geomorphological studies for all the phenomena of this science to highlight or clarify the utilitarian who can benefit from human, animal and plant, as well as the extrapolation of the potential risks that result from the presence of these phenomena, (Salhi & Ghurairy 2004, p 69).

A drainage basin is the part of the earth's surface that is drained by main stream and its tributaries. The drainage basin is fundamental geomorphic unit of land and all flow of surface is governed by its properties. It is an open system into which and from which energy flows.

(Christopher & other .2010, p 1279)

Morphometry is the measurement and mathematical analysis of the configuration of the earth's surface, shape and dimension of its landforms (Agarwal, 1998; Obi Reddy et al., 2002). Morphometric methods, though simple, have been applied for the analysis of area-height relationships, determination of erosion surfaces, slopes, relative relief and terrain characteristics as a whole. (Nongkynrih, & Husain . 2011, p647).

Morphometric studies involve evaluation of streams through the measurement of various stream properties. analysis of various drainage parameters namely ordering of the various streams and measurement of area of basin, perimeter of basin, length of drainage channels, drainage density (Dd), drainage frequency, bifurcation ratio (Rb), texture ratio (T) and circulatory ratio (Rc).

A major emphasis in geomorphology over the past several decades has been on the development of quantitative physiographic methods to describe the evolution and behavior of surface drainage networks (Horton, 1945; Leopold & Maddock, 1953; Abrahams, 1984). (Kuldeep Pareta, Upasana Pareta. 2010 .p248)

Results and Discussions

1-Schumm (1956) Equation

Since 5 decades, research studies have been suggested that schumm equation eligible to calculate elongation of Basin, it gained great interest by researchers during these decades. However, we noticed through application of Schumm equation, that there are some difficulties facing novice researchers when they apply this equation. The novice researchers required to know and use basin diameter and radius by circle, in addition to know basin area, and maximum basin length.

$$R = 2 \times \sqrt{(A / \pi)} / L$$

Where R= Elongation Ratio.

A = Area of the basin(km²).

π = 3.14.

L = Basin length(km).

Table (1) standard and classification of the river basin elongation proposed by schumm 1965 and later interpreted by strahle

Sequence	standard	classification
1	(< 0.5).	More elongated
2	(0.5-0.7)	elongated
3	(0.7-0.8)	Less elongated
4	(0.8-0.9)	oval
5	(0.9-0.10)	circular

1 - Kuldeep Pareta, Upasana Pareta Quantitative Morphometric Analysis of a Watershed of Yamuna Basin, India using ASTER (DEM) Data and GIS . INTERNATIONAL JOURNAL OF GEOMATICS AND GEOSCIENCES . Volume 2, No 1, 2011.

2 - Strahler, A.H., 1964. Quantitative Geomorphology of Drainage Basins and Channel Networks In. Handbook of Applied Hydrology, McGraw Hill Book Company, New York, Section 4.II.

1-The simplified Equation by Saad- Falah (2012)

Using mathematics in geomorphologic studies is one of the recent trends in this scientific field. Geomorphology is not seperated from other sciences in applying math as a quantitative revolution in all fields. However, still reasearcher is weak in math, for this reason, he kept away from using math to any equations, thought its so complex from his point view.

So, for this reason we do tried to simplify Schumm equation, by giving fixed factor to be used by researcher and therefore is need only to know the basin area and maximum basin length. As shown in following equation:

$$R = A \times \sqrt{B} / C$$

Where . R= Elongation Ratio.

A = Fixed factor (1.1282).

B = Area of the Basin / km².

C = Along the Basin/km.

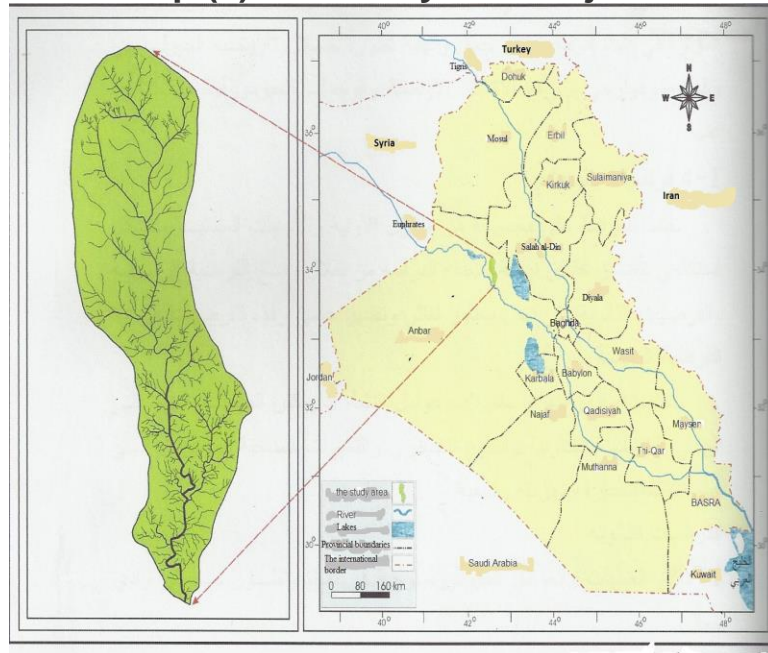
Application of simplified Equation

We do applied this simplified equation on Djaal Valley (in Iraq) and its secoudary basin with subsidiaries, to make sure that the results are accurate throught new simplified equation, as well as display its ease to apply. Basin and Djaal Valley is one of dray valley in area of Iraqi land. Its located within administrative of heat district. Djaal valley

located between ($33^{\circ}53'24''-34^{\circ}7'27''$) latitudes north, and between ($42^{\circ}34'48''-42^{\circ}36'52''$) longitudes, East as shown in may .

Its area equal to 124 km², and basin long equal to 26.13 km, fulls with water during rainy season by Euphrates River from its east side. Table 2 shows the area and the secondary basins length of Djaal Valley Basin.

map (1) site valley basin Djaal .



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The table shows (2) area and the length of secondary basins of the valley Basin Djaal.

Number of the basin	The area of the basin	The long of the basin
7	13.5 km	6.3 km
2	13.44km	5.4km
8	3.5km	2.4km

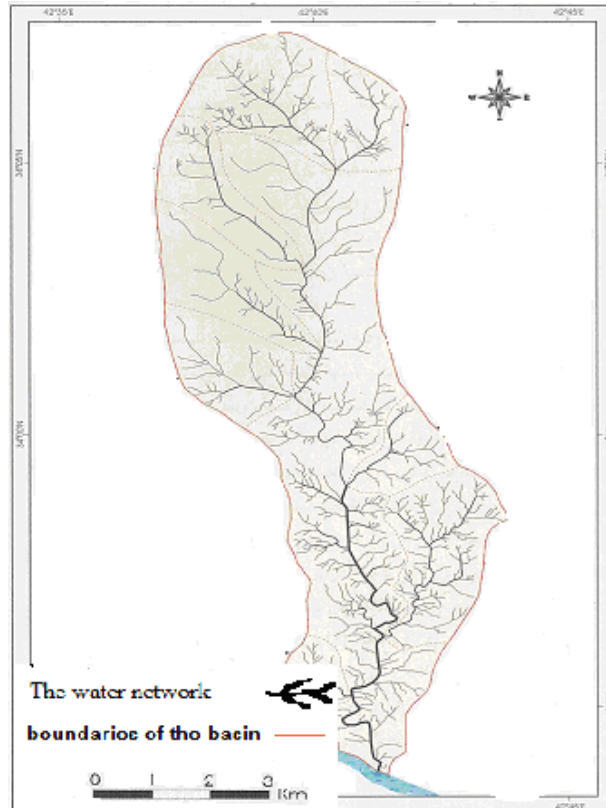
Applications of Both Equations

1-The more Elongated Basin

After applying both equation on Djaal Valley, the result showed (100%) identical to Schumm equation result, which the result of basin

elongated has been (0.48), and when we return to Schumm standard, this Valley is classified within the more elongated Valley, and this shape is not circular.as shown in map(2).

Map (2) Basin Valley Djaal. represents the basin more Elongated.

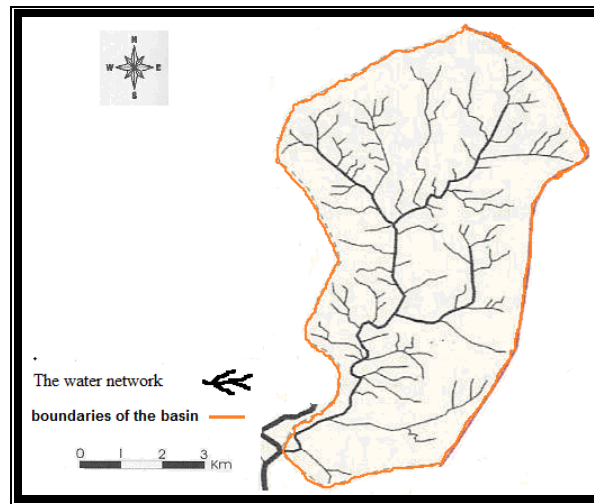


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2-The Elongated Basin

After applying both equation on basin (7) which is the second basin in map (3), its area is (13.5 km²) and its long (6.3) km, the result showed (100%) identical with Schumm equation result, and the result of basin elongated has been (0.66), this valley is classified as a elongated basin.

Map (3) the basin (7) one of the secondary Basin of the valley Dajjal basin. represents the basin of the elongation .

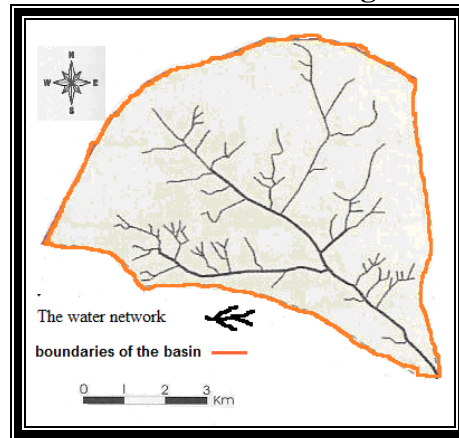


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3-The lest Elongated basin

After applying both equation on basin (2) which is the secondary basin as shown in map (4) its area is (13.44 km²), and (5.4 km) longe. The result found 100% identical with Schumm equation, which the result of this basin elongated from Schumm standard (0.77), and this valley is classified as a lest elongated.

Map (4) The Basin (2) one of the secondary Basin of the valley Dajjal basin. represents the basin of the Less elongation.

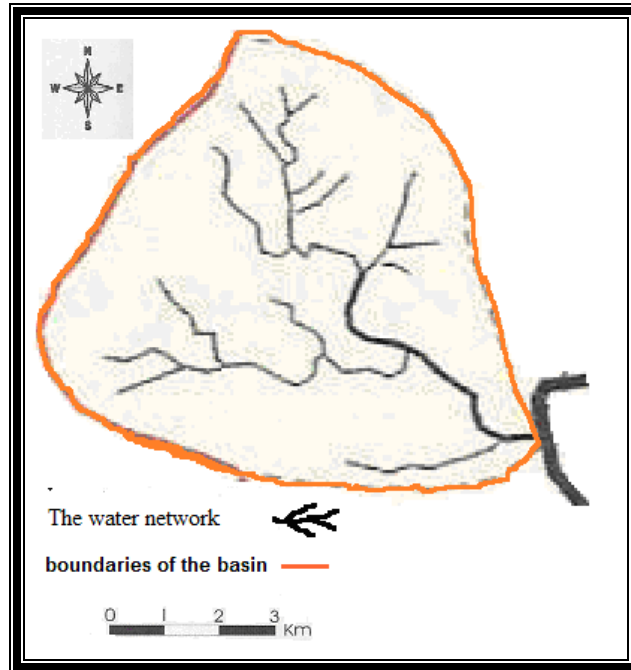


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4-The Basin Oval from

After applying both equation on basin (8), which is one of secondary basin shown in map (5), its area of this basin is (3.5 km²) and (2.4 km) longe, the result found 100% identical to Schumm equation result, and when applying schumm standard (0.88), and to find the shape of this Valley its classified as a Oval Valley.

Map (5)The basin (8) one of the secondary Basin of the valley Dajjal basin. represents the basin of the oval ..



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we also notes shortcut and clear steps, and easily in the application for the simplification of the new equation as shown in the following steps:

1 – Equation schumm 1956 :

$$R = 2 \times \sqrt{(124 \text{ km}^2 / 3.14)} / 26.13$$

$$R = 2 \times (11.13 / 1.77) / 26.13$$

$$R = 2 \times (6.28) / 26.13$$

$$R = (12.56) / 26.13$$

$$R = 0.48$$

2 – Simplify Equation by Saad-Falah 2013 .

$$R = 1.1282 \times \sqrt{124 \text{ km}^2} / 26.13$$

$$R = 1.1282 \times 11.13 / 26.13$$

$$R = 12.55 / 26.13$$

$$R = 0.48$$

According to Davis, the river passes through three stage : young. Maturity and Aging. We can apply these stages to schumm standard set (1956) and later explained by strahle as follow:

Table (3) classification of the basin Elongation by Dr saad aldarraji According to schomm and strahle and davis .

Sequence	standard	classification	the stages of the basin
1	(< 0.5- 0.7)	More elongated and elongated	Young
2	(0.7-0.9)	Less elongated and oval	Maturity
3	(0.9-0.10)	circular	Aging

When we applying strahle classification to Djaal Basin Valley and its secondary basins, we found that Djaal Basin Valley as shown in map (2) and its secondary valley (7) described in map (3) are classified as a young stage.

The geomorphological implication suggests that this river passes into young stage, which mean that the researcher has to be looking by himself in ground to determine its shape which characterized by young stage, and after that he should contact all measurements and documented.

The other secondary basin such basin (2), as described in map (4) and its basin (8), which is shown in map (5), these two basin classify into maturity stage. The other basins which have hydrological and geomorphological implication. The hydrological sings are indicated that the time it take to arrive water from upstream to downstream is less than previous stage, that means, takes preventive measures for flooding risk in parts of central and in the estuary. The geomorphological implicated suggests that land characteristic forms of this stage of river basin, the researcher should take ground and documented in field.

Conclusion and Finding

The scientist schumm had great role in serving to geomorphological of river basin studies through his equation of elongation basin proposed in 1956, which lasted more than five and half decades applying be researchers, and while we apperiate his role, we must say in all modesty, that we found some complexity faced by researchers when applying schumm Equation over past decades, so from our duty we found simplified application to schumm Equation, and we have succeeded in that, and researched simplify form, and we found that our equation more simply than schumm equation, and we recommended to adopt it by the researchers in geomorphology field, namely in river basin studies due to its simplicity and clarity and a short cut in steps.

References

- Schumm, S.A (1956), Evolution of drainage systems and slopes in Badlands at Perth Amboy. New Jersey. Geological Society of America Bulletin, 67, pp 597–646.
- 1 - Kuldeep Pareta, Upasana Pareta Quantitative Morphometric Analysis of a Watershed of Yamuna Basin, India using ASTER (DEM) Data and GIS . INTERNATIONAL JOURNAL OF GEOMATICS AND GEOSCIENCES . Volume 2, No 1, 2011.
- 2 - Strahler, A.H., 1964. Quantitative Geomorphology of Drainage Basins and Channel Networks In. Handbook of Applied Hydrology, McGraw Hill Book Company, New York, Section 4.II.
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تبسيط معادلة استطالة حوض النهر المقترحة من قبل شوم عام 1956
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الملخص

منذ خمسينات القرن العشرين ،اقترح شوم 1956 معادلته المعروفه بقياس استطالة حوض النهر:

$$R = 2 \times \sqrt{(A/Pi)} / L$$

حرف R الى نسبة الاستطالة . ويشير حرف A الى مساحة الحوض كم2 .في حين يشير حرف Pi الى رقم ثابت (3.14). بينما يشير حرف L الى طول الحوض كم.

وبقيت هذه المعادلة تتال اهتمام العديد من الباحثين في جميع انحاء العالم . وقد واجهت معادلة شوم العيد من الصعوبات من قبل الباحثين وطلبة الدراسات العليا اثناء التطبيق.لذلك حاولنا تبسيط هذه المعادلة لتكون سهلة التطبيق وفق التبسيط التالي :

$$R = A \times \sqrt{B} / C$$

حيث يشير الحرف R الى نسبة استطالة الحوض. ويشير حرف A معامل ثابت (1.1282). في حين يشير الحرف B الى مساحة الحوض بالكم2 . بينما يشير الحرف C الى طول الحوض. وقد تم تطبيق هذه المعادلة المبسطة على وادي جعال في العراق واعطت نفس النتائج التي اعطتها معادلة شوم .