Int.J.Curr.Microbiol.App.Sci (2019) *8*(3): 188-194

International Journal of Current Microbiology and Applied Sciences
***ISSN: 2319-7706* Volume 8 Number 03 (2019)**
Journal homepage: http://www.ijcmas.com

Original Research Article https://doi.org/10.20546/ijcmas.2019.803.026

Vegetation Cover in Rudat Norah and Morphmetric Analysis of Wadi Al-Atsh Watershed, Northwester Riyadh Region

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Keywords

Morphometric, Wadi Al-Atsh, Watershed, Drainage, Saudi Arabia

Article Info

Accepted:
04 February 2019
Available Online:
10 March 2019

A B S T R A C T

Vegetation Cover in Rawdat Norah was estimated to be 0.635 Km^2 or 16.2% of the total area of the Rawdat which is 3.924 km^2. The main dominant vegetation is *Rhazya strica*. Some morphometric properties and the characteristics of the watercourse system affecting the capacity of the Wadi Al-Atsh watershed to transform rainwater into surface runoff water had been determined. Accordingly, the drainage area of Wadi Al-Atsh has been calculated and found to be 13899.7 km^2, where the watershed length reaches 170.9 km, and the average width of Wadi Al-Atash watershed also reached 81.3 km. The form factor ratio was found to be less than 1.277 indicating that the shape of the watershed is not circular in shape, the shape of Wadi Al-Atsh watershed is located within the relatively rectangular watersheds where its elongation reaches 0.78. This study also proven that the watercourse network system is similar to the dendritic drainage system with a total of 1759 watercourses, which confirms the ability of the water watershed to turn the rainwater into surface running water which may end with devastating foods. This study indicated that management of rangeland must incorporate to conserve vegetation and biodiversity of ephemeral streams in hyper-arid and arid regions.

Introduction

In arid regions, patterns of vegetation are influenced by human disturbance such as overgrazing and environmental factors mainly climate and topography characteristics (Jiao *et al.*, 2011). Thus morphometric parameters analysis of watershed is an important aspect (Ali *et al.*, 2000; Al-Rowaily *et al.*, 2012). Shaw and Cooper (2008) noted that plant communities and other biotic patterns are controlled by the interactions of hydrologic and geomorphic regimes. The hydrological response in a basin is a result of the physiographic characteristics, such as area, slope, size and length of streams, size, shape, slope, and drainage density (Gregory and Walling, 1973). In hyper-arid and arid regions, many studies demonstrated that quantitative morphometric analysis has,

prioritization for soil and water conservation (Gajbhiye *et al.,* 2014; Meshram and Sharma 2015), environmental assessment (Magesh *et al.,* 2012; Rai *et al.,* 2014; Babu *et al.,* 2016), and evaluation and management of resources (Pandey *et al.,* 2004). Furthermore, comparison of the quantitative morphometric parameters helps understand the geomorphological effects on the spatial variation of hydrological functions (Romshoo *et al.,* 2012; Sreedevi *et al.,* 2013). Understanding drainage morphometry is also a prerequisite for runoff modeling, geotechnical investigation, identification of water recharge sites and groundwater prospect mapping (Sreedevi *et al.,* 2005; Fenta *et al.,* 2015; Roy and Sahu 2016). As such, morphometric analysis is an important procedure for quantitative description of the drainage system; thus enabling improved understanding and better characterization of s.

This study aims were to estimate vegetation cover in Rawdat Norah and some of the morphometric characteristics associated with Wadi Al-Atsh watershed.

Materials and Methods

The study area

Wadi Al-Atsh is located between the two longitude 45°00 and 46° 20' east, 24°20' and 25°58' north (Fig. 1). It is bordered by the edges of Tuwaiq Escarpment in the south, and by Wadi al-Nakhl watershed from the Northwest. Al-Qassap salted area is bordering Wadi Al-Atsh from the southwest side, while Al-Shawki valley from the north, and finally from the east is bordered by the lowlands of Rawdat Norah.

Wadi Al-Atsh stream is formed after the confluence of the water valley with the valley of Sidair at an altitude of about 590m near the Rawdat Quabaa. The Geological and relief characteristics of the Wadi Al-Atsh watershed are part of the sedimentary Arabian shelf structures. These structures vary in terms of age, geological structure and rock composition.

Vegetation and morphometric measurements

Vegetation cover was measured using GIS following Sharaf (2008) method using a satellite image, (Spot-6), with a resolution of 1.3. Vegetation (NDVI) was estimated from the image. A number of morphometric parameters such as area, elevation information, watershed length, and number and length of stream were computed. The area and shape of the drainage watershed had been calculated (length, width, and circumference). Stream order was carried out based on Strahler (1964) method.

The elongation ratio was calculated according to (Schumm, 1956).The elongation ratio value is calculated by applying the following equation:

$$R_e = \left[\frac{2}{L_b}\right]\left[\frac{A}{\pi}\right]^{0.5}$$

Where:
A: Watershed water drainage area (km^2).
L_b: Length of water watershed (km).

The Relative relief ratio was calculated according to (Melton, 1957) using the equation:

$$R_{hp} = \frac{1000\ H}{P}$$

Where:
H: The relief range which is the difference between the maximum and the lowest height in the water watershed (meters).
P: Length of water watershed circumference (km).

The Drainage intensity was calculated according to Faniran, (1968), using the equation:

$$Di = Fs/Dd$$

Where:
F_s: Frequency of watercourses (stream/km^2).
D_d :Density of watercourses (Km/Km^2).

Results and Discussion

From satellite image, area of Rawdat Norah was estimated to be 3.924 km^2. Vegetation Cover in Rawdat Norah was estimated to be 0.635 Km^2 or 16.2% (Figures 2). The main dominant vegetation is *Rhazya strica*.

The results of this study revealed that the maximum elevation of Wadi Al-Atsh watershed was1001 m at the edge of Tuwaiq Mountain in the southwest of the drainage area, and the minimum elevation of the watershed was 541m at the outlet of the watershed in the lowlands of Rawdat Noura (Figure 3).

Wadi Al-Atsh watershed area was estimated to be 13899.7 km^2. Some of the watershed shape characteristics which govern the rate at which water is supplied to the main channel also estimated basin length (170.9 km); main basin width (81.3 km), form factor ratio (0.48), elongation ratio (0.78), circularity ratio (0.41), and compactness coefficient (1.57) (Table 1).

The total stream was 1759 with total length of 7154.5 km. The first order streams make about 76.86% of the total number and 50.53% of the total length (Table 2 and Figure 4).

Table.1 Morphometric parameters of Wadi Al-atsh northwest of Riyadh Region

Watershed derange Area (km^2)	Peri-meter (km)	Water-shed length (km)	Mean water-shed width (km)	Form factor ratio	Elongation ratio	Circularity ratio	Compactness coefficient	Lemniscate factor
13899.7	652.7	170.9	81.3	0.48	0.78	0.41	1.57	0.02

Table.2 Stream order, number of streams, stream length, mean stream length, of Wadi Al-atsh northwest of Riyadh Region

Stream order	No. of stream	%	Bifurcation ratio	Total stream length (Km)	Mean stream length (Km)
1st	1352	76.86	-----	3614.9	2.67
2nd	316	17.96	4.28	1798.8	5.69
3rd	66	3.75	4.79	923.2	13.99
4th	19	1.08	3.47	525.4	27.65
5th	5	0.28	3.80	226.2	45.25
6th	1	0.06	5.00	66.0	65.98
Total/mean	1759	100	4.27	7154.5	4.07

Fig.1 Al-Atsh watershed location in Saudi Arabia

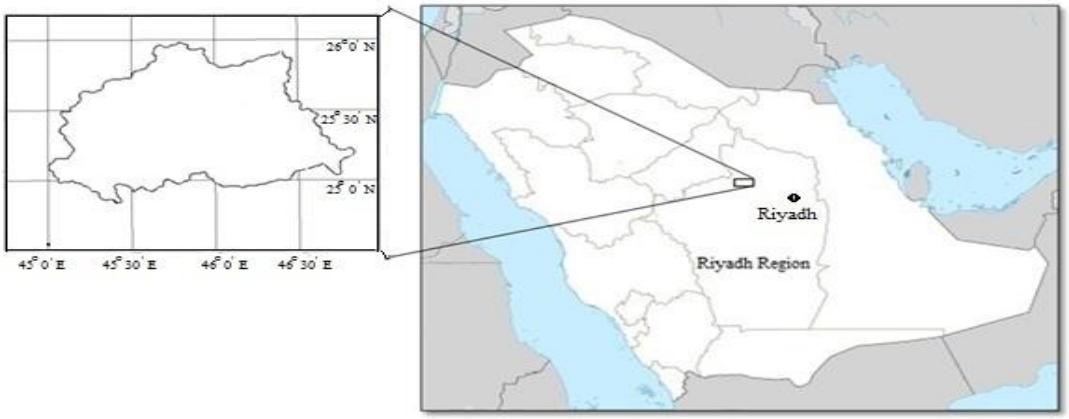


Fig.2 Satellite image showing Rawdat Norah location and vegetation cove

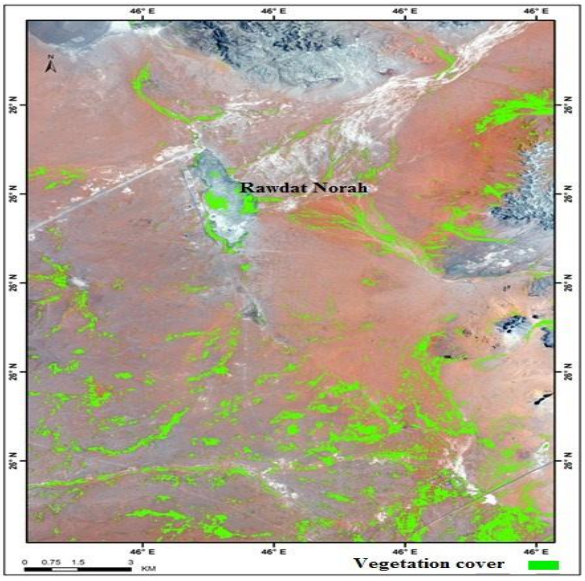


Fig.3 Elevation map of Wadi Al-Atsh watershed

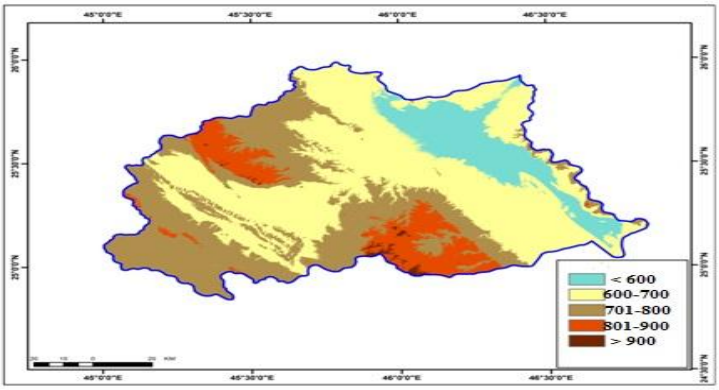
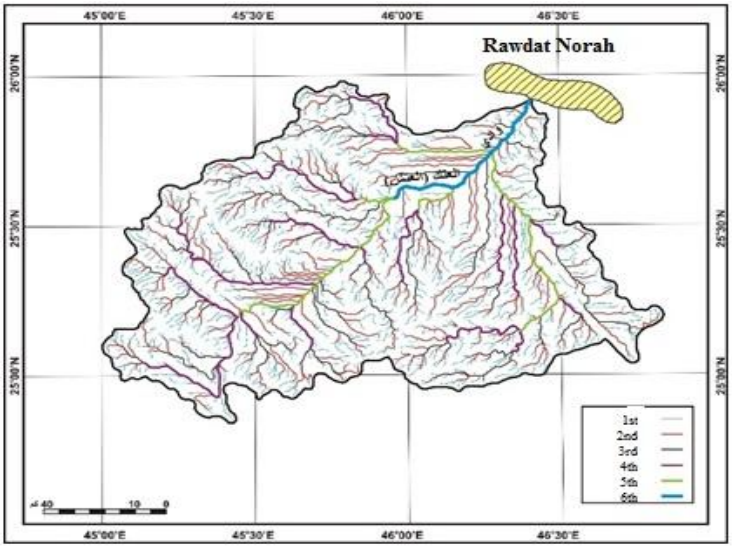


Fig.4 Hierarchical of stream orders of Wadi Al - Atsh Watershed (ranked according to Strahler 1964)



Vegetation cover of Rawdat Norah was low because of human disturbance such as overgrazing and environmental factors mainly climate and topography (Jiao *et al.,* 2011; Xu *et al.,* 2008). Determination of stream networks' behavior and their interrelation with each other is of great importance in arid and semiarid ecosystems because watershed area is considered the source that supplies water needs (Leopold *et al.,* 1964). Wadi Al-Atsh watershed is well drained with stream order of six. This hierarchical arrangement of watercourses determines surface runoff water and the development of the waterway in the watershed. The watercourse network system in Wadi Al-Atsh is similar to the dendritic drainage system (Fig 4) with a total of 1759 watercourses, that confirms the ability of the water watershed to turn the rainwater into surface running water.

The presence of large number of streams in Wadi Al-Atsh watershed (1759) indicates that the topography is still undergoing erosion and at the same time, less number of streams indicates mature topography. The calculated result matched with Strahler (1964), that the total number of streams decreases gradually as the stream order increases. High values of first-order streams may indicate a possibility of flash floods after heavy rainfall in the down streams (Chitra *et al.,* 2011). From the parameters obtained, the average slope of Wadi Al-Atsh watershed is 2.67 m/km,which considered as high, and the high relief value of the watershed indicates the gravity of water flow, low infiltration and high runoff conditions. Magesh *et al.,* (2012) noted similar observations in Tamiraparani sub-watershed because the presence of Western Ghats acts as a common relief-contributing factor. The Drainage Intensity (DI) of Wadi Al-Atsh watershed is 0.25 watercourse/km^2 which indicates that the watershed has a weak or permeable subsurface material with intermediate drainage and low relief (Chorley 1969).

The present study has proved that analysis of some morphometric parameters of a watershed also can helps to understand vegetation. Degradation of vegetation resources of Rawdat Norah as a result of human disturbance mainly heavy grazing,

resulted in low vegetation cover, low productivity, low plant diversity, and the replacement of palatable species by unpalatable *Rhazya strica*. Thus, rangeland management practices must incorporate to conserve biodiversity of ephemeral streams in hyper-arid and arid regions (Sarr, 2002).

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How to cite this article:

Rashid H.R. Al-Dosari, A.M. El-Sheikh Al-Ansari, F.H. Al-Juaidi and Al-Taisan, W.A. 2019. Vegetation Cover in Rudat Norah and Morphmetric Analysis of Wadi Al-Atsh Watershed, Northwester Riyadh Region. *Int.J.Curr.Microbiol.App.Sci.* 8(03): 188-194.
doi: https://doi.org/10.20546/ijcmas.2019.803.026