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Some Morphometric Aspects of Drainage Pattern of Newaj Watershed, Rajgarh District, M.P.: Hydrological Implications.

Syed Akram Ali and H. U. Usmani

Dept. of Geology, Govt. M.V.M. Bhopal, M.P.

email: akram.mpcost@gmail.com

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Abstract

Morphometric analysis of drainage network in the Newaj Watershed, in the Rajgarh district of M.P. has been carried out using Spatial Technology with a view to understand the hydrological condition of the basin. Stream ordering carried out for the analysis of bifurcation ratio, drainage texture, drainage density, relief ratio and circulatory ratio. The inferences drawn from this analysis indicate that the area has not suffered any major deformation. As the value of bifurcation ratio is low the result of analysis of these parameters also indicate that the drainage texture is fine to medium and drainage density 2.55 km / sq. km which is low indication moderate run off. The runoff and infiltration which signify that the area needs some measures to be taken to maintain and to improve groundwater conditions of area for sustainable development.

Introduction

Groundwater is a valuable natural resource, which has a direct influence on the health of people, ecology and economics of a region. It's a precious resource, a haphazard and over use of it threatening the available resources. With the latest powerful technology of Remote Sensing and computer based GIS technique it has become reather easier to analyse and manage natural resources, particularly water resources. Drainage pattern of an area provides important information on the groundwater potential of the area. drainage pattern of the area indirectly infers the topography which helps in understanding of surface water conditions, its runoff and infiltration under ground, it reflects present lithology and structure on the rocks. It also helps in evaluation of groundwater condition, to some extent. Drainage network present over a landmass is classified on the basis of their form and texture,

form and shape pattern of drainage is the reflection of surface topography and its also influenced by the subsurface geological conditions. Development of drainage is the result of least resistance offered by the rocks in erosion. Drainage texture is governed the available volume of water and also by the infiltration capacity of soil. In the present study the stream ordering is done using strahler method of stream ordering and other parameters calculated using the standard formulas proposed by Horton and Strahler and interpreted.

Study Area

Present study carried out over the Newaj watershed, which is a part of Rajgarh district, M.P. The study area lies within the latitudes 23°50'00" to 24°16'52" N and longitudes 76°36'45" to 76°53'00" E, and falls in the survey of india Toposheet no. 54 D/11, 54 D/12, 54D/15, 54 D/16, 54 A/9 and 55 A/13, the study area is part of Newaj River (Fig.1) and geological composed of Deccan Basalt of basic volcanic nature. The area represent an undulating topography. The basalt is covered by B.C. Soil where ever more weather.

Processing and Digitization

The georefrencing of satellite data was performed with refrence to toposheets covering the watershed and area is demarcated on the image (Fig.2). the image processing carried out adopting different band combination using Erdas Imagine for fine detailing of I^{st} order streams. Field check also were carried out to avoid and diserepecy and to avoid the main made structures. The drainages of all order digitized followed by transfer of image to ARcGIS software for complete processing of image. The drainage pattern of study area is shown in the drainage map (Fig.3)

Morphometric Analysis

In the present drainage morphometric analysis the bifurcation ration, drainage dencity, drainage texture, relief ration and circulatory ration has been calculate and interpreted accordingly.

First step of this analysis is stream ordering, ordering started from the lowest first order to the highest available order, i.e. sixth order following Hortons (1962) method.

Stream ordering

After Ordering of streams in the present watershed, all the numbers of each order has been counted and tabulated below:

Order of Stream	Total number of stream in each order
First order	1589
Second order	800
Third order	451
Fourth order	153
Fifth order	116
Sixth order	1
Total Stream	3110

Bifurcation Ration (Rb)

Bifurcation ratio is calculated by using formula proposed by Strahler (1957):

Rb = Nu / Nu+1

Where, Rb = Bifurcation ratio

Nu = Total no. of streams segment of order 'u'

Nu+1 = Number of streams of the next higher order

In the present watershed the value of Bifurcation ration are as:

Rb1	1.99
Rb2	1.77
Rb3	2.95
Rb4	1.32
Rb5	116.00

Drainage Texture (T)

It is a very useful in delineating the texture of drainage over a topography fine, medium and course (Smith, 1950). Drainage texture of the present watershed is 13.48. This parameter also indirectly infers the calculated value of infiltration capacity, their permeability or lack of fault and fracture. According to this value the drainage texture is medium

Stream Frequency (Fs)

It is calculated using the formula (Horton, 1945):

Fs = Nu / A

Where, Fs = Stream frequency

Nu = Total number of stream present in the drainage basin.

A = Area of drainage basin

Fs = 3110 / 588.35 = 5.29 per sq km

Drainage density (Dd)

Drainage density of the present area is calculated using Horton (1945) formula:

Dd = Lu / A

Whaer, Dd = Drainage density

Lu = Total stream length of all orders

A = Total area of basin

Dd = 1503.21 / 588.35 = 2.55 km / sq km

Relief ratio (Rh)

This ratio calculated by the relation Rh = H / Lb (Horton, 1945)

Where, Rh = Relief ratio

H = Total relief of the basin

Lb = Basin length

Rh = 193 / 50.50 = 3.82

Discussion and Conclusion

The drainage map reveals the dominance of lower order streams. The number of order streams reducing from lower to higher order. The main trunk is sixth order stream i.e. Newaj River. The general pattern of drainage is mainly dendritic. The drainage texture is fine to medium texture, the shape of basin is elongated extending roughly N-S. in some part drainage becoming sub-dendritic. The lithology in the present area that is basalt. The lack of major structural disturbance as the present area is free from major folding and faulting (Deccan Trap) Similarly second and third order drainage do no show large variation.

Bifurcation ratio as calculated between different order also more or less steady except the last pair i.e.5^{th} / 6^{th} order. Lower value of bifurcation ratio indicating less deformation and this increase in value of Rb5 may be due to some local variations.

The high value of drainage density 2.55 km / sq km. indicate moderate infiltration. Value of stream frequency is 5.92 which is moderate to high and relief ratio 3.82 is also a low relief suggesting more residence time of rain to stand for longer duration at surface which helps in more percolation of water down wards (Todd, 1980).

Hence, on the basis above discussion it may be concluded that the area is broad, flat with meandering nature of main channel, low gradient and low stream velocity. Though, the drainage density 2.55 km / sq km is a relatively higher value indicating a high runoff and low infiltration. But it is observed during field visits that the post monsoon groundwater levels are quite high which reveals that the presence of gently slopingcondition provides sufficien time to the rain water to stay longer on the surface which lead more infiltration and highly jointed basaltic rocks provide the channel way to trickle rain water under ground. Being an agriculture prone area it seems reasonable to suggest certain measures to improve the groundwater to sustainable development. As most of the agriculture activity practice is groundwater dependent and almost all the agriculture lands using groundwater for irrigation thus some measures to improve groundwater resources must be given priority.

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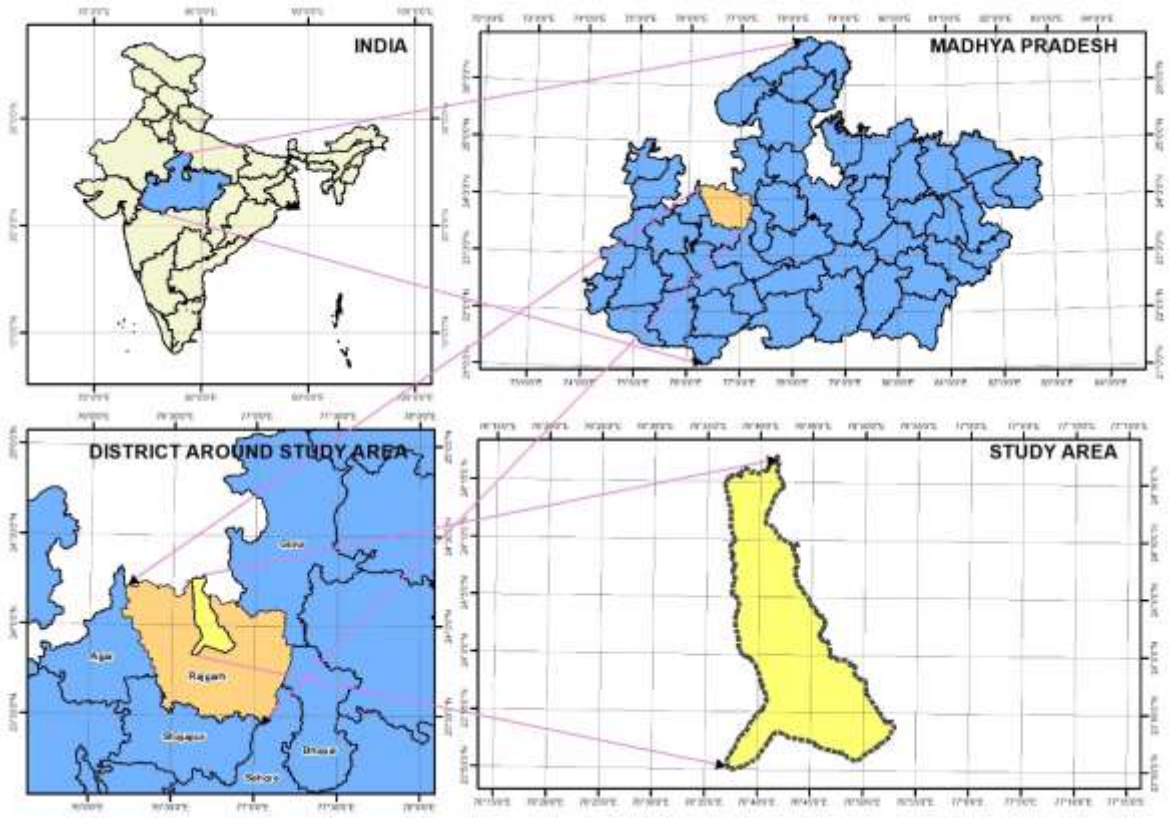

Fig. 1 Location map of study area

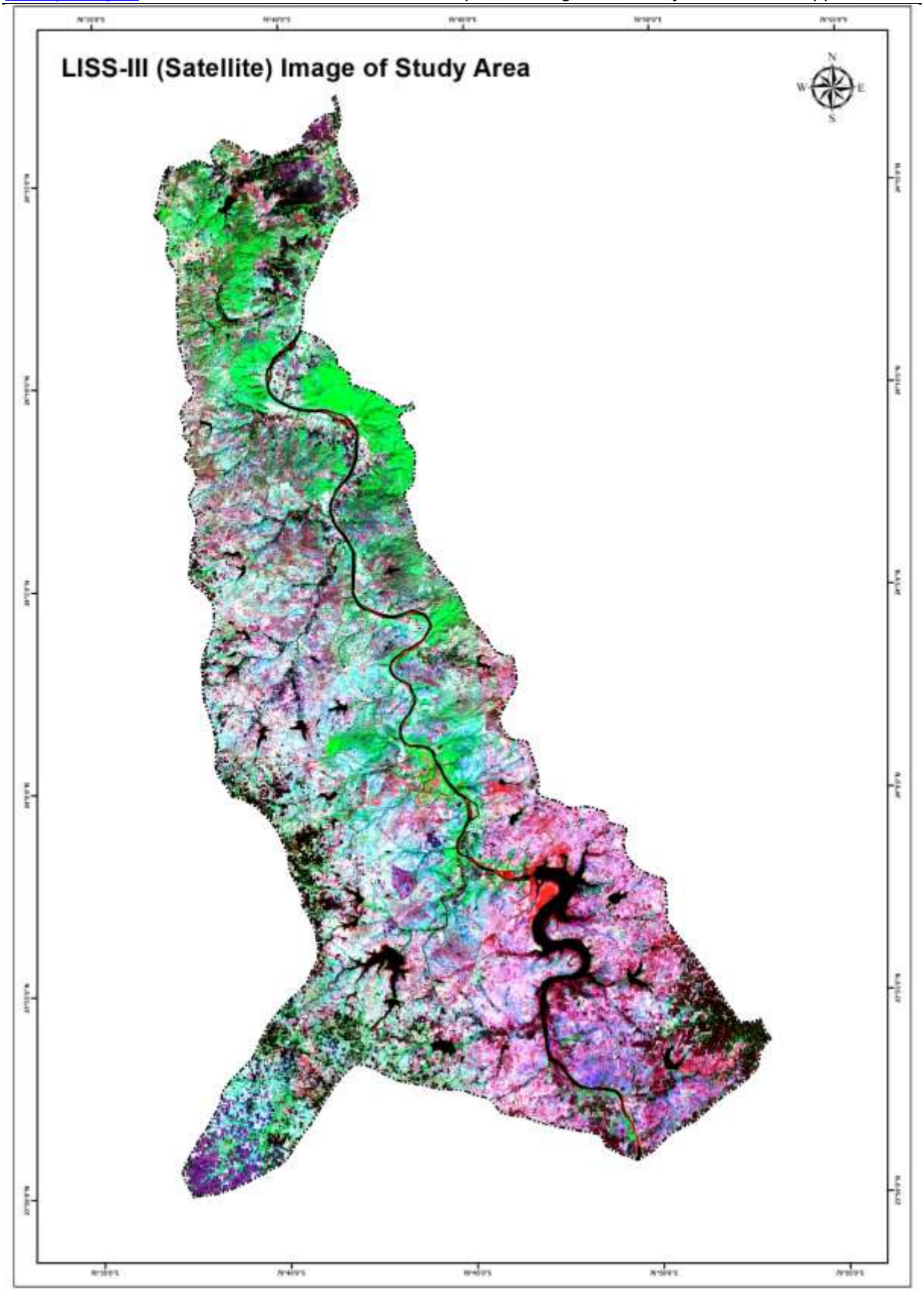

Fig. 2 Satellite image of study area

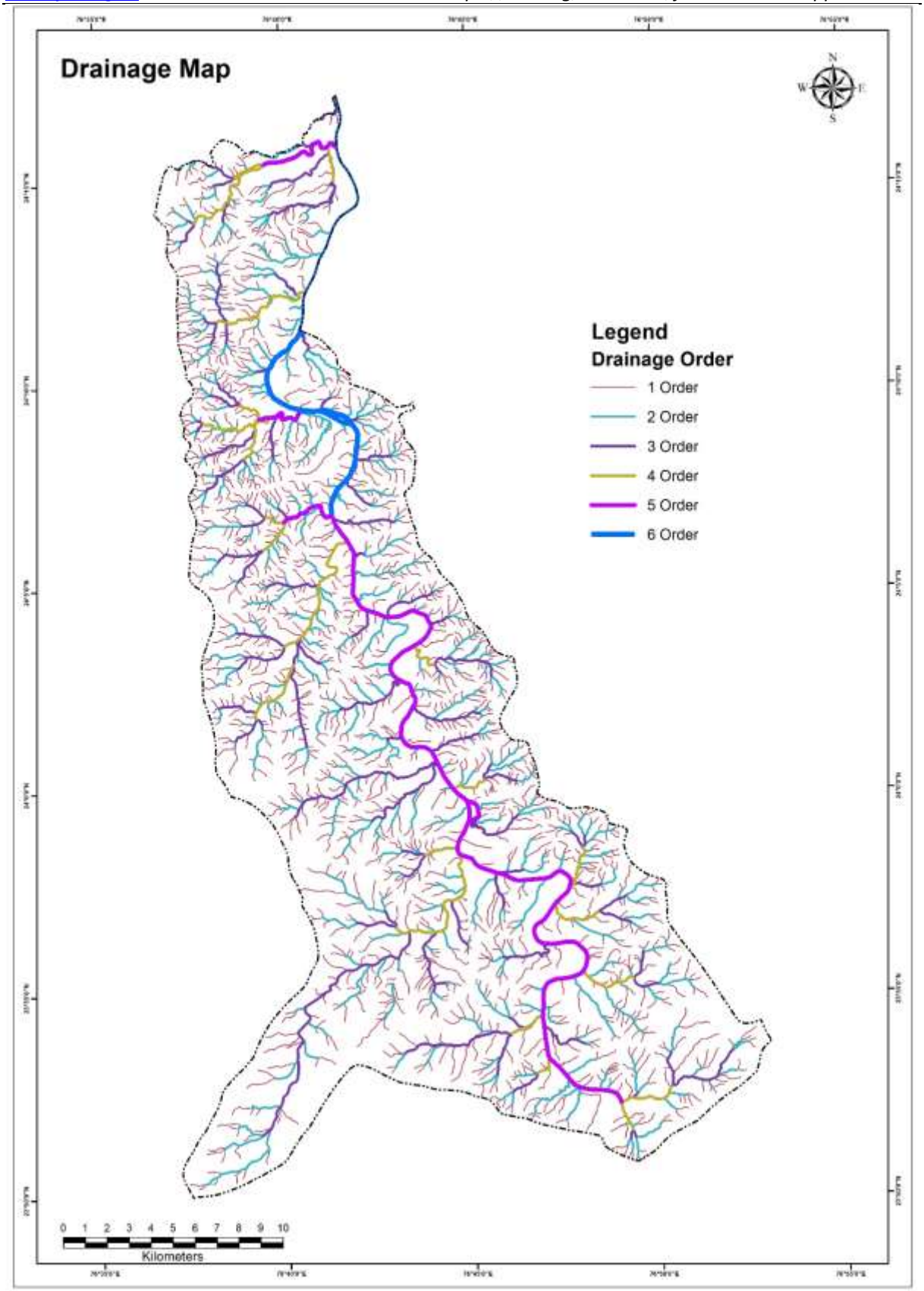

Fig. 3 Drainage map of study area