

# Identification of Suitable Sites for Watershed Management Structures in Chapadgaon Mili Watershed of Shevgaon Tahsil

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## **Abstract:**

Ahmednagar district is known as drought prone region, Shevgaon tahsil is one of the tahsil which is always facing scarcity of the water almost throughout the year. Hence all the river basins in Ahmednagar district require one or other structures of watershed management. Chapadgaon mili watershed is selected as a case study for present research paper.

Chapadgaon mili watershed covered an area of 55.201 km<sup>2</sup>. Shevgaon tahsil is receiving 549 mm rainfall. 23 years of rainfall data have been taken into consideration for this study. Monsoon rainfall is very less and short duration. Main stream is locally known as River Kathpadi. It has 5<sup>th</sup> order stream and average bifurcation ratio is 2.70. Shape of the mili watershed is elongated. Maximum height is 595 m and 450 m at the mouth of the Chapadgaon mili watershed. It is necessary to increase new watershed management structures for the sustainable development of the region.

Frequently drought condition is occurring in this area and main problem of water scarcity in the summer season. Therefore, identification of suitable sites for watershed management structure is necessary in Chapadgaon mili watershed. Correlation is calculated between the rainfall and rainy days and r value is 0.76. Using geospatial technique and field observation suitable sites have been identified for proposed watershed management structures in Chapadgaon mili watershed. On the basis of all the information and analysis, structures have been suggested like contour trench and check dam.

**Key words:** Chapadgaon Mili Watershed, Rainfall Characteristics, Morphometric Analysis and Watershed Management Structure.

## • **Introduction:**

A watershed is an area of land that drains all the streams and rainfall to a common outlet such as the outflow of a reservoir, mouth of a bay, or any point along a stream channel (USGS, 2019). A watershed may be only a few hectares or hundreds of square kilometres. It is accepted globally that water is highly required aspect which can be stored scientifically through watershed management (Tideman, 2007). Geomorphic analysis of a river basin is essential for watershed management study, many scientists has been studied (Horton, 1945; Smith, 1950; Strahler, 1964). The importance of watershed management can be gauged from the experiences of the Hivre Bazar and Ralegansiddhi villages of Ahmednagar district in western Maharashtra and from many other villages across the country (CSE, 2009). There are number of studies done by NRSA on the watershed management structures (NRSA, 2003).

Ahmednagar district is known as drought prone region, Shevgaon tahsil is one of the tahsil which is always facing scarcity of the water almost throughout the year. All the river basins in Ahmednagar district require one or other structures of watershed management. Hence, Chapadgaon mili watershed is selected as a case study for present research paper.

## **Aims and Objectives:**

The main aim of the study is to find out suitable sites for the watershed and suggest type of structures for their particular sites based on the local geomorphic characteristics of the area.

1. To study the hydrological characteristics of Chapadgaon mili watershed.
2. To study the morphometric analysis of River Kathpadi in the basin.
3. To identify suitable sites for watershed management structures.

## **Study Area:**

Chapadgaon mili watershed is located in Shevgaon tahsil of Ahmednagar District, Maharashtra. It is covered an area 55.201 km<sup>2</sup>. Main stream is locally known as River Kathpadi which is tributary of River Khatkal and River Khatkali is a Right bank tributary of River Godavari. This mili watershed having 5<sup>th</sup> order stream and average bifurcation ratio is 2.70. Shape of the watershed is elongated. Maximum height observed at south-east side of the Thate village, which is 595 m and lowest height is found at the confluence of River Khatkali, which is 450 m.

There are 09 villages located in Chapadgaon mili watershed, namely Mangrul Khurd, Mangrul Budruk, Hasnapur, Kolgaon, Warkhed, Sonangvi, Chapadgaon, Prabhu-Wadgaon and Khampimpri. A type of soil is different in color in the area, which red at few places and gray at few places.

## Location Map of the Study Area

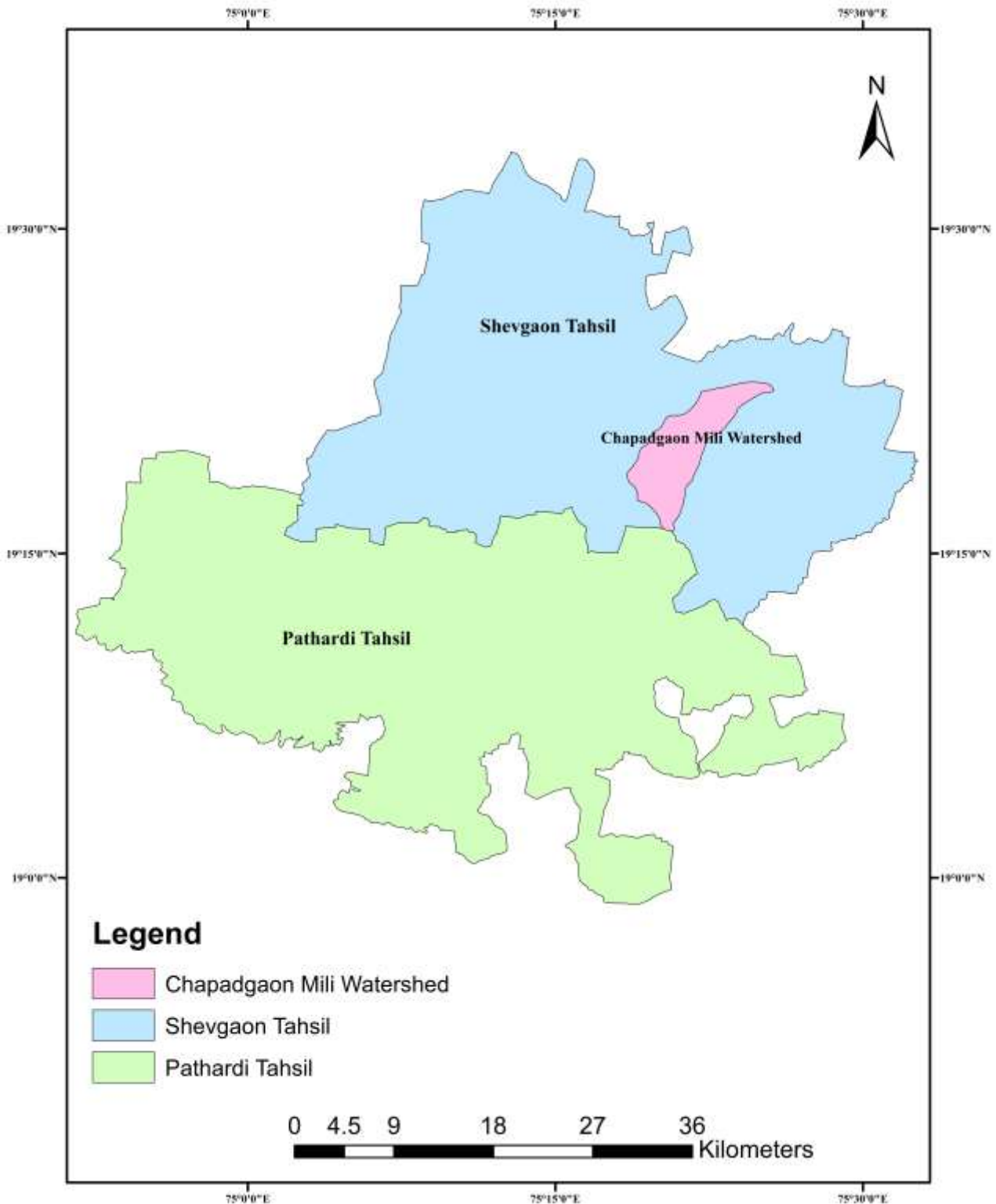


Figure - 1: Location Map of Chapadgaon Mili Watershed

### Review of Literature:

Chadha and Neupane are studied in 2011, significance of geomorphic analysis of watershed for the optimization of recharge structures. They have suggested technique for optimum utilization of the available runoff at different locations within the watershed based on stream ordering and geomorphic analysis of the drainage area. Gebre et.al focused on Water Resource Management using GIS for Chelekot Micro-Watershed, Tigray, Ethiopia in 2015.

Saptarshi and Raghavendra studied in 2009, GIS based evaluation of micro-watersheds to ascertain site suitability for water conservation structures. The remote sensing and GIS techniques can be utilized for identifying suitable sites for soil and water conservation measures in the micro-watersheds in Bavdhan watershed in Pune city.

Unde and Telore stated in 2013 watershed development programme is essential for sustainable regional development. Authors studied Nidhal Micro-Watershed for critical drought prone area of upper Yerla basin. Telore, Unde and Jawre focused on Sustainable Rural development through Micro Watershed Management and site suitability for watershed management structures at deccan trap of Maharashtra in 2016.

• **Materials and Methods:**

1. Rainfall data of 23 years (from 1998 to 2020) have been taken into consideration.

(Source: - <https://maharain.maharashtra.gov.in/>)

2. Village wise population data is used.

(Source: Census – 2011)

**Following methods are used for this research paper:**

➤ Delineation of watershed from Survey of India toposheet No. 47 M/7

(Scale:- 1:50,000).

➤ Review of literature is carried out from different sources.

➤ Digitization is completed with the help of Global Mapper v15.1 software.

➤ Various maps have prepared for the morphometric analysis and DEM.

➤ Calculation of morphological variables in this area is taken into consideration.

➤ During the field survey geomorphic condition is observed.

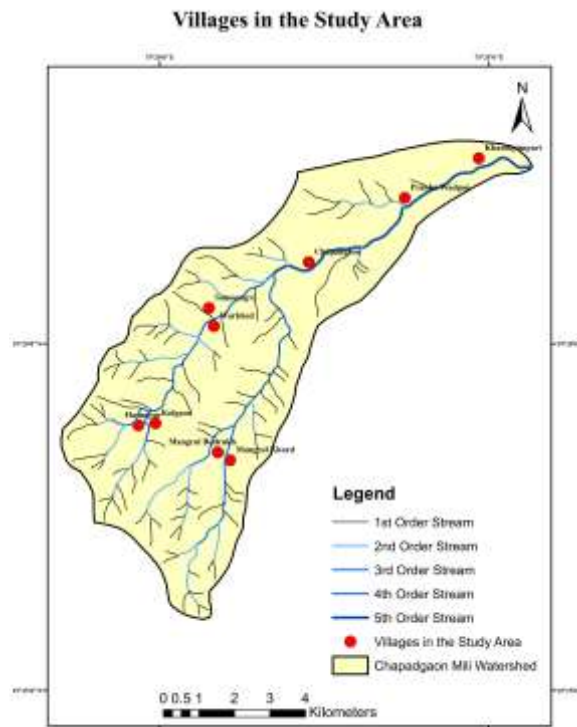
➤ Suitable sites have been identified for the proposed different watershed management structures in the watershed on the basis of field observation and morphometric analysis.



**Photo 1: River Kathpadi at Chapadgaon**



**Photo 2: River Kathpadi at Prabhu Wadgaon**



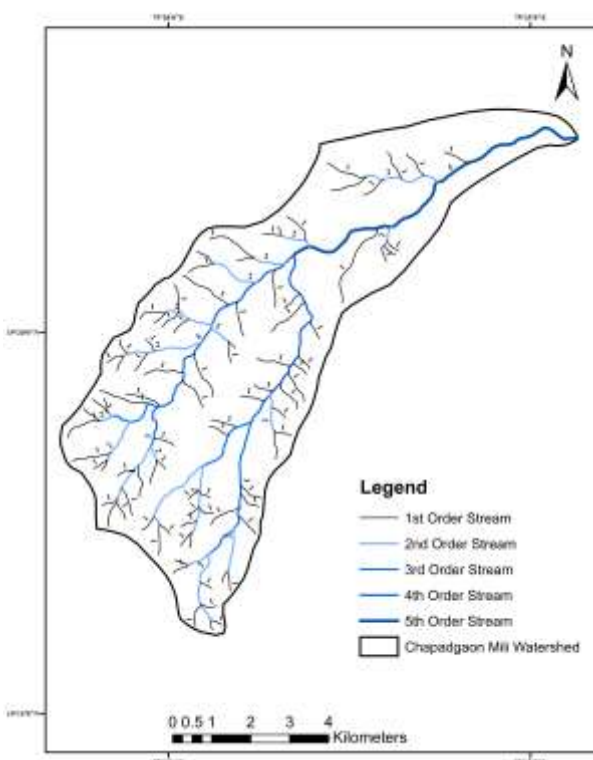
**Figure 2: Villages with Streams in the Study Area**

**Table 1: Village Wise Population of Chapadgaon Mili Watershed (2011 Census)**

| Name of the Village | Population (2011) | Ranks |
|---------------------|-------------------|-------|
| Mangrul Khurd,      | 526               | 9     |
| Mangrul Budrukh,    | 1,065             | 6     |
| Hasnapur,           | 2,077             | 2     |
| Kolgaon,            | 1,062             | 7     |
| Warkhed,            | 1,277             | 5     |
| Sonesangvi,         | 1,040             | 8     |
| Chapadgaon,         | 3,984             | 1     |
| Prabhu Wadgaon      | 1,931             | 4     |
| Khampimpri.         | 2,059             | 3     |
| <b>Total</b>        | <b>15,021</b>     |       |

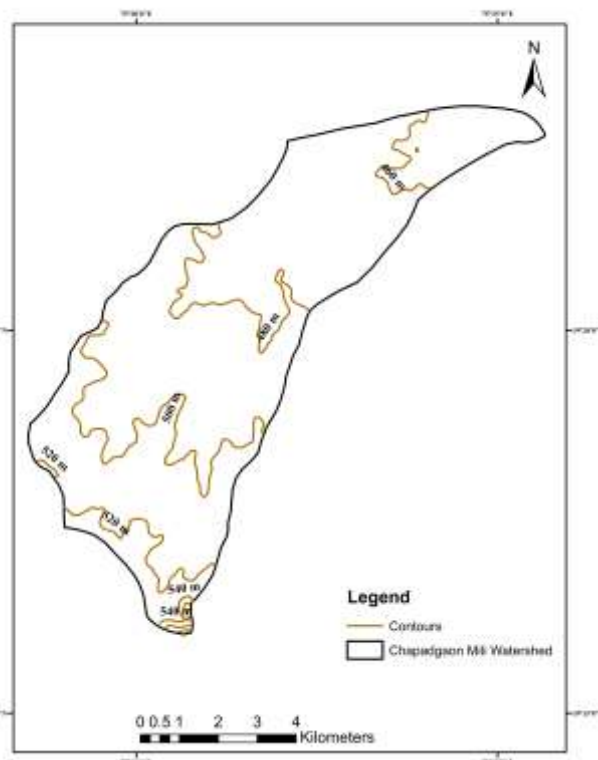
There is 15,021 population lived in Chapadgaon mili watershed. Highest population lived in Chapadgaon village and lowest population in Mangrul Khurd village according to 2011 census data. According to the natural law population density of the hilly area is low and it's increase towards the lower course of the river.

**Stream Order Map of the River Kathpadi**



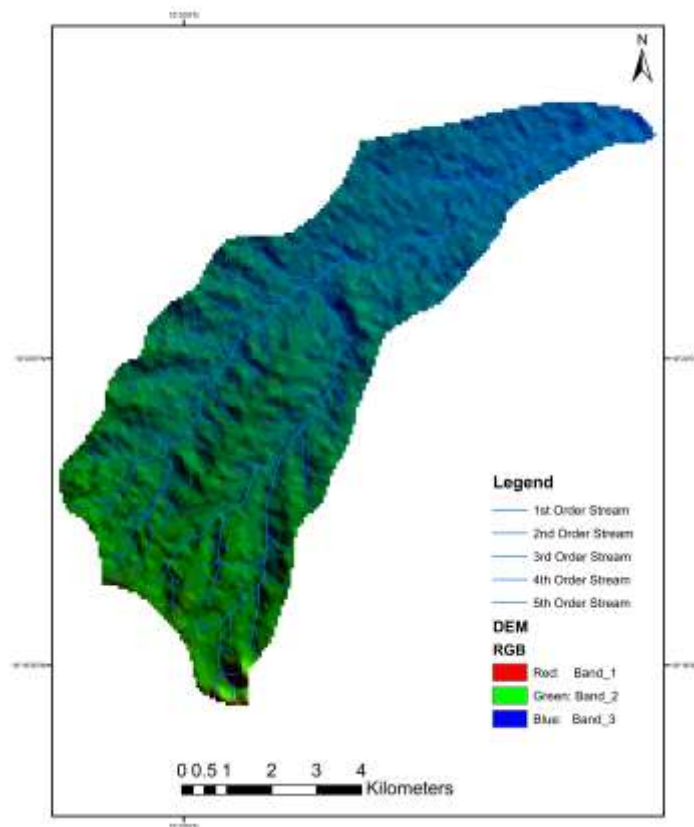
**Figure 3: Stream Order Map of the River Kathpadi**

**Contour Map of Chapadgaon Mili Watershed**



**Figure 4: Contour Map of Chapadgaon Mili Watershed**

**DEM with Stream of the Study Area**



**Figure 5: DEM with Stream of the Study Area**

**Morphometric Analysis of River Kathpadi**

Morphometric analysis is essential for watershed management study of any river. Therefore, morphometric analysis is carried out of River Kathpadi for Chapadgaon mili watershed.

**Table 2: Bifurcation Ratio of River Kathpadi**

| Stream Order ( $\mu$ ) | Number of Streams ( $N\mu$ ) | Bifurcation Ratio ( $R_b$ ) |
|------------------------|------------------------------|-----------------------------|
| 1                      | 91                           | 4.78                        |
| 2                      | 19                           | 4.74                        |
| 3                      | 4                            | 2.00                        |
| 4                      | 2                            | 2.00                        |
| 5                      | 1                            | -                           |

**Table 3: Linear Aspects of River Kathpadi**

| Stream Order ( $\mu$ ) | Number of Streams ( $N\mu$ ) | Total length of streams in km ( $L\mu$ ) | Log $N\mu$ | Log $L\mu$ | Mean Stream Lengths ( $MSL = L\mu / N\mu$ ) |
|------------------------|------------------------------|--|------------|------------|---|
| 1                      | 91                           | 54.561                                   | 1.95       | 1.73       | 0.22  |
| 2                      | 19                           | 20.416                                   | 1.27       | 1.30       | -0.03                                       |
| 3                      | 4                            | 7.796                                    | 0.60       | 0.89       | -0.29                                       |
| 4                      | 2                            | 10.076                                   | 0.30       | 1.00       | -0.70                                       |
| 5                      | 1                            | 8.172                                    | 0          | 0.91       | -0.91                                       |
| <b>Total</b>           | <b>117</b>                   | <b>101.021 km</b>                        |            |            |   |



**Table 4 : Morphometric Parameters of Chapadgaon mili Watershed**

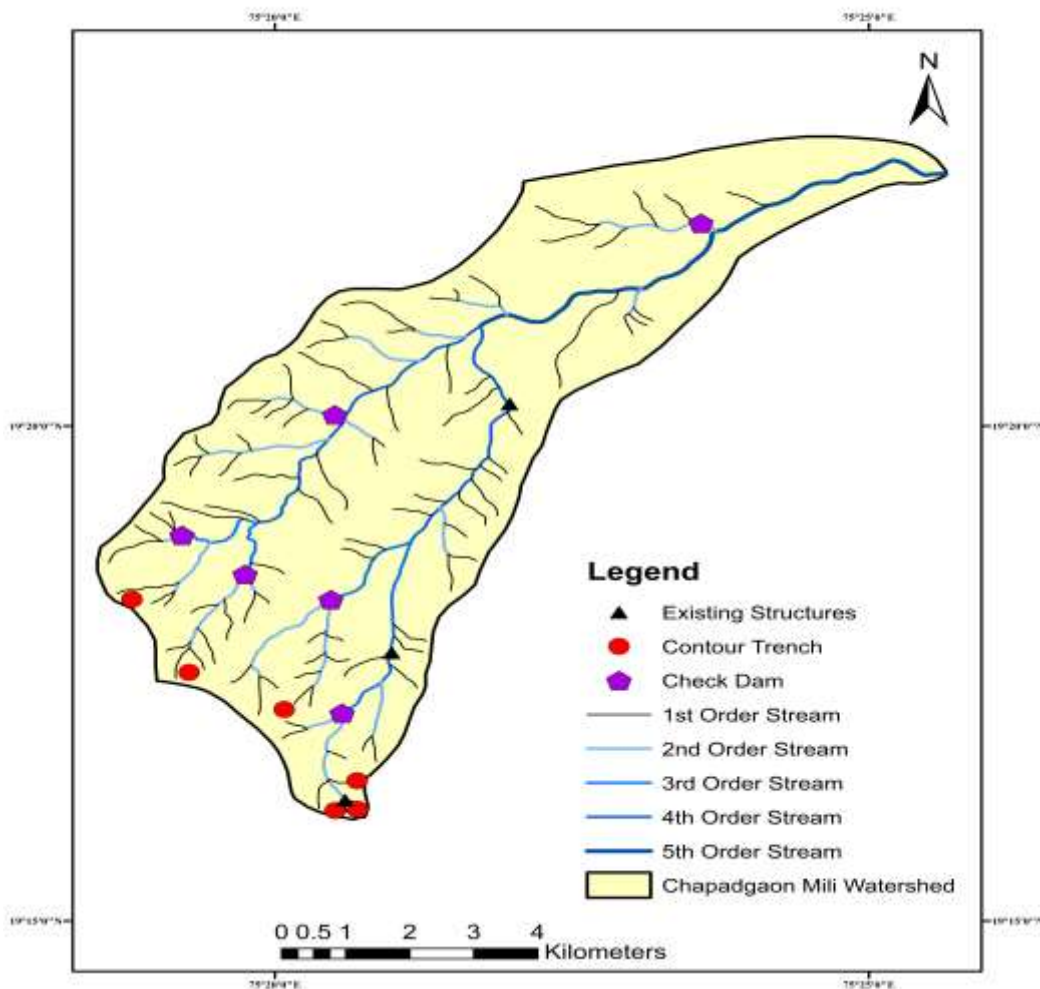
| Morphometric Parameters | Calculated Value       |
|-------------------------|------------------------|
| Area (Sq. km)           | 55.201 km <sup>2</sup> |
| Perimeter (km)          | 39.547 km              |
| Drainage Density        | 1.83 P/Sq.km           |
| Stream Frequency        | 2.11 P/Sq.km           |
| Texture Ratio           | 2.95                   |
| Basin Length (km)       | 14.46 km               |
| Elongation Ratio        | 0.58                   |
| Circulatory Ratio       | 0.44                   |
| Form Factor Ratio       | 0.26                   |

**F value** of this basin is 0.26, which shows that basin is elongated.

**Site Suitability for Watershed Management Structures (WMS):**

Since the basin course in the Chapadgaon mili-watershed and lithology of the area is more or less same, only two types of structures can be suggested at different stages or the various zones in the watershed. In the upper part of the basin slope is 5 to 15 degrees, where contour trenching is best filled because it reduces the water velocity and soil erosion at these locations and the flowing water in the trenches can be percolated at lower reaches. Check dams at the lower slopes in the middle course of the stream will be useful, which can have advantage of water storage. Depending on the lithology and local geomorphic condition of the Chapadgaon mili watershed only two types of structures can be suggested.

**Site Suitability Map of Chapadgaon Mili Watershed**



**Figure 6 : Site Suitability Map of Chapadgaon Mili Watershed**

- **Results and Discussion:**

A hydrological characteristic is an important for the watershed management study. Rainfall is one of the important parameter of hydrological study of any region. We have considered 23 years of rainfall and rainy days data from 1998 to 2020 of Shevgaon tahsil for this research paper. Positive correlation is observed in average rainfall and rainy days in the study area, which is 0.76. Though there is a strong positive correlation between monsoon of rainy days and amount of rainfall in the region but it is for the monsoon period only where, all the collected water flows in a downstream channel at the same time percolation takes place on a higher rate and evaporation is also more therefore, the highly correlated amount of water if can be stored will be use full if watershed management structures can be useful to solved the problem of drinking water and water for agriculture purposes.

- **Conclusion:**

On the basis of field survey and morphometric analysis following watershed management structures has been suggested in Chapadgaon mili watershed such as, contour trenching and check dam. Since the watershed is very small. So, in the upper part contour trenching and lower part check dam are useful, as discuss with the local people also.

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