CHAPTER III

GEOMORPHOLOGY AND DRAINAGE BASIN CHARACTERISTICS
CONTENTS

3.1 Introduction
3.2 Regional Geomorphology
3.3 Geomorphic units of Parri Basin
3.4 Drainage Basin Characteristics of Parri Nadl
   3.4.1 Linear Properties
   3.4.2 Areal Properties
   3.4.3 Relief Properties
3.5 Slope analysis and Landforms
3.6 Lineament/Fracture Analysis

FIGURE :-

3.1 Regional Geomorphology
3.2 Geomorphology of Parri Basin
3.3 Fluvial Features
3.4 Stream order/Drainage map of Parri Basin
3.5 Drainage density variation map of Parri Basin
3.6 Stream Frequency variation map of Parri Basin
3.7A Longitudinal profile of Parri Stream
3.7B Area distance curve
3.8 Hypsometric curve
3.9 Slope category map of Parri Basin
3.10 Slope Profile and Geomorphic units.
3.11 Lineament map.

**TABLE:**

3.1 Linear properties of Parri Basin
3.2 Areal properties of Parri Basin
3.3 Relief properties of Parri Basin
3.4 Spatial Variation of Drainage Density
3.5 Spatial Variation of Drainage Frequency
3.6 Slope and associated Landform Features.

**PLATE:**

3.1 Field Photograph Showing Formation of Kankar Nodules as Secondary Deposits.
3.2 Field Photograph Showing Meandering of Stream South East of Rajnandgaon.
3.3 Rocky and Stony Slopes with Scanty Vegetation Seen in the Thelkadih Chaweli area.
3.4 Uplands Geomorphic Unit without Shrubs occurs near Chawell Muhrum Khurd Road.
3.5 Field Photograph showing intensive agriculture in the Alluvial Belts, South of Rajnandgaon.
3.6 Rolling upland slopes merging into lowlying undulating plains.
3.7 Field Photograph: Waste Lands in undulating Pediplains.
3.1 INTRODUCTION:


3.2 REGIONAL GEOMORPHOLOGY:

The Rajnandgaon tract exhibits contrasting topography in relation to geology. Geomorphology of the study area has been strongly influenced by lithology, structure and climatic conditions. The area exhibits bonteous geomorphic set up comprising different geomorphic units belonging Archean to Recent alluvium deposits.

Regionally, the study area is dominated by erosional Land forms. The north western part represents a fairly rugged relief of structural hills of Maikal range (741 metres amsl) belonging to metasediments and Archeans. The Linear ridges of quartzites are common. Major streams originate from this zone. To the east, this zone is bordered by piedmont and pedimented areas, as well as pediplains. In the foot hills the area depicts a vast pediment, the monotony of
which is broken by the residual hill relief around Dongargarh. The famous Mata Dongri lies (565 metres amsl) to the north west of Parli basin. A number of isolated residual Granitic hills scattered in this zone. The terrain eastwardly lowering down towards Rajnandgaon plains where Chhattisgarh sedimentary horizon occupies the lowlying area (below 360 metres). The uplands of Chhattisgarh undulating plains are characterized by occurrence of laterite as capping material throughout the area (above 340m-amsl) area. The occurrence of alluvial sand and gravel deposits is confined to stream banks and river courses.

A regional geomorphological map (Fig 3.1) has been prepared by using IRS Satellite imagery. The following predominant geomorphic units have been delineated.

1) Structural Hills          3) Slopes & Piedmont zone.
2) Residual Hills          4) Pediments
5) Undulating plains      6) Flood plains

3.2.1 STRUCTURAL HILLS :-

The structural hills show clear dip slope and steep escarpment slopes, occurring in the western part of the study area. The structural hill ranges trend more or less NNE-SSW. These hills comprises Archean, granite, gneiss, quartzite, meta sediments of Maikal Range. The exogenic and endogenic forces that have acted in mounting the landforms most of the region. Maikals had their impact on the geomorphic characters of the basin as well. Most of these land forms are covered with thick mixed forests. The forested part of hills exhibit dark red colour on FCC imagery.
FIG 3.1 Regional Geomorphology (Based on IRS satellite data interpretation)
is dominated by Mahanadi fluvial system. This zone exhibits horizontal to gently sloping lands (3°-5°) with few scattered uplands with laterite cap. This unit shows high cultivation practice. Mohara, Madanpur, Musra, Tumribod, Tilal, Rajnandgaon, & Durg falls in this zone.

3.2.6 FLOOD PLAINS :-

The flood plain is restricted to seasonal and ephemeral rivers and streams. It is composed of gravel and alluvial sand. The Seonath and Kharkhara are the perennial source of water, others are ephemeral in nature. High cultivation practice is common in this belt as this zone is confined along the banks of river and its major tributaries.

3.3 GEOMORPHOLOGY OF PARRI NADI BASIN :-

Parri Nadi lies in the west margin of Great Chhattisgarh plains where the area is fed by Seonath fluvial system. The present landscape evolved predominantly under the fluvial erosion system. Fluvial geomorphological evaluation is quite useful for water resource study in river basin planning. The evolution of the landscape of the Parri basin is mainly resulted due to various natural geomorphic processes like erosion, deposition and peneplanation.

A detailed geomorphic map prepared using aerial photographs (Panchromatic B & W) scale 1:40,000 photoscale and IRS FCC LISS II data. The standard recognition criteria for visual interpretation tone, texture, colour, pattern, association, size and shape have been utilized during mapping of geomorphic units. Following geomorphic units have been identified and delineated (Fig. 3.2).

1) Uplands  
2) Shallow buried pediplain  
3) Deep buried pediplain  
4) Alluvium / Valley fills
INDEX

FIG. 3.2  Geomorphology of Parri Basin (Based on Aerial Photo Interpretation)
The geomorphological map shows that the area is characterized by gently undulating pediplain country with uplands, slopes, shallow and buried pediplains and valley fills.

3.3.1 UPLAND :-

The upland occurs as capping of laterite in the basin peripheries and water divide zones. It shows a typical erosional surface of pediplains because these dissected mounds have a flat convex top indicating an earlier erosion surface. Laterite is the product of sub-aerial residual physico-chemical weathering of country rock. This acts as a recharge zone to the basin ground water and run off zone for surface water resource.

3.3.2 SHALLOW BURIED PEDIPLAIN :-

The undulating pediplains have concealed with thin soil covers. It occurs in the slopes of uplands where terrain lowering down towards middle part of the basin. The thickness of soil mantle varies from 1 to 2 metres and slope (2°-2.5°). Limited cultivation is practised in this unit. The ground water potential zone occur where two or more lineament / fracture intersected.

3.3.3 DEEP BURIED PEDIPLAIN :-

In lowlying areas and deeper zones of the basin thick sediments and soil concealed the pediplain. This unit shows mostly agricultural lands. It is confined to inner belt of the basin and acts as discharge zone for g.w.

3.3.4 ALLUVIUM FLOOD PLAINS & VALLEY FILLS :-

A narrow belt of alluvial and colluvial flats occupies along the Parri, Seonath and its major tributaries. Most of the streams have a zone of colluvial flat of channel fill with very gentle slope (0°-1°). The alluvial deposits comprising
silt, sand & clay have a thickness ranging from 1 metre to 4 metres as seen in some bank sections. The quaternary alluvial deposits found along river course are good discharge zone.

3.3.5 FLUVIAL FEATURES :-

River Seonath flows from west to east in the south of Rajnandgaon city and a wide flood plain has been developed by river courses of Seonath. The most conspicuous geomorphic feature include river cliff, unpaired valley fill terraces (Fig 3.3). The river on the flood plain have a shifting tendency and develop meandering scars. Paleochannels in form of meander scars were identified to the south east of Bharregaon and south of Jhola. Paleochannels acts as potential ground water reservoirs. (Gautam, 1994).

In the flood plain the occurrence of meander scars/old Channels indicate that the Seonath river has shifted its course from south to north. In the flood plain the deranged drainage pattern developed to the south west of Khuteri. A sand island has been identified at the mouth of Parri. Here the Parri meets with high water channel of Seonath river which leads to the development of sand island. The higher part of the channel and island forms nuclei of further deposition by over bank flows (Sharma, 1986). Floods of moderate discharge build the flood plains and high flow destroy the earlier flood plain topography. It appears from aerial photographs that the island can be divided into two levels, the low level (t1) and high level terraces (t2). The level t1, has been dissected by channel and this level shows convexity towards Parri Nadi mouth. The Seonath shows meandering phenomenon over a long distance. In meandering stream, abandoned channel depression due to cut off and avulsion lie at different distance from the active channels (Schumm & Litchy, 1963). The old channel seems to spread about 2 Km. from present active channel of Seonath in the south east of Bharregaon and between doab of Seonath and Kharkhara river which need detail investigation in
FIG. 3: ELUVIAL GEOMORPHOLOGY (Based on Aerial Photographs)
order to evaluate the water resource utility in adjoining areas.

3.4. DRAINAGE BASIN CHARACTERISTICS OF PARRI NADI:-

The drainage basin is considered as a geomorphic unit. The drainage area of a basin is the area which contributes water to a particular channel or set of channels within a drainage basin.

A drainage basin provides a limited unit of the earth’s surface within which basic climatic quantities can be measured and characteristic landforms described and a system within which a balance can be struck in terms of inflow and outflow of energy. (Luna B. Leopold, Wolman, Miller, 1964). Parri Nadi constitutes a subbasin of Seonath river which is a major tributary of Mahanadi river system in western part of Chhattisgarh plains. Drainage Basin characteristics of Parri Nadi has been worked out under linear, areal and relief aspects. The basin has been analysed morphometrically using Survey of India toposheets as base map, linear & areal measurement was done by rotameter and planimeter respectively.

3.4.1 (A) LINEAR PROPERTIES OF PARRI BASIN:-

3.4.1 A1. STREAM ORDER :-

Stream order is the process of identification of links in a stream network within drainage basin. The Strahler’s method (1952, 1964) of stream ordering system has been adopted in determining stream order in Parri Basin. The stream order analysis reveals that the Parri Nadi basin belongs to 4th order basin (Fig. 3.4). The run off zone constituted by 1st order streams covering is 63 Sq. Km in Parri basin upper catchment.
FIG 3.4 Stream Order & Drainage Pattern of Parri Basin, RJN.
### TABLE 3.1

<table>
<thead>
<tr>
<th>Order</th>
<th>Stream No. of streams of streams</th>
<th>Ratio</th>
<th>B.R. = N_u/N_u+1</th>
<th>Ratio</th>
<th>B.R. = N_u/Nu</th>
<th>Ratio</th>
<th>B.R. = L_u/L_u-1</th>
<th>Mean Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>161</td>
<td>0.927</td>
<td>4.12</td>
<td>2.116</td>
<td>3.9</td>
<td>4.5</td>
<td>6.0</td>
<td>7.99</td>
</tr>
<tr>
<td>II</td>
<td>39</td>
<td>1.966</td>
<td>4.29</td>
<td>2.182</td>
<td>3.9</td>
<td>4.5</td>
<td>6.0</td>
<td>7.99</td>
</tr>
<tr>
<td>III</td>
<td>10</td>
<td>4.29</td>
<td>1.966</td>
<td>2.182</td>
<td>3.9</td>
<td>4.5</td>
<td>6.0</td>
<td>7.99</td>
</tr>
<tr>
<td>IV</td>
<td>1</td>
<td>24.80</td>
<td>24.80</td>
<td>2.116</td>
<td>3.9</td>
<td>4.5</td>
<td>6.0</td>
<td>7.99</td>
</tr>
<tr>
<td><strong>TOTAL IV</strong></td>
<td>211</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
</tbody>
</table>

**Linear Properties of Pari Basin**

**TABLE 3.1**
\[ R_b = \frac{N_u}{N_u + 1} \]

Where \( R_b \) = Bifurcation ratio, \( N_u \) = Number of segment of a given number, \( N_u + 1 \) = Number of segments of the next higher order.

Bifurcation ratio gives an idea of the development of drainage in an area because it is an index of the degree of integration of streams of various orders in drainage basin. A low value shows a higher degree of drainage integration. The Parri basin shows an average bifurcation ratio 6.0, a little above from normal value which ranges between 2 to 5. This indicates that higher concentration of water from low order (IIIrd order) into high order (IVth order) streams because a higher value 10.0 is observed between these streams. The high value in lower Parri basin area is influenced by fluvial geomorphology of Seonath and lithology of the Parri basin. The master Seonath river is flowing to the south of Rajnandgaon in a meandering channel with a wide flood plain. Evolution of drainage network in lower reaches decreased (i.e., frequency) and length of 4th order stream increased, which is responsible for high bifurcation value between 3rd and 4th order. It is evidenced by sudden decrease in the width of basin in lower reaches which promote elongation of basin shape to accommodate itself adjacent to master river.

3.4. A6 WEIGHTED MEAN BIFURCATION RATIO:-

Weighted mean bifurcation ratio (Strahler, 1952) is a representative value for basin because the average bifurcation value 6.0 does not hold true value for whole basin. It is obtained by following formula:-

\[
R_{bw} = \frac{R_{b1} N_1 + R_{b2} N_2 + \ldots \ldots + R_{bn} N_n}{N_1 + N_2 + N_3 + \ldots \ldots + N_n}
\]

Where \( R_{bw} \) = Weighted mean bifurcation ratio, \( R_{b1} \) = Bifurcation ratio between 1st and 2nd order stream, \( N_1 \) = total no. of stream segments involved in
determination of Rb1 and so on (Singh et al. 1997). This Parri basin gives 4.5004 weighted mean bifurcation ratio which is considered as a representative value for complete basin.

3.4 A7. STREAM LENGTH RATIO :-

The average stream length ratio of Parri basin is 3.359 and value ranges from 2.116 to 5.780. It is the ratio of the mean length of stream of one order to the next lower order (Horton, 1945).

\[ RL = \frac{Lu}{Lu-1} \]

Where \( RL \) = Stream length ratio, \( Lu = \) The mean stream of all stream segments of the order \( u \), \( Lu-1 = \) The mean length of stream segments of the next lower order.

It is observed that the stream length ratio between 3rd and 4th order streams shows high value 5.780. This high value is due to excessive length of 4th order stream which in turn depends on geomorphic stage or development of the basin.

3.4.2 B AREAL PROPERTIES OF PARRI BASIN:-

Areal properties of a drainage basin of catchment includes basin area, length, width and perimeter which determines the areal extent and shape parameter (Table 3.2).

3.4.2. B. 1 ELONGATION RATIO :-

It is the ratio of the diameter of a circle having the same area as the basin and the maximum basin length (Schumm, 1956).

\[ Re = \frac{d}{Lb} \text{ or } Re = \frac{\sqrt{2 A / \pi}}{Lb} \]
### TABLE 3.2: AREAL PROPERTIES OF PARRI BASIN

| Basin Length (Km) | Width of Basin (Km) | Perimeter (Km) | Area (Km²) | Elongation Ratio | Flow Form Factor | Drainage | Stream Density | Overland Density | Maintenance Flow Frequency | Channel Constant of Density | Form Factor | Lemaître Drainage Area Expansion
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1.2510</td>
<td>0.8978</td>
<td>1.9893</td>
<td>0.9714</td>
<td>0.5406</td>
<td>0.2294</td>
<td>1.0893</td>
<td>1.2510</td>
<td>0.2294</td>
<td>0.8978</td>
<td>1.125</td>
<td>1.000</td>
<td>0.9714</td>
</tr>
</tbody>
</table>

Form Factor = \( \frac{A}{L^2} \)

Drainage Density = \( \frac{D}{A} \)

Channel Density = \( \frac{D}{L} \)

Overland Density = \( \frac{D}{P} \)

Stream Density = \( \frac{D}{F} \)

Maint. Flow Frequency = \( \frac{F}{A} \)

Channel Constant = \( \frac{L}{D} \)

Lemaître Drainage Area Expansion = \( \frac{A}{P} \)

Elongation Ratio = \( \frac{P}{B} \)

Ratio = \( \frac{L}{P} \)

Elongation Factor = \( \frac{L}{P} \)

Circular Perimeter = \( \pi \times D \)

Width of Basin = \( \frac{A}{L} \)

Length of Basin = \( \frac{A}{P} \)

Area = \( \frac{A^2}{L^2} \)

Depth of Channel = \( \frac{D}{L} \)

Area of Drainage Basin = \( \frac{A}{L} \)

Remainder of table entries are not provided due to unclear or missing data.
### Table 3.3: Relief Properties of Parral Basin

<table>
<thead>
<tr>
<th>Height of highest point on watershed (Zmts)</th>
<th>Height of basin mouth (Zs mts)</th>
<th>Total Relief (H = Z-Zs)</th>
<th>Channel Sinuosity Index (Cl)</th>
<th>Slope Relief Ratio (Rh = H/Lb)</th>
<th>Sinuosity Index (SI)</th>
<th>Valley Index (VI)</th>
<th>Channel Index (CI)</th>
<th>Relief Ratio of basin (RL)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.672</td>
<td>1.177</td>
<td>0.00193</td>
<td>1.333</td>
<td>0.62</td>
<td>1.672</td>
<td>1.177</td>
<td>1.333</td>
<td>0.62</td>
</tr>
</tbody>
</table>
Where Re is elongation ratio d is diameter of a circle of the same area as the basin, Lb is max. basin length parallel to the principal drainage line. The value vary between 0.6 to 1.0. It is categorized into four classes:

Circular  
above 0.9

Oval  
0.8 to 0.9

Less elongated  
0.7 to 0.8

Elongated  
below 0.7

Parri basin gives 0.5406 elongation ratio which falls under elongated class. The ratio gives an idea about hydrological behaviour or character of basin i.e. a circular basin is more efficient in the discharge of runoff than an elongated basin i.e. Tc or time of concentration of runoff is less in elongated basin which leads peak runoff.

3.4.2.8.2 FORM FACTOR:-

It is the ratio of basin area to the square of basin length (Horton, 1932).

\[ R_f = \frac{A}{L_b^2} \]

Where \( R_f \) = Form factor, \( A = \) Area of The basin, \( L_b = \) Length of the basin.

Parri basin represents form factor of 0.2294. This low value indicates elongated shape of the basin in which geometrical relationship of the basin area and length involved.

3.4.2.8.3 CIRCULATORY RATIO:-

This shape factor is influenced by drainage density, drainage frequency, geological structure, vegetation and land cover of catchment. It is a ratio
of basin area to the area of circle having the same perimeter as the basin (Miller, 1953).

\[ Rc = \frac{\text{Area of Basin}}{\text{Area of Circle with same perimeter as Basin}} = \frac{4\pi A}{P^2} \]

Where \( Rc \) = Basin Circulatory, \( A = \text{Area of Basin} \), \( P = \text{Basin Perimeter} \).

The Parri basin having 0.5346 circulatory ratio which exhibits elongated basin shape.

3.4.2.4.4 LEMINSCATE: -

Chorley (1957) introduced leminscate as shape parameter of drainage basin. It is stated as:

\[ K = \frac{L^2}{4A} \]

Where \( L = \text{Length of Basin} \), \( A = \text{Basin Area} \).

The Parri basin having above one leminscate (1.0893) which reveals that the basin is elongate. It is concluded that elongation ratio, circulatory ratio, form factor, and leminscate parameters indicates that the Parri basin is elongate in shape and hydrologically it signifies accordingly.

3.4.2.5 DRAINAGE PATTERN: -

Drainage pattern is the spatial arrangement of the streams segments. The drainage patterns classified into eight basic categories (Howard, 1967) but Parvis (1950) have described six basic and twenty four modified basic patterns. The Parri basin shows dendritic drainage pattern which indicates uniform resistance and homogeneity in lithology. (Fig. 3.4)
3.4.2.8.6 DRAINAGE DENSITY :-

It is a ratio between total length of stream of all orders within a basin and the basin area (Horton, 1932). The Parri basin shows an average drainage density value of 1.2510 Km/Km². This gives an idea of spacing of stream segments. Low drainage density is favoured in region of highly resistant or highly permeable sub soil materials. Under dense vegetation and low relief. Where as high drainage density is favoured in region of weak or impermeable subsoil materials, sparse vegetation and mountain relief (Chow, 1964). The drainage density of Parri basin has been found high as it is influenced by shaly terrain. A drainage variation map (Fig 3.5) of Parri basin is prepared from 1:50,000 scale toposheet. For the measurement of density toposheet is divided into one square Km grid. This map depicts that one third area comes under v. low drainage density zone and low drainage density occupies half of the basin whereas high drainage density found over laterite mounds with limited extent. The map also shows that values above 2 Km/Km² occurs in pockets in central part of the basin and confined particularly within low lying areas. (Table 3.4)

Drainage density is the network extent and is of considerable hydrogeological and geomorphological significance since it is an index of which measures both the nature of dissection within the basin and extent of hydrogeologically significant network (Gardiner, 1981).

3.4.2.8.7 DRAINAGE FREQUENCY :-

It is an index of drainage texture of the basin (Horton, 1945) and denotes total number of channel of streams per unit area within basin. The Parri Nadi basin shows average drainage frequency of 0.8978/Km2. The drainage frequency ranges from 1 to 8.0 (west of Madanpur). A drainage frequency variation map (Fig. 3.6) has prepared which shows that about 40% of the basin area comes under very
### TABLE 3.4
Spatial Variation of Drainage Density

<table>
<thead>
<tr>
<th>S.No.</th>
<th>Class</th>
<th>D.O. Value</th>
<th>Area %</th>
<th>Cumulative %</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>High above 3</td>
<td>0.56</td>
<td>0.24</td>
<td>0.24</td>
</tr>
<tr>
<td>2.</td>
<td>Medium</td>
<td>1.4</td>
<td>44.26</td>
<td>45.96</td>
</tr>
<tr>
<td>3.</td>
<td>Low 1 - 2</td>
<td>4.1</td>
<td>123.57</td>
<td>168.53</td>
</tr>
<tr>
<td>4.</td>
<td>Very Low less</td>
<td>4.7</td>
<td>76.77</td>
<td>100.00</td>
</tr>
</tbody>
</table>

### TABLE 3.5
Spatial Variation of Drainage Frequency

<table>
<thead>
<tr>
<th>S.No.</th>
<th>Class</th>
<th>Stream Area %</th>
<th>Cumulative %</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Very High above 6</td>
<td>1.70</td>
<td>1.70</td>
</tr>
<tr>
<td>2.</td>
<td>High</td>
<td>1.4</td>
<td>44.26</td>
</tr>
<tr>
<td>3.</td>
<td>Medium</td>
<td>0.4</td>
<td>60.00</td>
</tr>
<tr>
<td>4.</td>
<td>Low</td>
<td>0.2</td>
<td>100.00</td>
</tr>
</tbody>
</table>
3.5 Drainage - Density variation map, Parri Basin
INDEX

Stream frequency Km/Km²

- above 6 Km/Km²
- 4-6 Km/Km²
- 2-4 Km/Km²
- Below 2 Km/Km²

 Sect 3.6 Stream Frequency Variation Map, Parri Basin, RJN.
basin (Schumm, 1963). This is evidenced in Parri basin where due to low relief, the mean channel gradient of the main valley, decreases the carrying capacity of load in the channel. The sediments of bed load deposited between Nawagaon-Khapri Kalan and Dhaba to confluence point due to low carrying capacity of stream bed load of the channel & pronounced soil erosion in upper reaches.

3.4.3.A3 SINUOSITY INDEX:-

The term meandering is applied to sinuous channel that exhibits a certain degree and regularity of sinuosity. Seonath river and Parri Nadi both contains sinuous channels. Sinuosity index is the ratio between Channel length (CL) and river valley length (VL). It varies from 1.0 to 4.0 or more, stream having sinuosity index below 4.0 are called sinuous and more than this are called meandering (Leopold, Woolman, and Miller, 1969). According to this classification Parri is a sinuous river which gives sinuosity index 1.177.

3.4.3.A4 STANDARD SINUOSITY INDEX :-

It is the ratio of channel index and valley index which obtained by dividing channel and valley length with their respective air distances. On the basis of this index basin may be classified into three stages of development 1. youthful (less than 1.5) 2. Early Mature (1.15 to 1.30) 3. mature (more than 1.30) (Mueller, 1968). It is observed that Parri basin attains mature stage. (SSI 1.672)

3.4.3.A5 LONGITUDINAL PROFILE:-

A longitudinal profile of Parri Nadi (Fig 3.7A) is concave to sky, but some portions are convex. It shows that there is a maximum fall in relief occurs in the first 1.4 km. length of stream then it gradually decline when it reaches to the plain. It shows concave sloping curve between 350 and 320 metres above mean sea level. It represents that the river posses mature stage and equilibrium condition. Area
Distance curve (Fig 3.7B) indicates that mid profile of Parri represents 73% of the basin area.

3.4.3. A6 HYPSOMETRIC ANALYSIS: -

The hypsometric curve of Parri basin is obtained by plotting h/H and a/A percentages in ordinate and abscissa. The hypsometric analysis of Parri basin indicates that 51.93% of basin area remains as solid mass and the basin has progressively reaching monadnock phase of erosion and at present, it attained the mature stage of equilibrium. (Fig 3.8).

3.5 SLOPE ANALYSIS: -

The slope of a drainage basin is an important variable which not only shaping the geometry of the basin but also determines the development and management practices of drainage basin or watershed. A slope map of Parri basin was prepared from Topo sheets on 1:50,000 Scale with 10 metres contour interval to understand the terrain, nature of upland and river valleys. (fig. 3.9)

The Parri basin is divided into grids of one sq. km. and average slope value is determined by using Wentworth’s (1930) formula which is stated as.

\[
\tan \theta = \frac{N_c \times I}{636.6}
\]

Where \(N_c\) = Number of Contour crossing / Km², \(I\) = Contour interval in metres.

3.5. A SPATIAL DISTRIBUTION OF SLOPE & GEOMORPHIC UNIT: -

The Parri basin has been into four high (above 3°), moderate (2°-3°), low (1°-2°) and very low (below 1°) slope classes. The area represents an undulating plain country except a small area in the northern part of dissected upland which
FIG. 3.8 HYPSOMETRIC CURVE SHOWING EROSION STAGE OF PARRI BASIN
FIG. 3.9  Slope category map, Parri Basin, RJN.
shows convexity, with more than 3° slopes. The areal extent of different slope classes shows that slope category less than 2° occupy 73% while the slope class above 3° occupy only 7% of the area. This indicates pediplained nature of the terrain. The slope categories are correlated with landforms of the basin (Table 3.6) which can be utilised for landuse management practices. It is observed that buried pediplains having low to very low slope classes and mostly occupied by agricultural lands. A slope profile of Thelkadih-Hardi section is illustrated in Fig. (3.10) which shows major geomorphic units adjacent to Parri & Seonath.

3.6. LINEAMENT/FRACTURE ANALYSIS:-

A lineament map (Fig. 3.11) of Parri basin has been prepared using satellite data IRS LISS II FCC, 1:125,000 scale. It shows that the Parri basin exhibits two major directions of lineament striking NNW-SSE and NNE-SSW. Lineament map depicts that NNW-SSE is the prominent direction along which fracture and joints have been oriented, because in this direction 60% fractures aligned, which is also the main axes of Parri basin in Upper reaches. On the basis of lineament study and well inventory studies cross sections A, B, C & D are marked as G.W. potential sites for exploitation. Here major lineaments cut perpendicular to each other leads development of favourable zone for groundwater occurrence. Being poor aquifer zones available in the Parri basin the lineaments are major tool in targeting g.w.
FIG. 3.10 Geomorphic Units in Thekadih-Hardi Slope Profile, Parri Basin
INDEX

- Lineament
- G W Potential Site
- Drainage Basin Boundary

FIG.3.11, Lineament Map of Parri, leads G.W. Targetting
PLATE 3.1  FIELD PHOTOGRAPH SHOWING FORMATION OF KANKAR NODULES AS SECONDARY DEPOSITS.

PLATE 3.2  FIELD PHOTOGRAPH SHOWING MEANDERING OF STREAM SOUTH EAST OF RAJNANDGAON.
PLATE 3.3. ROCKY AND STONY SLOPES WITH SCANTY VEGETATION SEEN IN THE THELKADIH CHAWELI AREA.

PLATE 3.4 UPLANDS GEOMORPHIC UNIT WITHOUT SHRUBS OCCURS NEAR CHAWELI MUHRUM KHURD ROAD.
PLATE 3.5. FIELD PHOTOGRAPH SHOWING INTENSIVE AGRICULTURE IN THE ALLUVIAL BELTS SOUTH OF RAJNANDGAON.

PLATE 3.6. ROLLING UPLAND SLOPES MERGING INTO LOWLYING UNDULATING PLAINS.
PLATE 3.7. FIELD PHOTOGRAPH: WASTE LANDS IN UNDULATING PEDIPLAINS.

PLATE 3.8. OCCURRENCE OF SHALLOW BURIED PEDIPLAIN IN LOWLYING AREAS: SUBDUEDE TOPOGRAPHY.