

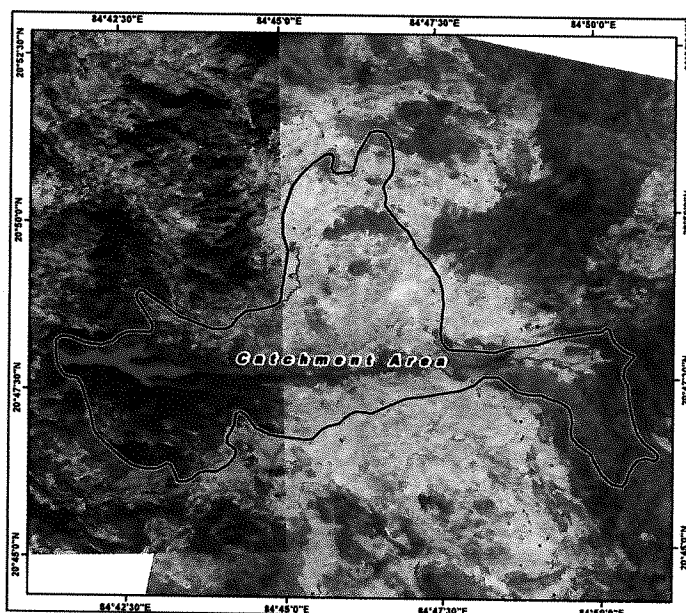


GOVERNMENT OF ODISHA
DEPARTMENT OF WATER RESOURCES

CATCHMENT AREA TREATMENT (CAT)

FOR


KUTULISINGA IRRIGATION PROJECT



DIST: ANGUL, ODISHA

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December 2020


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1. Introduction

The Catchment Area Treatment (CAT) targets overall improvement in the environmental conditions of the region. All the activities are aimed at treating the degraded and potential areas of severe soil erosion. The plan provides benefits due to biological and engineering measures.

The CAT Plan would cover the following aspects:

- Identification of free draining catchment
- Assessment of Land Use, Soil, Slope in the catchment based on Remote Sensing (RS) /Geographic Information System (GIS) and Validation through field survey
- Erosion levels the watershed and prioritization of water sheds will be done by appropriate methods.
- As per the requirement of Ministry of Environment & Forests and Climate Change (MoEF & CC), Government of India, the treatment measures will be proposed for the area falling higher priority erosion categories. Both Engineering measures as well as Biological treatment measures will be proposed in the CAT plan.
- The cost of the administrative set up and mitigative measures will include recommendation from State Forest Department for all forest lands and from the Soil Conservation Department for non – forest land.

2. Need

Reservoirs formed by dams on rivers are subject to sedimentation. The process of sedimentation embodies the sequential processes of erosion, entertainment, transportation, deposition and compaction of sediment. The study of erosion and sediment yield from catchments is of utmost importance as the deposition of sediment in reservoir reduces its capacity, and thus affecting the water availability for the designated use. The eroded sediment from catchment when deposited on streambeds and banks causes threading of river reach. The removal of top fertile soil form catchment adversely affects the agricultural production. Thus, a well-designed catchment area treatment plan is essential to ameliorate the above –mentioned adverse process of soil erosion.

The CAT plan highlights the management techniques to control erosion in the catchment area of a water resource project. The life span of a reservoir is greatly reduced due to erosion in the catchment

area. Adequate preventive measures are thus needed for the treatment of catchment for its stabilization against future erosion.

Quantifying soil erosion and reservoir sedimentation is necessary for prioritizing catchments for treatment and development of a suitable treatment mix. It is, therefore, also required that the effect of various treatments on controlling soil erosion are quantitatively known. River gauging data are the best information source for undertaking the above activities. As such data are not available for this catchment, so estimation procedure is adopted. At the present level of data availability and based on the past experience, **Sedimentation (Silt) Yield Index (SYI)** appears to be an acceptable parameter for use in catchment prioritization work.

SYI is calculated using an empirical formula. Based on the numerical value of SYI, catchments are categorized into five priority classes from Very High ($SYI > 1300$) priority to Very Low ($SYI < 1000$) priority. The method was proposed by **All India Soil Survey and Land Use Planning (AISSLUP)** currently known as **Soil and Land Use Survey of India (SLUSI)** based on several studies. The method has been used to prioritize catchments in India totaling in area of millions of hectares. It is reported that, the SYI procedure is reliable for determining priority watersheds. The empiricism in this method is manifest in the selection of unit area (mapping unit) and assigning an appropriate value of delivery ratio to it. SYI method is widely used because of the fact that it is easy to use and lesser data requirement. Moreover, it can applied to a larger areas like sub watersheds etc.

3. Methodology adopted

Database on natural resources, terrain conditions, soil type of the catchment area is a pre-requisite to prepare CAT plan. Various thematic maps were prepared and used in preparation of the CAT plan, in Geographic Information System (GIS) platform.

The methodology adopted for development of CAT plan for the project is as under:

- Catchment boundary delineation from Survey of India Topo sheets
- Watershed boundary form watershed Atlas of India and website of Soil and Land Use Survey of India (SLUSI) and the micro watershed boundary collected from Watershed Mission of Odisha
- Land use/Land cover map preparation from recent 5.8m resolution LISS-IV Multi Spectral Satellite image

- Contour digitization from Survey of India OSM topo sheet and generation of slope map
- Soil map preparation from National Bureau of Soil Survey and Land Use Planning (NBSS&LUP)
- Assigning weightage value of mapping units based on slope, land use and soil texture and Delivery ratio based on distance from nearest stream
- Estimation of Soil Loss using Silt Yield Index
- Watershed Prioritization
- Selection of locations of treatment and Catchment Treatment (CAT) Plan
- Cost Estimate

Thematic data integration and erosion index modeling was done using relevant map layers in GIS.

Silt Yield Index (SYI) of various micro watersheds within the free catchment was estimated. Watershed management approach were proposed for optimal use of soil and water resources within the catchment with the broad objective of

- increasing infiltration into soil
- control excessive runoff
- manage & utilize runoff for useful purpose

3.1. Brief Description of Kutulusinga Dam

This project aims at construction of a 323.00 M. long and 39.15 M. high earth dam having a central ogee gated spillway of 33.00 M. length. All the alternatives of dam axis have been explored and the present one has been approved by the Engineer-in-Chief, DoWR, Odisha. The total catchment area at the dam site is 83.30 Sq. Km. The maximum annual rainfall of the catchment area is 2728.50 mm. and the Net dependable yield is 75% that is 1995.09 Ham. The project has an average water utilization of 71.86 % considering 29 years data. The earth dam is proposed to be of homogeneous section with provisions of vertical sand chimney to drain the seepage water through the filter drains and rock-toe.

The 33.00M. long central spillway shall be ogee type & gated. The crest level of the spillway is 193.00 M. fitted with radial gates of 11m X 8m size. The spillway is designed to discharge maximum flood of 979.00 Cumecs. The project shall provide irrigation to C.C.A of 2540 Ha. The project will irrigate 2158 Ha. in kharif and 1015 Ha, in rabi by means of two main canals. The length of left main canal is 11.344 Km. (approx.) and right main canal is 13.04 Km. Minors and Sub-minors' network shall be provided as per the requirement after detailed survey is done. Besides creating above irrigation potential, 20 % of the water

has reserved for riparian use at the downstream & upstream as per suggestion of Central Water Commission. The project is entirely in the state of Odisha and hence the question of interstate aspect does not arise. The Catchment of Kutilisinga Irrigation project is enclosed at **Plate-1** superimposed on SOI Topo sheet.

3.2. Irrigation planning

The project comes under Athamalik Block of Angul district which is a hilly and drought prone area. The present land use practice and the traditional farming is primitive and continuing from generations. The modern methods of cultivation are yet to be practiced due to the erratic behavior of the monsoon. Paddy is the principal crop generally grown by the people of this locality. At present the area under less cultivation having very less yield. After completion of the project irrigation to an area of 2158 Ha. in kharif and 1015 Ha, in rabi with an annual irrigation of 3175 Ha shall be developed. Besides, the project will also provide drinking water and other riparian use at the downstream and upstream.

3.3. Main Canal distribution System

There are two main canals i.e. left and right of length 11.344 Km. and 13.04 Km. respectively. Both the canals shall be contour canals.

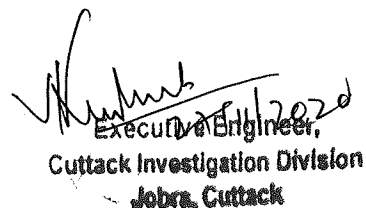
Land Levelling:

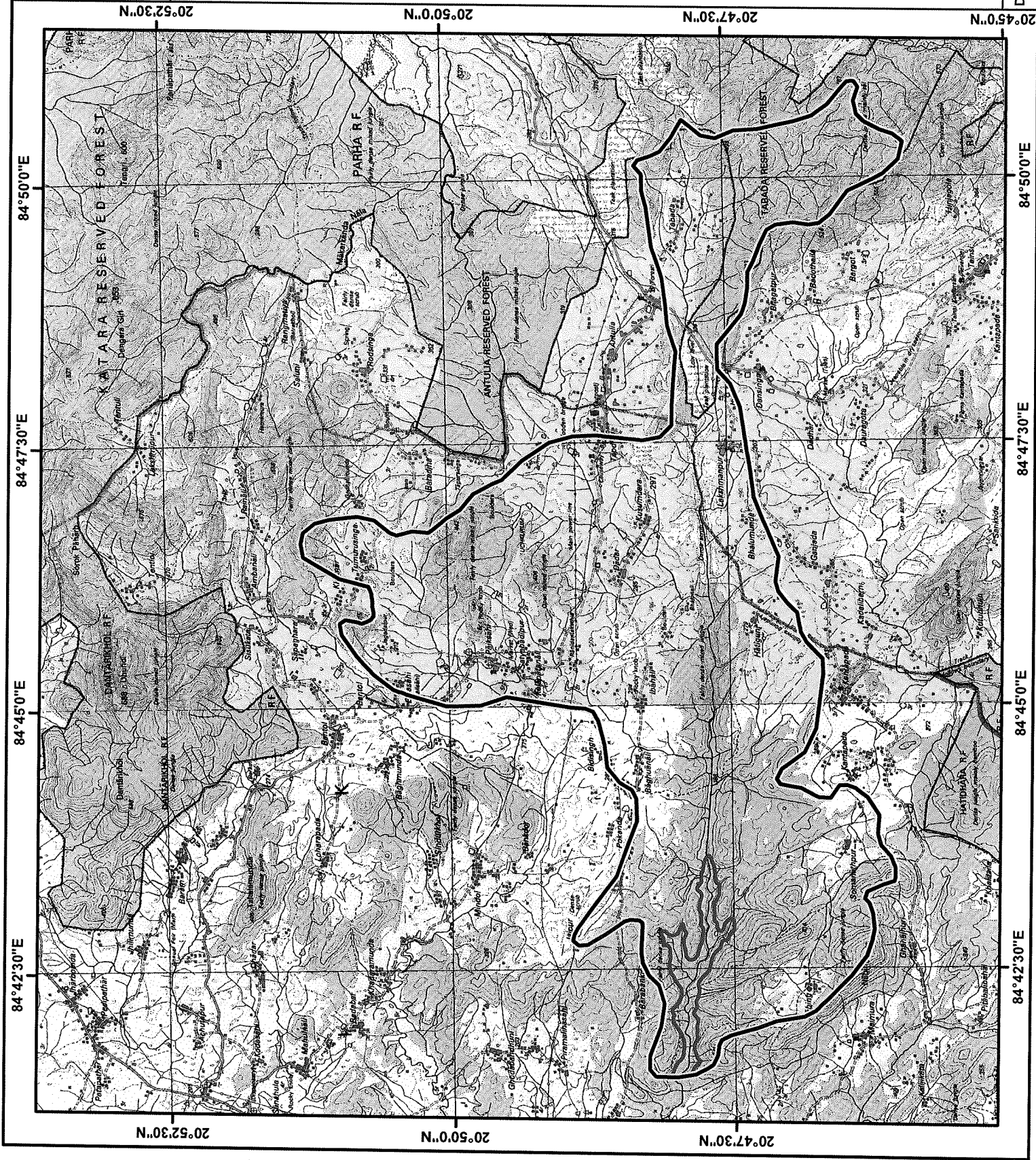
Since a large area of the ayacut is undulated, land levelling in the command area cannot be done. This activity shall be automatically undertaken by the beneficiaries of the command area after development of the irrigation facilities. Also, other beneficiary-oriented schemes can be extended by the D.R.D.A at subsidized rates.

Cropping Pattern and crop water requirement

Before irrigation, paddy is the main crop generally grown by the people of this locality. Due to uncertainty of rainfall in the ayacut neither any high yielding variety paddy nor any cash crops are cultivated. After creating assured irrigation high yielding paddy as well as crops like vegetables, groundnuts, maize and other oilseeds will be cultivated. State Agricultural Department provides technical know-how as well as advice for better crop yields. Crop water requirement based on statement of State Agriculture Department for different months have been calculated as per guidelines of Ministry of Agriculture.

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Legend

Ponding Alignment

Catchment Boundary

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3.4. Reservoir Stimulation Study

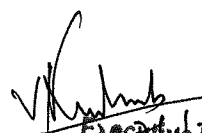
Period of Simulation is 1977-78 to 2005-06 (hydrological year). First of all, sediment analysis is carried out with reference to I. S. Code No. IS-5477 (part I)-1969 (Methods for fixing the capacities of Reservoirs) for 50 years and 25 years. Revised Area Capacity are computed with assumption of new zero elevation. Finally, new zero elevation with reference to 50 year's silt loads is 171.65 M. and in case of 25 year's silt load is 170.50 M. Hence D.S. L is fixed at an elevation of 174.00M. Evaporation loss data is adopted from Kutulusinga medium irrigation project report already approved by the C.W.C. F. R.L is finalized by hit & trial at an elevation of 190.50 M. which will take care to supply the irrigation needs to an area of 2540 Ha. of C.C.A. For simulation studies, 25 years sedimented revised area capacity curves are used. Simulation studies are carried for 29 years and the percentage of success is 86.20 %. The percentage of water utilization is 71.86 %.

Water Account Statement

The Water Account statement reflects the percentage of utilization of water potential maximum up - to 71.86 %. The project aims at maximum utilization of water by providing irrigation up - to 81 % of C.C.A. in kharif, 40 % of C.C.A. in rabi and 121 % of C.C.A. as annual irrigation.

Table-1: Abstract of forest & Non-Forest land involved in the project

Sl No	Tahasil	Village	Forest Area		Non-Forest Area		Total Area	
			Acre	Hectare	Acre	Hectare	Acre	Hectare
1	Athamalik	Taleipathar	20.680	8.369	7.930	3.212	28.610	11.581
2		Arkhakud	0.190	0.077	0.740	0.299	0.930	0.376
3		Nuaarakhakud	1.450	0.587	1.050	0.427	2.500	1.014
4		Karavahalikhaira	8.890	3.598	5.000	2.022	13.890	5.620
5		Gunduri	0.060	0.024	5.110	2.067	5.170	2.091
6		Anandapur	5.220	2.113	5.530	2.238	10.750	4.351
7		Tabada	2.410	0.975	2.840	1.150	5.250	2.125
8		Kutulisinga	14.510	5.872	2.470	1.000	16.980	6.872
9		Ranibandha	0.610	0.247	17.410	7.045	18.020	7.292
10		Hatasimili	0.030	0.012	1.130	0.456	1.160	0.468
11		Sadanandapur	3.280	1.327	6.430	2.601	9.710	3.928
12		Alekhapur	2.260	0.915	5.700	2.306	7.960	3.221
13		Thakurgar	0.500	0.202	1.960	0.793	2.460	0.995
14		Kutulisinga RF	320.650	129.766	0.000	0.000	320.650	129.766
Total Area			380.740	154.084	63.300	25.616	444.040	179.700


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The FRL of this project has been kept at RL 201.00 M & the top bank level is kept at RL 204.00 M. By creation of the reservoir total 124.713Ha. of land will be submerged involved no cultivated land.

4. Thematic Map Generation

As mentioned in the methodology, various thematic layers like catchment, watershed, drainage, contour, slope, land use, soil were prepared in Geographic Information System (GIS) platform using satellite image, OSM Sol Topo Sheet and other secondary source data. For seamless integration of different thematic layers and interactive spatial analysis, the themes were generated UTM (Universal Transverse Mercator) projection system. This projection system is used in the recent publication Open Series Map (OSM) of Sol and is also suggested in National Map Policy. Datum used for the projection is WGS 1984 and Zone is UTM 45 North.

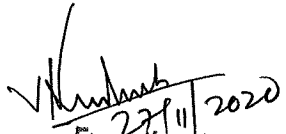
4.1.Catchment and Watershed map

The catchment boundary of Kutulusinga dam was delineated from Sol topo sheets F45S9 & F45S13, looking at the contours and drainage. The drainage map of the project is enclosed at **Plate-2**. Since the catchment is very small, it was decided to prepare the CAT plan at Micro Watershed level instead of Watershed level. The micro watersheds are prepared using the information available in Watershed Atlas of India, website of Land Use Survey of India (SLUSI) and the micro watershed boundary collected from Watershed Mission of Odisha. The micro watershed map is enclosed at **Plate-3**.

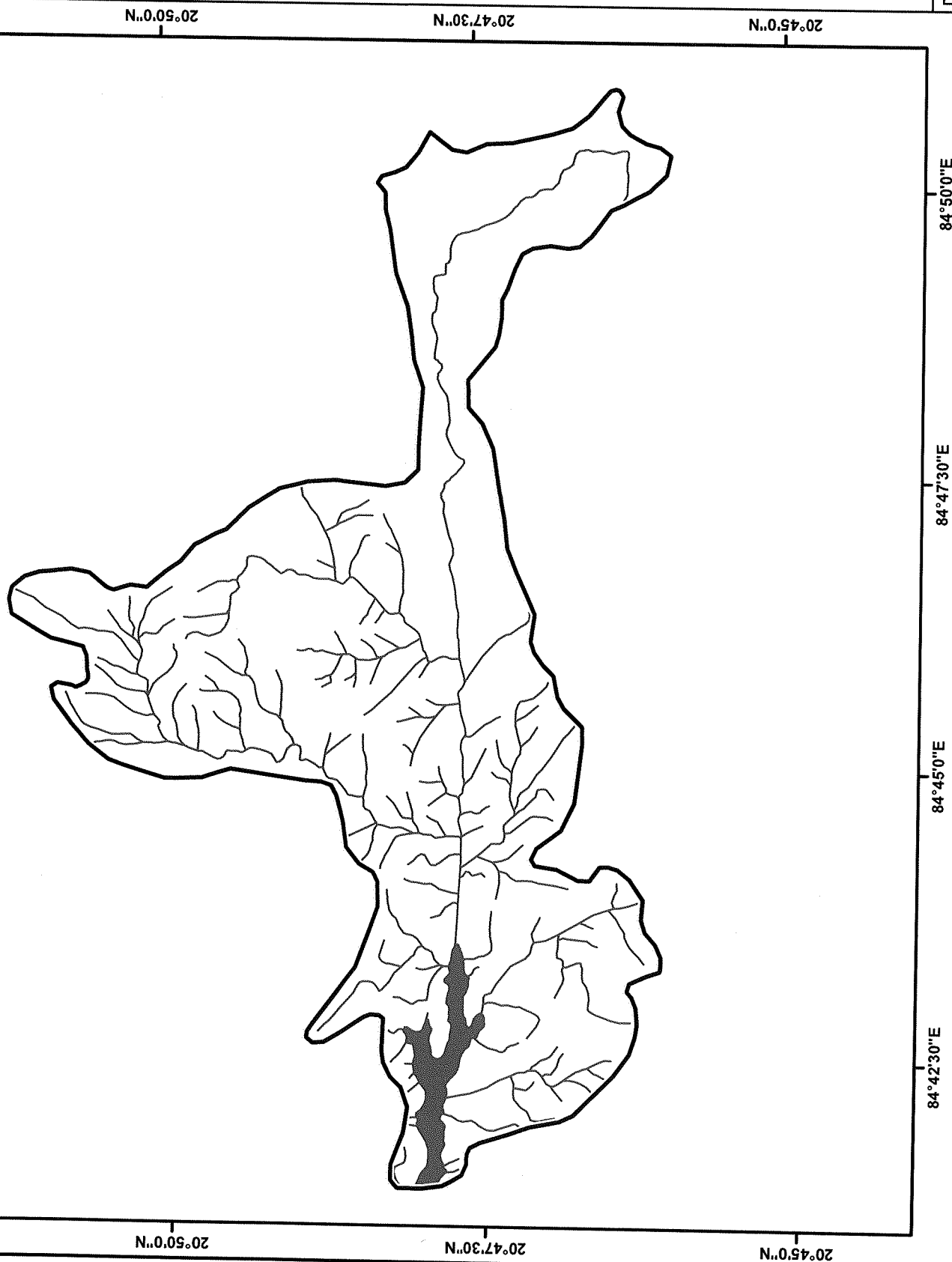
4.2.Slope Map

The Slope map was derived from contours shown on Sol topo sheet. After marking the catchment area, all the contours and spot heights shown on the topographical maps were mapped with 'Z' value (height above MSL in m). Since the area is mostly flat and contours are wide spaced, the spot heights collected in DGPS (differential GPS) during ground truthing of land use were also used as input.

A surface was created using the elevation values stored in the form of contours or points. A Digital Terrain Model (DTM) of the area was then prepared, which was used to derive a slope map. The slope was divided in classes of slope percentages. The areas falling under various standard slope categories have been tabulated in **Table-3** and the contour & slope map is enclosed at **Plate-4 & 5** respectively.


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Drainage Map



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**Catchment Area Treatment Plan
Kutulisinga Irrigation Project
Sub-Watershed Map**

Legend



Catchment

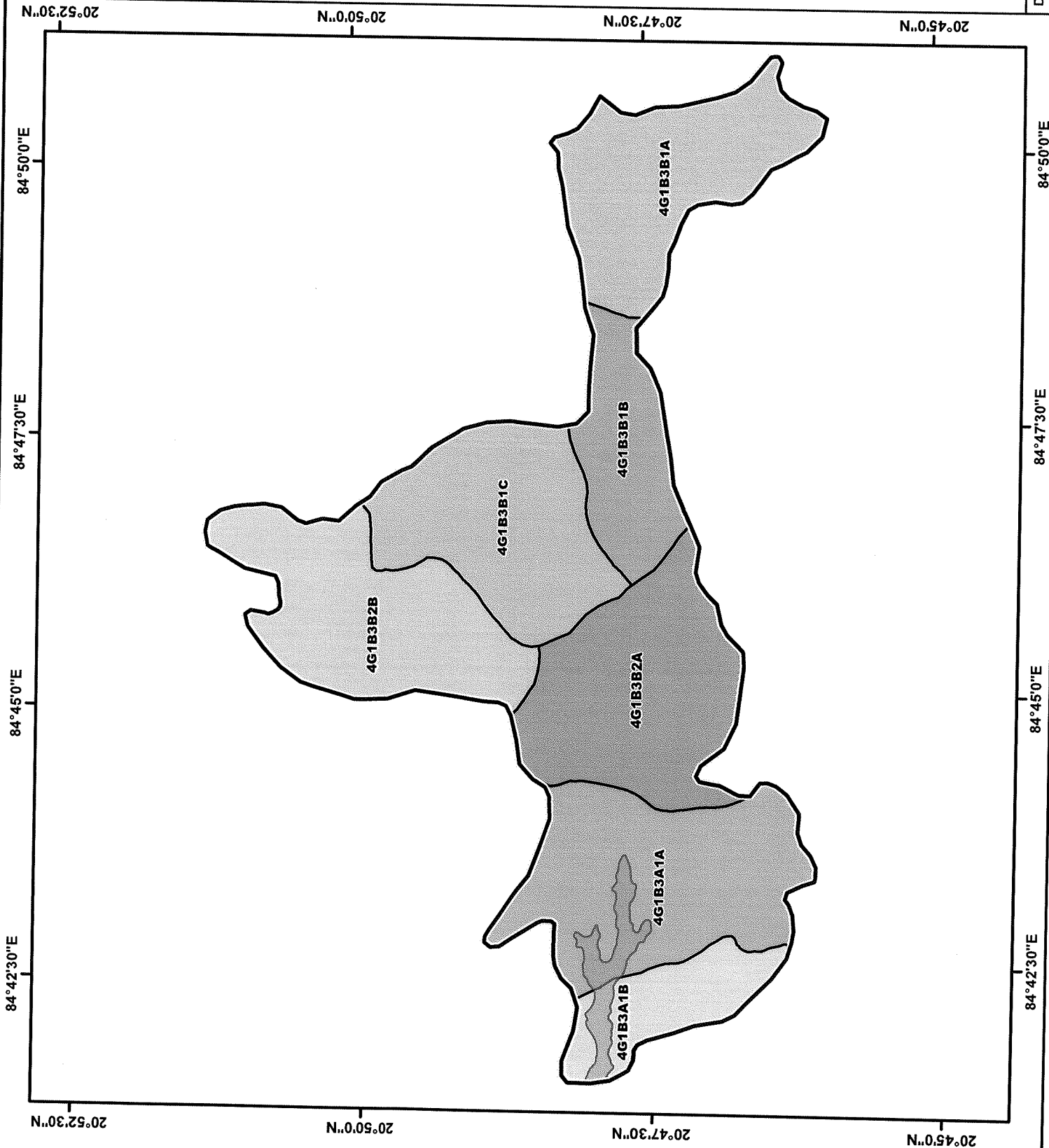


Sub-Watershed

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Department of Water Resource, ODISHA



Catchment Area Treatment Plan
Kutulisinga Irrigation Project
Contour Map

Legend

-  Catchment
-  Reservoir/River
-  Contour(100m interval)
-  Contour(20m interval)

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84°50'0"E

84°47'30"E

84°45'0"E

84°42'30"E

20°50'0"N

20°47'30"N

20°45'0"N

84°50'0"E

84°47'30"E

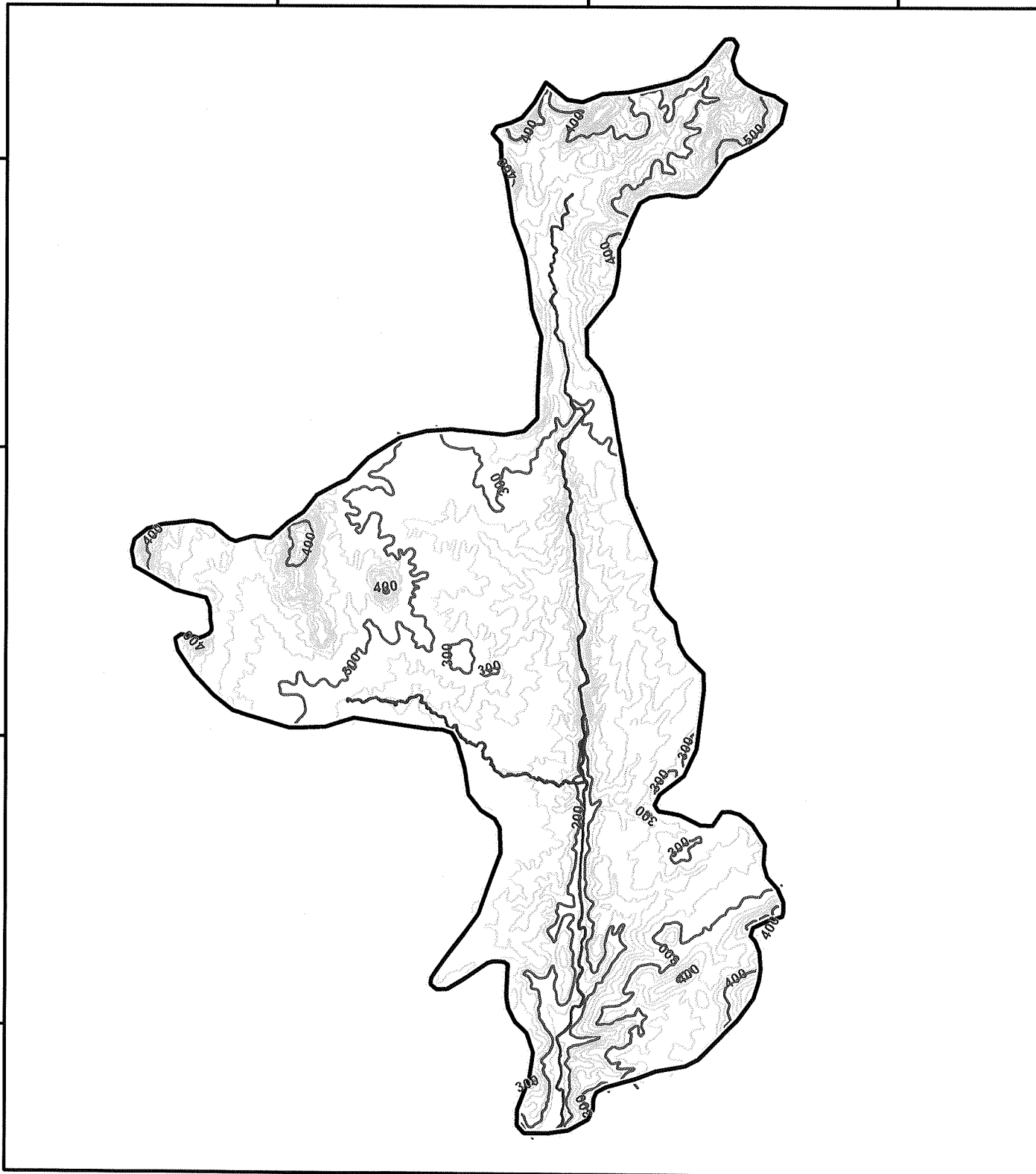
84°45'0"E

84°42'30"E








20°50'0"N

20°47'30"N

20°45'0"N



Legend

-  Catchment Boundary
-  Gently Slopping
-  Moderately Slopping
-  Strongly Slopping
-  Steeply Slopping
-  Very Steeply Slopping
-  Drain/River

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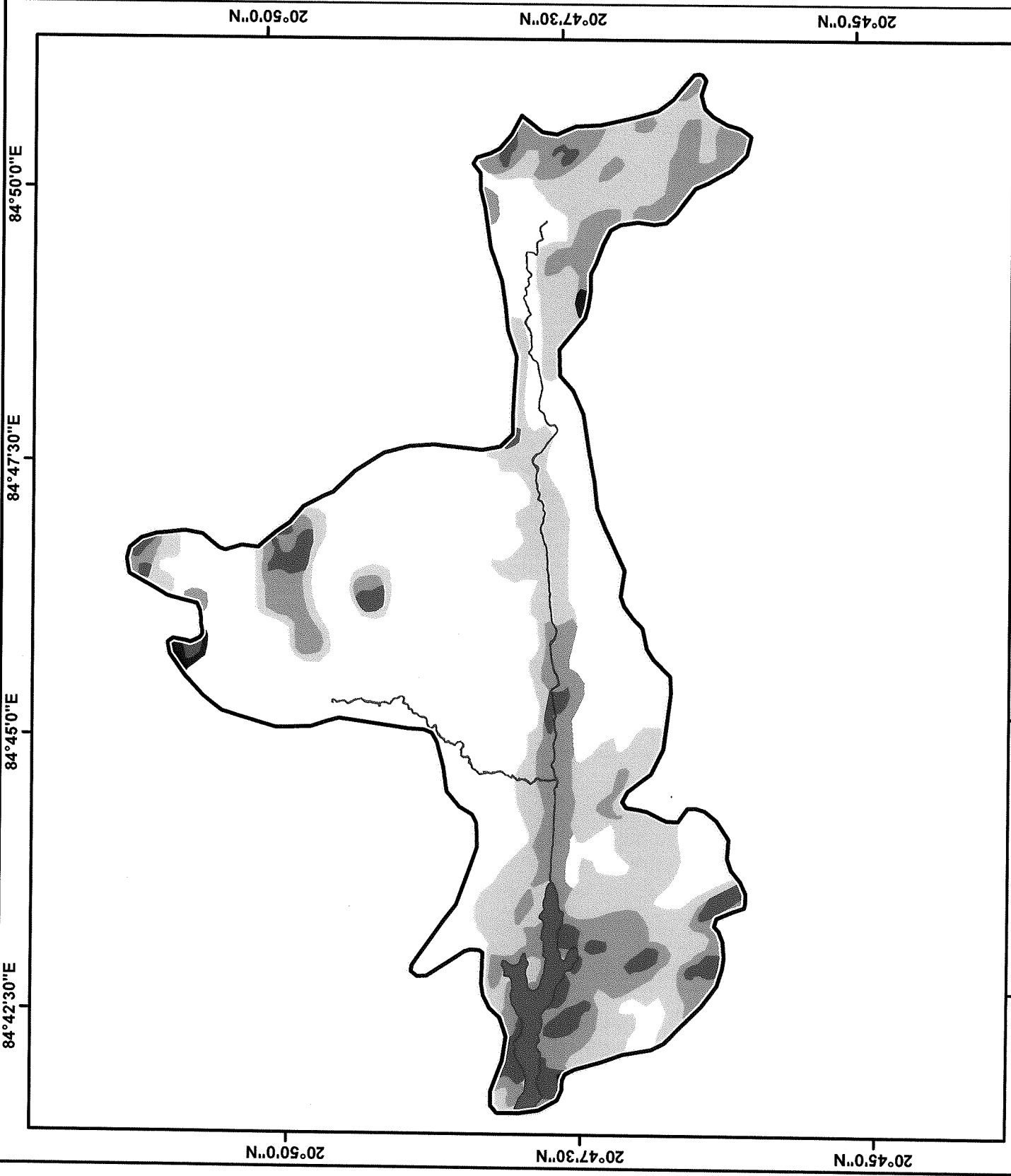


Table-3: Area falling under different slope category

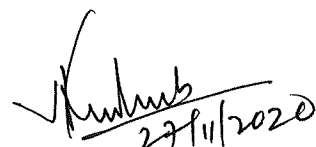
Slope Category	Slope (%)	Area in Km ²	Area in %
Gently Slopping	0-15	29.50	50.77
Moderately sloping	15-30	15.68	26.98
Strongly sloping	30-45	10.08	17.35
Steeply sloping	45-60	2.57	4.42
Very steeply sloping	60-75	0.28	0.48
Total		58.11	100

4.3.Land Use/ Land Cover Map

Land Use map was prepared from recent 5.8m resolution LISS-IV Multi Spectral satellite image collected from National Data Centre of National Remote Sensing Centre (NRSC), Hyderabad. Details of Satellite Image are given bellow.

Satellite: IRS-P6
Sensor: LISS-IV MX (Multi Spectral)
Date of Pass: 1st April 2015
Path: 103
Row: 057

The image was geo-referenced using the common Ground Control Points (GCP) of Survey of India topographical sheets and satellite image with the help of feature registration techniques in standard image processing software. The satellite image map is enclosed at **Plate-6**. As the catchment area is very small, visual interpretation of the geo-referenced satellite data was done by qualified professionals using standard enhancement techniques followed by detail ground truthing to enhance the quality of image interpretation. The classified land use map of the catchment area is depicted in **Table-4** and the map is enclosed at **Plate-7**.


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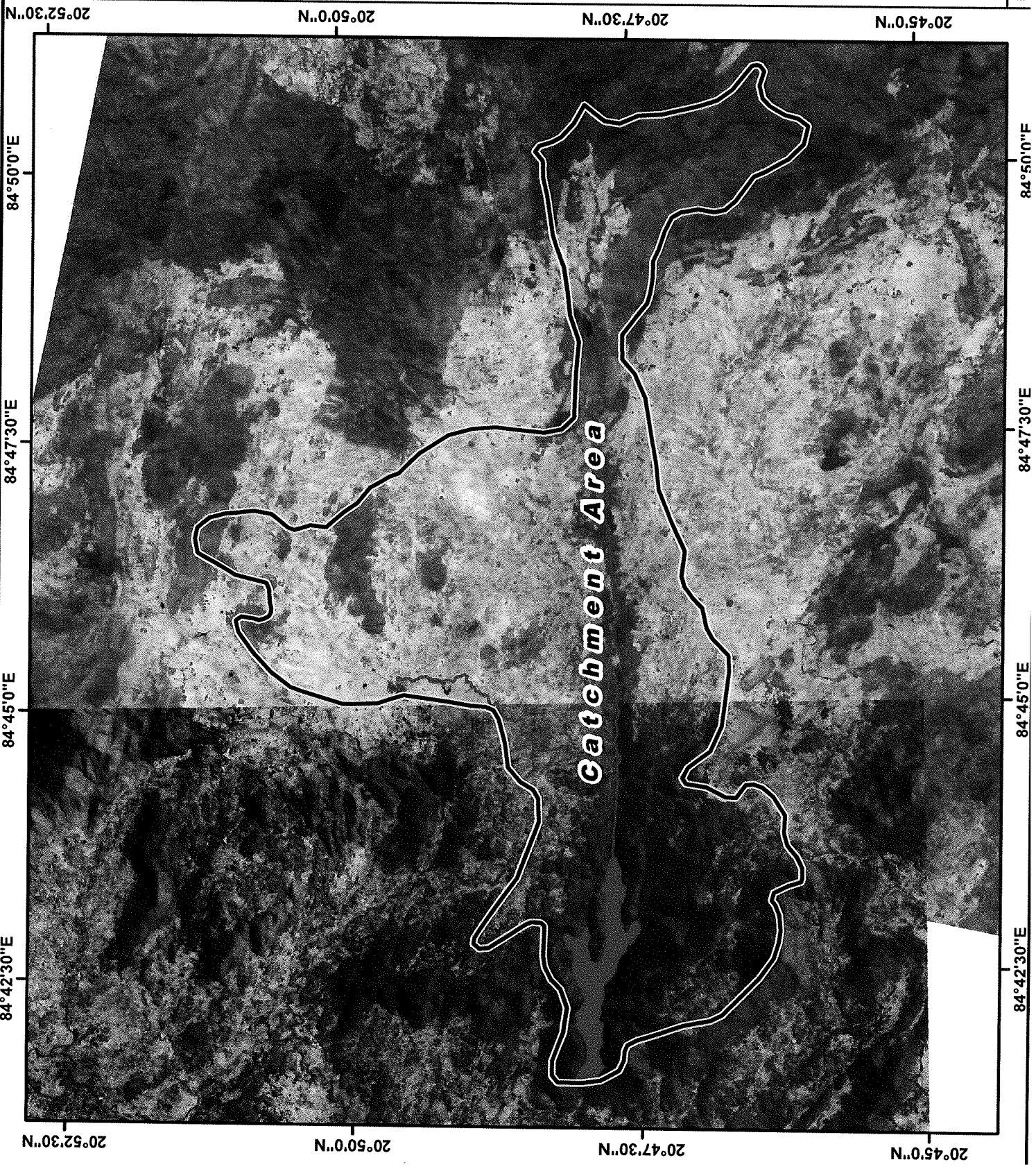





Plate-6
Catchment Area Treatment Plan
Kutulisinga Irrigation Project
LISS-IV Multi Spectral,
Satellite Image

Legend

-  Catchment Boundary
-  River
-  Pondage Area

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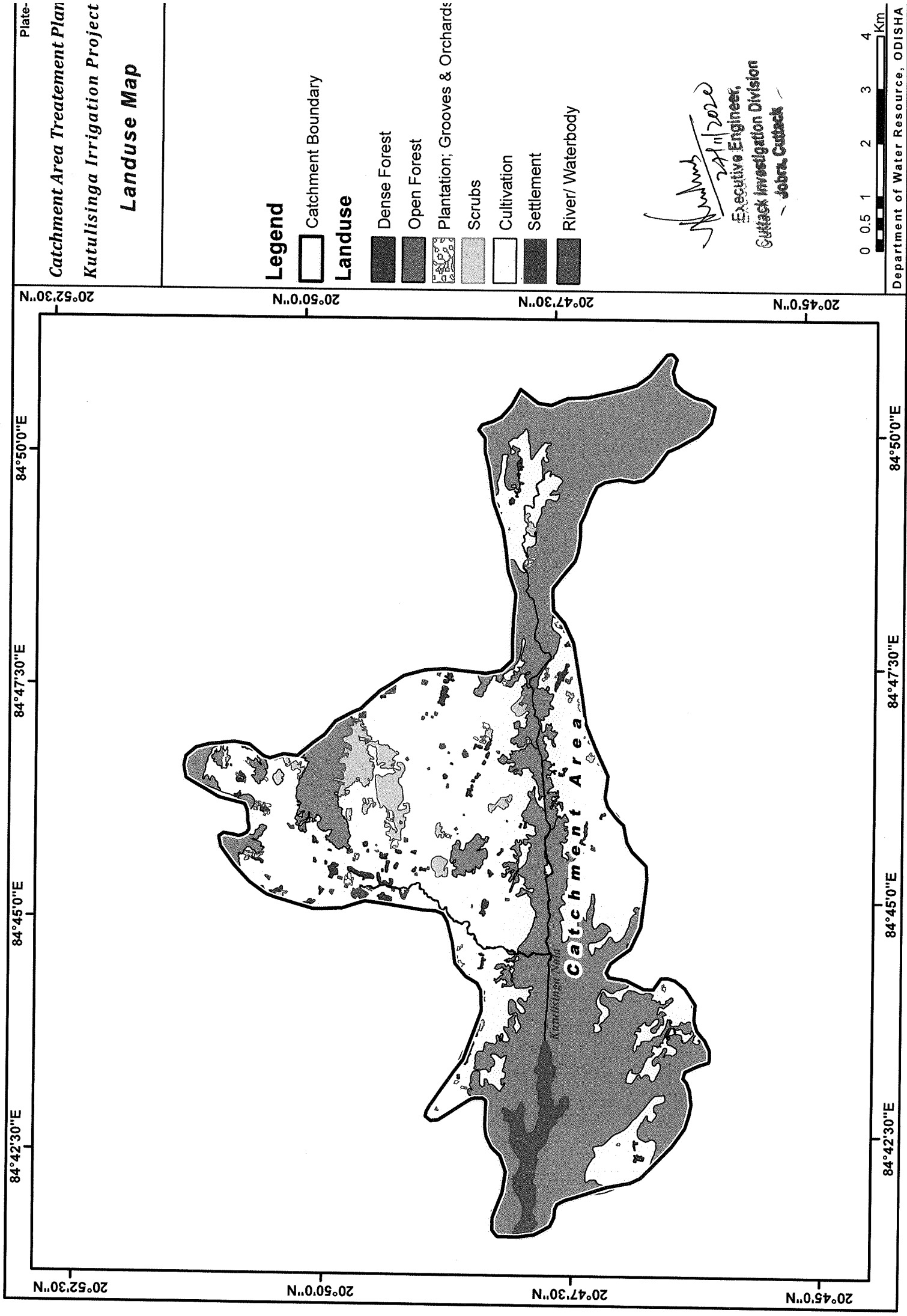


Table-4: Area falling under different Land Use

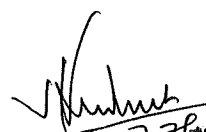
Description	Area in Km ²	Area in %
Open Forest	27.79	47.82
Plantation	0.31	0.53
Scrub	1.77	3.04
Cultivation	27.10	46.63
River	0.27	0.47
Waterbody	0.23	0.39
Settlement	0.65	1.12
Total	58.11	100

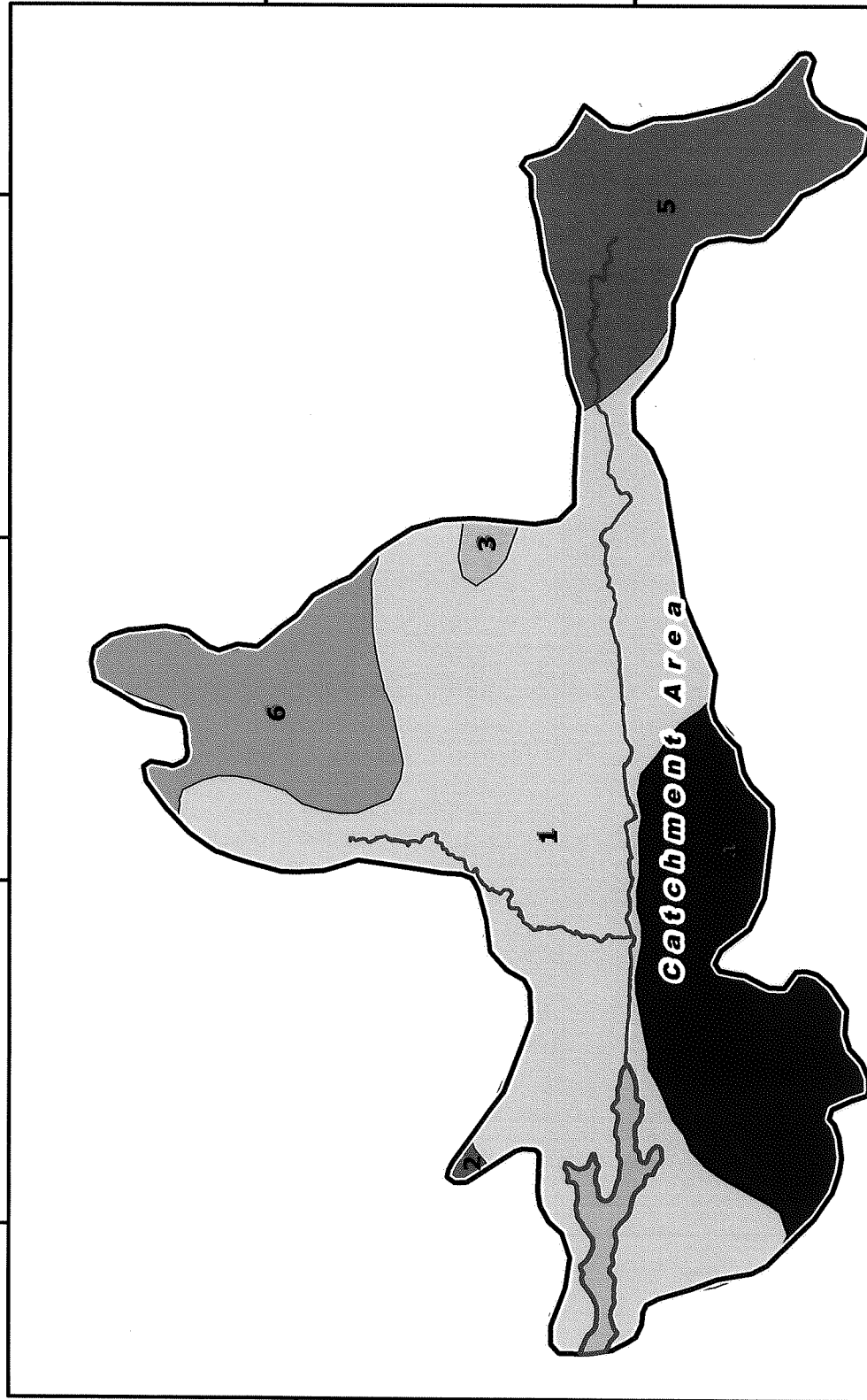
4.4. Soil Map

Soil map was prepared by digitizing the soil map collected from National Bureau of Soil Survey and Land Use Planning (NBSS & LUP) for Odisha and undivided Madhya Pradesh. The soil map is depicted at **Plate-8** and catchment area coming under different soil category is depicted in **Table-5**.

Table-5: Area falling under different soil category

Code	Description	Texture	Area in km ²	Area in %
1	Shallow, well drained coarse-loamy soils with loamy surface and moderate erosion.	Coarse-loamy	31.11	53.54
2	Moderately deep, well drained, coarse loamy soils with loamy surface and severe erosion.	Coarse-loamy	0.15	0.26
3	Very deep, poorly drained, fine soils with loamy surface and moderate erosion.	Fine	0.45	0.77
4	Deep, imperfectly drained fine swell-shrink soils with clayey surface and slight erosion.	Fine	10.79	18.57


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Code		Description	Texture
	1	Shallow, well drained coarse-loamy soils with loamy surface and moderate erosion.	Coarse-loamy
	2	Moderately deep, well drained, coarse loamy soils with loamy surface and severe erosion.	Coarse-loamy
	3	Very deep, poorly drained, fine soils with loamy surface and moderate erosion.	Fine
	4	Deep, imperfectly drained fine swell-shrink soils with clayey surface and slight erosion.	Fine
	5	Moderately shallow, somewhat excessively drained, coarse-loamy soils with sandy surface, severe erosion	Fine-loamy
	6	Shallow, well drained, loamy soils with loamy surface moderate erosion.	Loamy

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5	Moderately shallow, somewhat excessively drained, coarse-loamy soils with sandy surface, severe erosion	Fine-loamy	8.7	14.97
6	Shallow, well drained, loamy soils with loamy surface moderate erosion.	Loamy	6.91	11.89
Total			58.11	100

5. Estimate of Soil Loss intensity using Silt Yield Index (SYI) method

The Sedimentation (Silt) Yield Index Model (SYI), considering sedimentation as product of erosivity, erodibility and arial extent was conceptualized in the AISLUS, as early as 1969 and has been in operational use since then to meet the requirements of prioritization of smaller hydrologic units. The erosivity determinants are the climatic factors and soil and land attributes that have direct or reciprocal bearing on the unit of the detached soil material.

The Silt Yield Index (SYI) is defined as the Yield per unit area and SYI value for hydrologic unit is obtained by taking the weighted arithmetic mean over the entire area of the hydrologic unit by using suitable empirical equation.

In SYI methodology, each Erosion Intensity Unit (EIU) is assigned a weightage value. When considered collectively, the weightage value represents approximately the relative comparative erosion intensity. The slope, soil and land use theme of the catchment were combined using union tool in GIS and EIU were formed using different combination of soil, slope and land use categories.

SYI was calculated using following empirical formula:

$$SYI = \frac{\sum (A_i \times W_i \times D_i) \times 100}{A_w} \quad [\text{where } i = 1 \text{ to } n \text{ (n is the No. of EIU)}]$$

A_i = Area of i^{th} unit (EIU)
 D_i = Delivery Ratio of the i^{th} unit EIU
 W_i = Weightage value of the i^{th} unit EIU
 A_w = Total area of Micro-watershed

Weightage Value (W)

Weightage Value is a combination of two factors K and X. A basic factor of K = 10 was used in determining the weightage values. The value of 10 indicates a static condition of equilibrium between erosion and deposition. Any addition to the factor K (10+X) is suggestive of erosion in ascending order whereas subtraction, i.e. (10-X) is indicative of deposition possibilities.

Delivery Ratio (D)

Delivery ratios were assigned for each of the erosion intensity unit. The delivery ratio suggests the percentage of eroded material that finally finds entry into reservoir. Area of each EIU in each micro watershed was then estimated.

Delivery ratios were assigned to all erosion intensity units depending upon their distance from the nearest stream. The criteria adopted for assigning the delivery ratio are as follows:

Nearest Stream	Delivery Ratio
0 - 0.9 km	1.00
1.0 - 2.0 km	0.95
2.1 - 5.0 km	0.90
5.1 - 15.0 km	0.80
15.1 - 30.0 km	0.70

1.0 km, 2.0 km, 5.0 km, 15.0 km and 30.0 km buffers were created around the main stream and reservoir using GIS. EIUs falling in different buffer zone were assigned the Delivery ratio of the respective buffer zone. Prioritization of Micro Watershed based on SYI findings

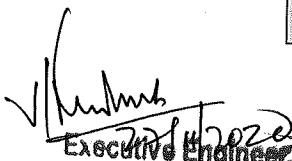
The objective of the SYI method is to prioritize micro watershed in a catchment area for treatment. For prioritizing the micro watersheds, these are to be divided in to different categories based on their SYI. The SYI values for classification of various categories of erosion intensity rates are depicted below

Priority categories	SYI Values
Very high	> 1300
High	1200-1299
Medium	1100-1199
Low	1000-1099
Very Low	<1000

The micro watershed wise SYI and category of erosion is depicted in **Table-6**.

Table-6: Soil Erosion Priority Category of Micro Watersheds

SL	MWS Code	SYI	Priority
1	4G1B3B1C	1092	Low
2	4G1B3B1B	1059	Low
3	4G1B3A1A	1153	Medium
4	4G1B3A1B	1119	Medium


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5	4G1B3B2B	1251	High
6	4G1B3B2A	1205	High
7	4G1B3B1A	1343	Very High

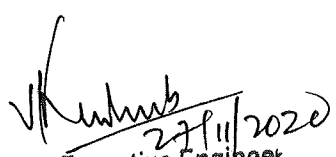
Area under very high categories is proposed to be treated at the project. A base map showing land use, reserve forest boundary, slope, major drains and priority watershed is enclosed at **Plate-9** for micro planning of the catchment area treatment plan as the step areas are more prone to soil erosion, looking at the land use and topography **4G1B3B2B & 4G1B3B2A** micro watersheds finally selected for treatment which is directly draining to the Badajor Nalla. The detail map for preparation of treatment plan is enclosed at **Plate-10**. The topographic map, drainage and contour map and land use and slope map of the sub watershed is enclosed at **Plate-11a, 11b and 11c** respectively.

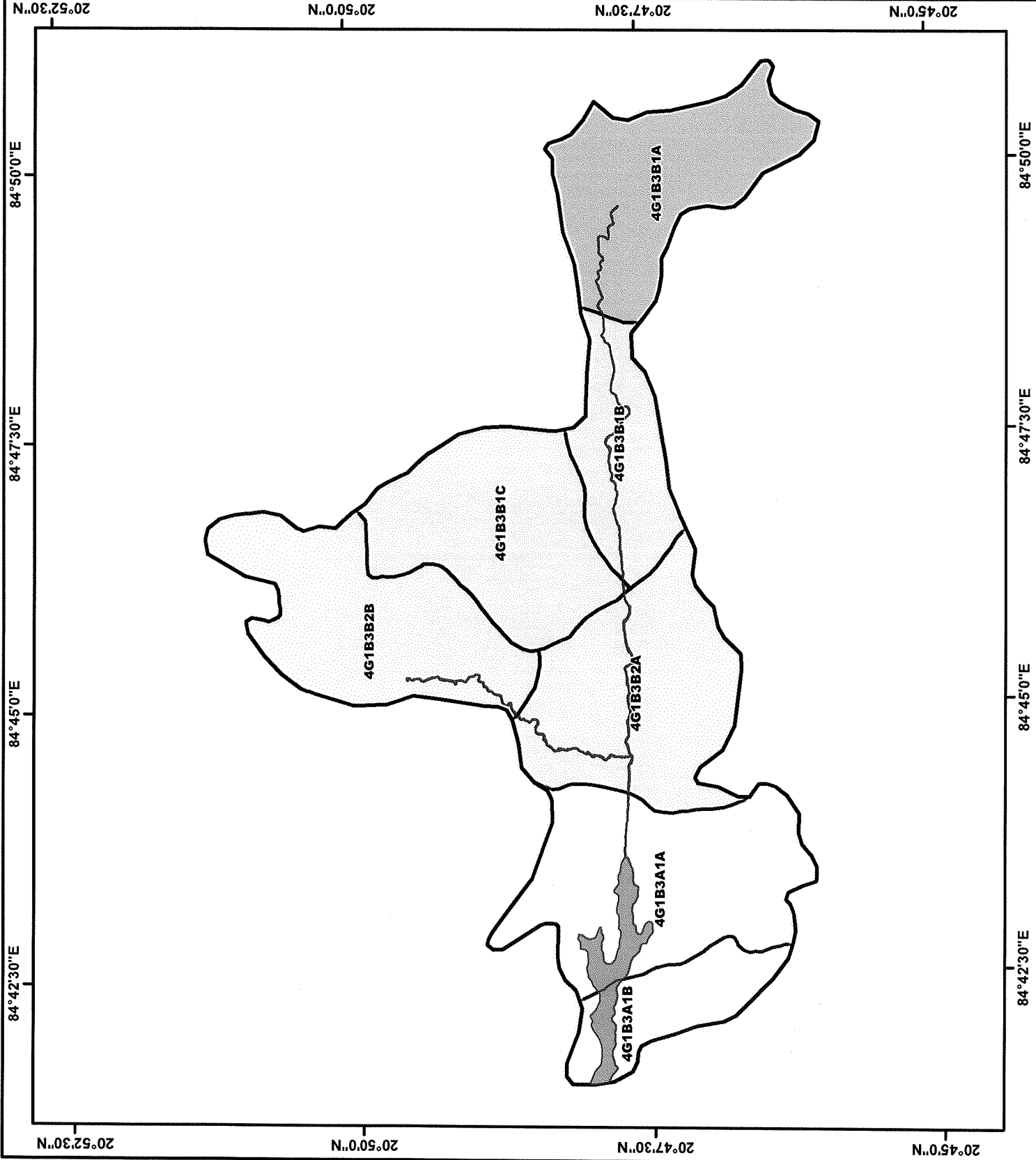
7. Demography of the watershed

The village map of the sub watersheds is enclosed at **Plate-12**. The demography of the villages of Micro Watershed **4G1B3B2B & 4G1B3B2A** as per Census 2011 are depicted below.

Table-7: Demography of Watersheds as per Census 2011

Sl No	Name of the Village	Population	Male	Female	SC	ST	Litrated	Worker
1	Godakhalamundia	387	216	171	12	10	291	118
2	Satyabadipur	38	17	21	0	0	26	10
3	Khamar	827	434	393	242	109	619	270
4	Baradhip	488	245	243	4	362	332	317
5	Tumurusinga	428	227	201	145	33	326	257
6	Jagadalapur	160	86	74	0	0	118	93
7	Paikasahi	1758	912	846	215	776	1018	945
8	Baghuanali	127	70	57	6	89	56	67
9	Bidisingbasu	295	155	140	0	4	214	145
10	Kalapatanali	502	264	238	152	82	296	263
11	Talabahali	535	261	274	23	180	360	273
12	Uchakurum	70	33	37	0	68	13	41
13	Hatigenja	380	192	188	27	0	293	172
14	kantapada	1413	685	728	337	108	991	885
15	Depur	4	2	2	4	0	1	4


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Legend



Catchment Boundary



Micro-Watershed

Silt Yield Index



Very High



High



Medium



Low

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20°50'0"N

20°47'30"N

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Jobra Cutback

W. K. Miller
Executive Engineer

PLATE-10



This is a detailed topographic map of a region in India, likely in the northeastern part of the country. The map shows a large area outlined in thick black, which appears to be a specific administrative or military zone. The map includes contour lines indicating elevation, with peaks reaching up to 3000 feet. Various place names are scattered across the map, including Tumursingha, Baradina, Uchkurum, Dacar, Kusumdera, and Lakshmanpur within the outlined area. Other locations like Sapaghara, Bantol, Baidisigh, Pokanda, and Kantapada are visible outside the outline. The map also shows features like 'Fairly dense mixed jungle', 'Open mixed jungle', and 'Dense scrub'. Grid lines are present, and the map is labeled with coordinates such as 4G1B3B2B and 4G1B3B2A. The map is oriented with North at the top.

Legend



Sub-Watershed Boundary

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4°42'30"E

84°45'0"E

84°47'30"E

20°50'0"N

20°50'0"N

20°47'30"N

20°47'30"N

84°42'30"E

84°45'0"E

84°47'30"E

Plate-11.b

Catchment Area Treatment Plan

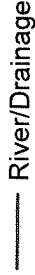
Kutulisinga Irrigation Project

Drainage & Contour Map of the Priority Watershed

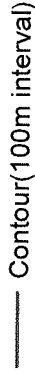
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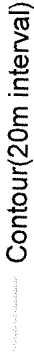
Sub-Watershed Boundary



River/Drainage

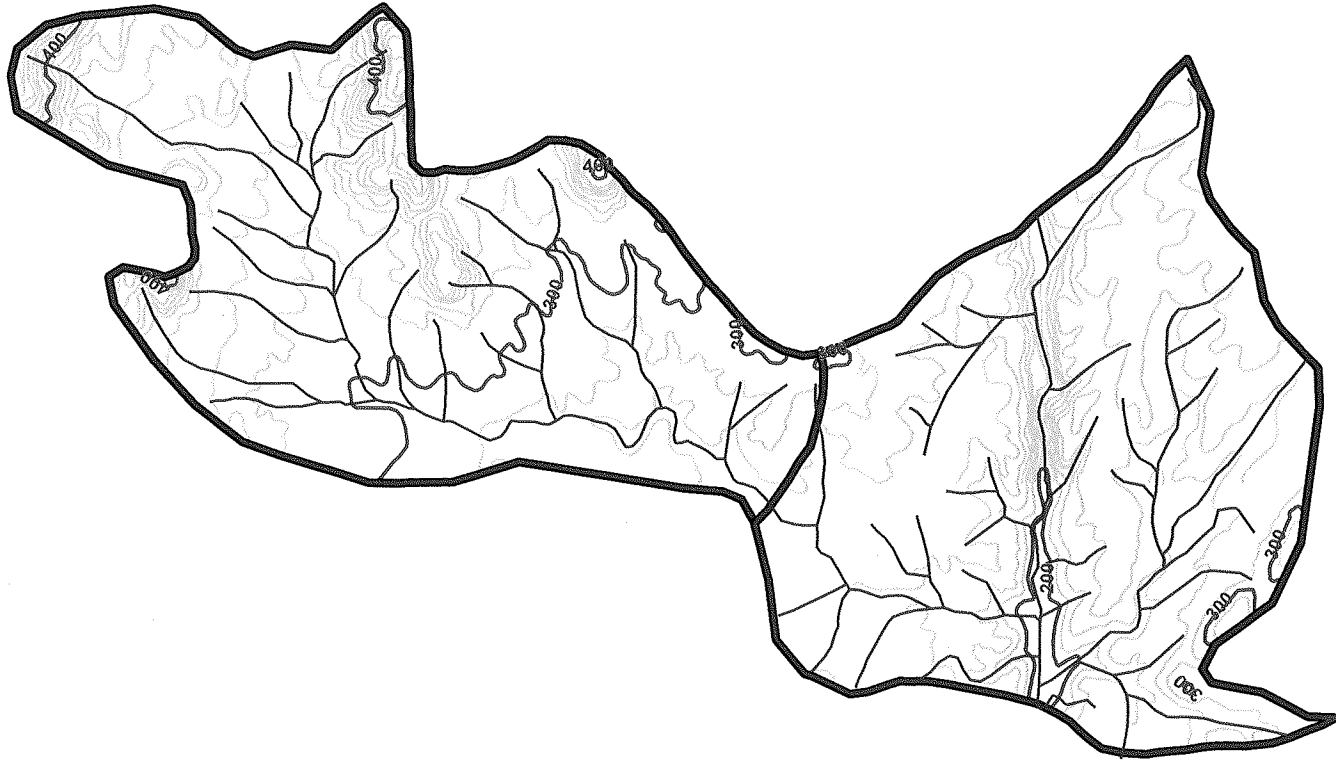


Contour (100m interval)



Contour (20m interval)

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84°42'30"E

84°45'0"E

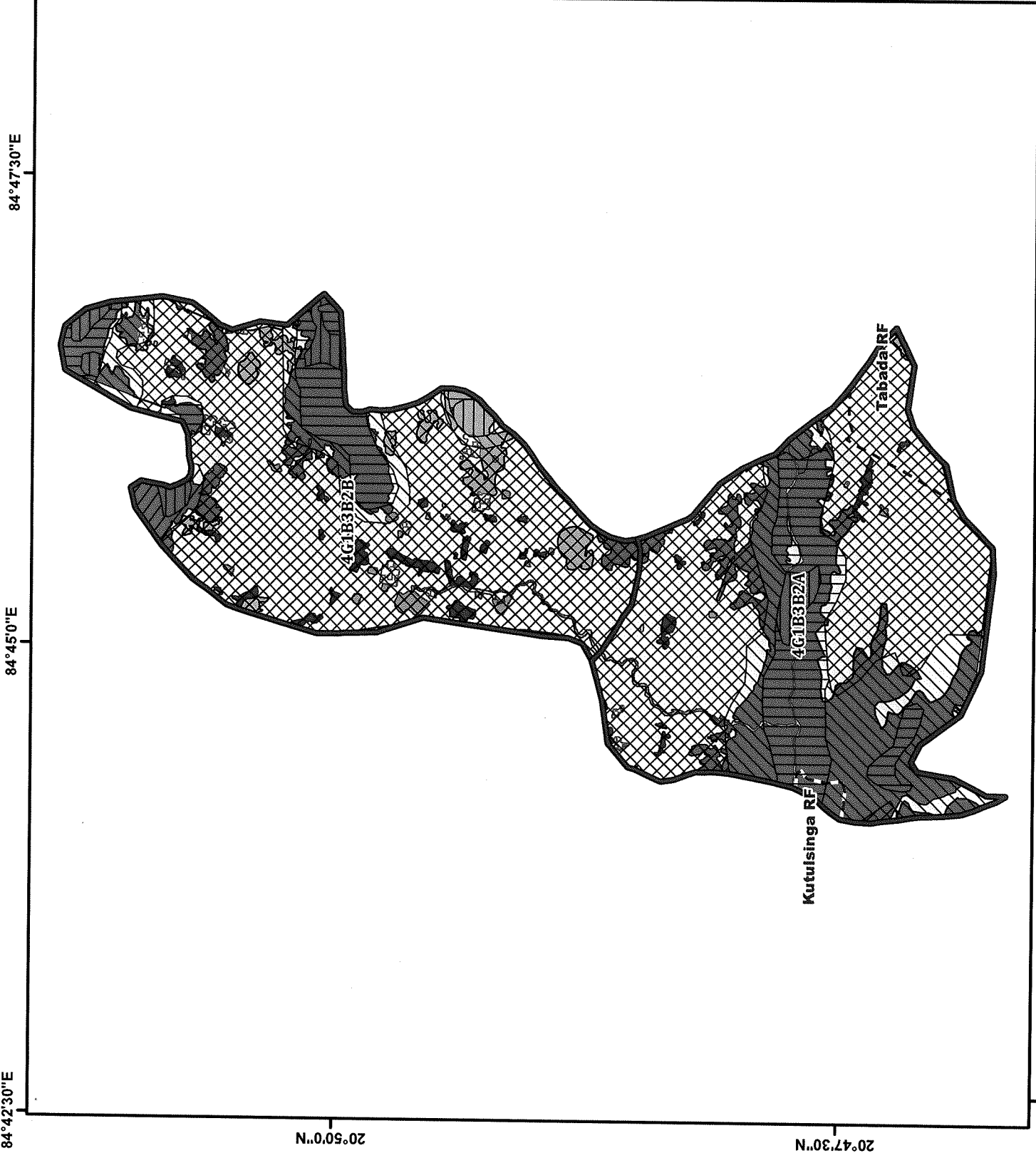
84°47'30"E

Plate-11.0

**Catchment Area Treatment Plan
Kutulisinga Irrigation Project
Land Use & Slope Map of
the Priority Watershed**

20°50'0"N

20°47'30"N



Legend

- Sub-Watershed Boundary
- Reserve Forest
- Slope**
 - Gently Slopping
 - Moderately Slopping
 - Strongly Slopping
 - Steeply Slopping
 - Very Steeply Slopping
- Landuse**
 - Open Forest
 - Plantation; Grooves & Orchards
 - Scrubs
 - Cultivation
 - Settlement
 - River/ Waterbody

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84°42'30"E

84°45'0"E

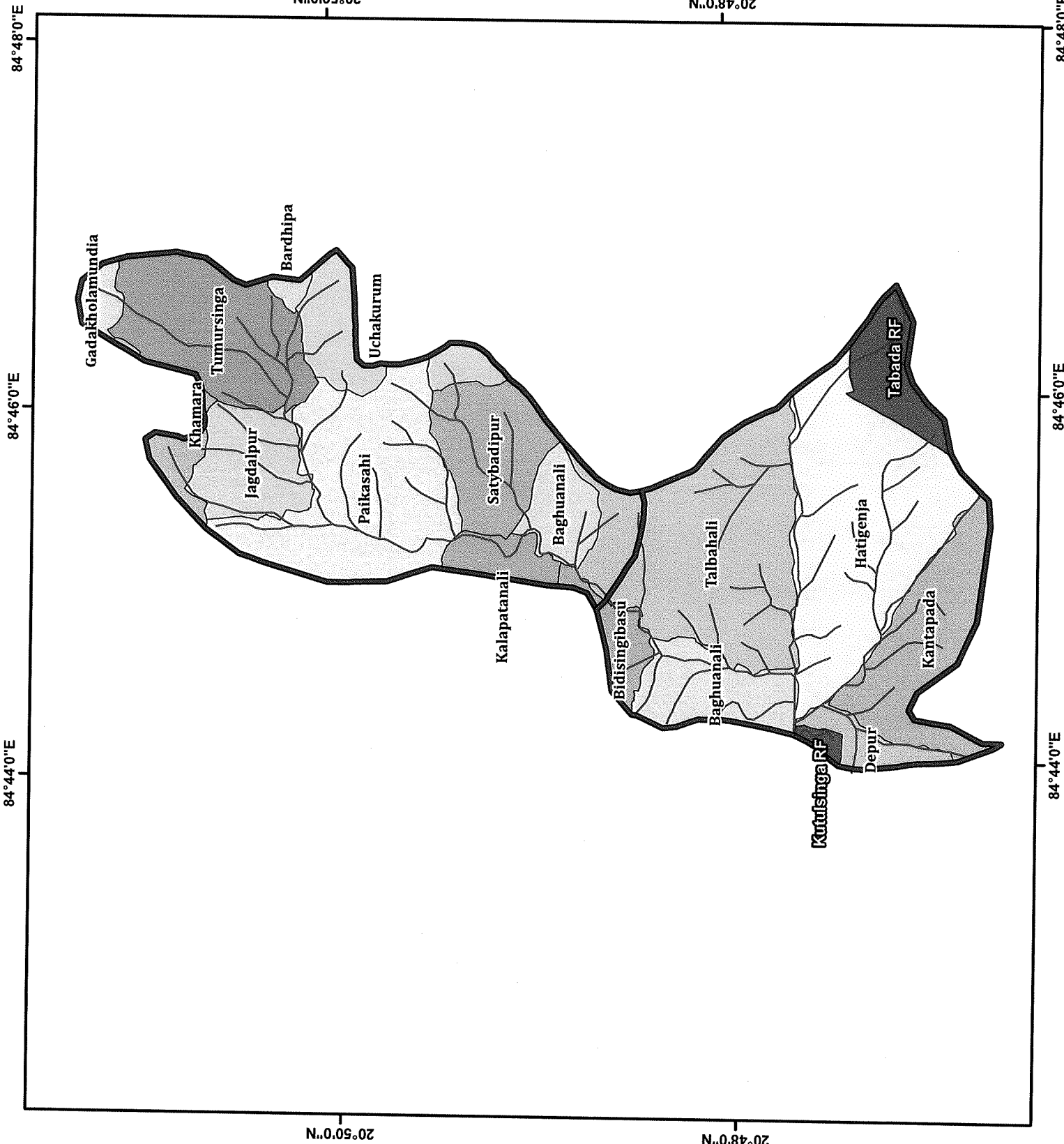
84°47'30"E

Department of Water Resource, ODISHA

**Catchment Area Treatment Plan
Kutulisinga Irrigation Project
Village Map of
the Priority Watershed**

20°50'0"N

20°48'0"N



84°44'0"E

84°46'0"E

84°48'0"E

20°50'0"N

20°48'0"N

84°44'0"E

84°46'0"E

84°48'0"E

Legend



Watershed Boundary



River/Waterbody



Drainage



RF

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8. Catchment Area Treatment (CAT) Plan

Following Engineering and Biological measures are planned for the catchment area treatment depending upon the requirement and suitability:

- a. Biological measures
 - Assisted Natural Regeneration
 - Block Plantation/Afforestation
 - Fodder land development
- b. Engineering measures (Water Harvesting Structures)
 - Loose boulder wall-gully plugging in small hilly streams
 - Stone masonry check dams – in major drains
- c. Others
 - Awareness campaign for farm management, control grazing etc.
 - Drinking Water facilities to Villagers

As most of the area is agricultural land (81.92%), awareness campaign will be done for farm management (negatives of burning farm residuals, adoption of proper cropping pattern etc.), digging of farm pond, controlled grazing in graze land, etc.

8.1 Assisted Natural Regeneration

Assisted Natural regeneration is suggested in 100ha in open forests available within the watersheds. The sites to be treated are depicted in **Plate-13**. The detail estimate is depicted at **Annexure-1**.

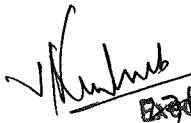
8.2 Block Plantation/Afforestation

The village wise revenue forest and govt. land is depicted in the below.

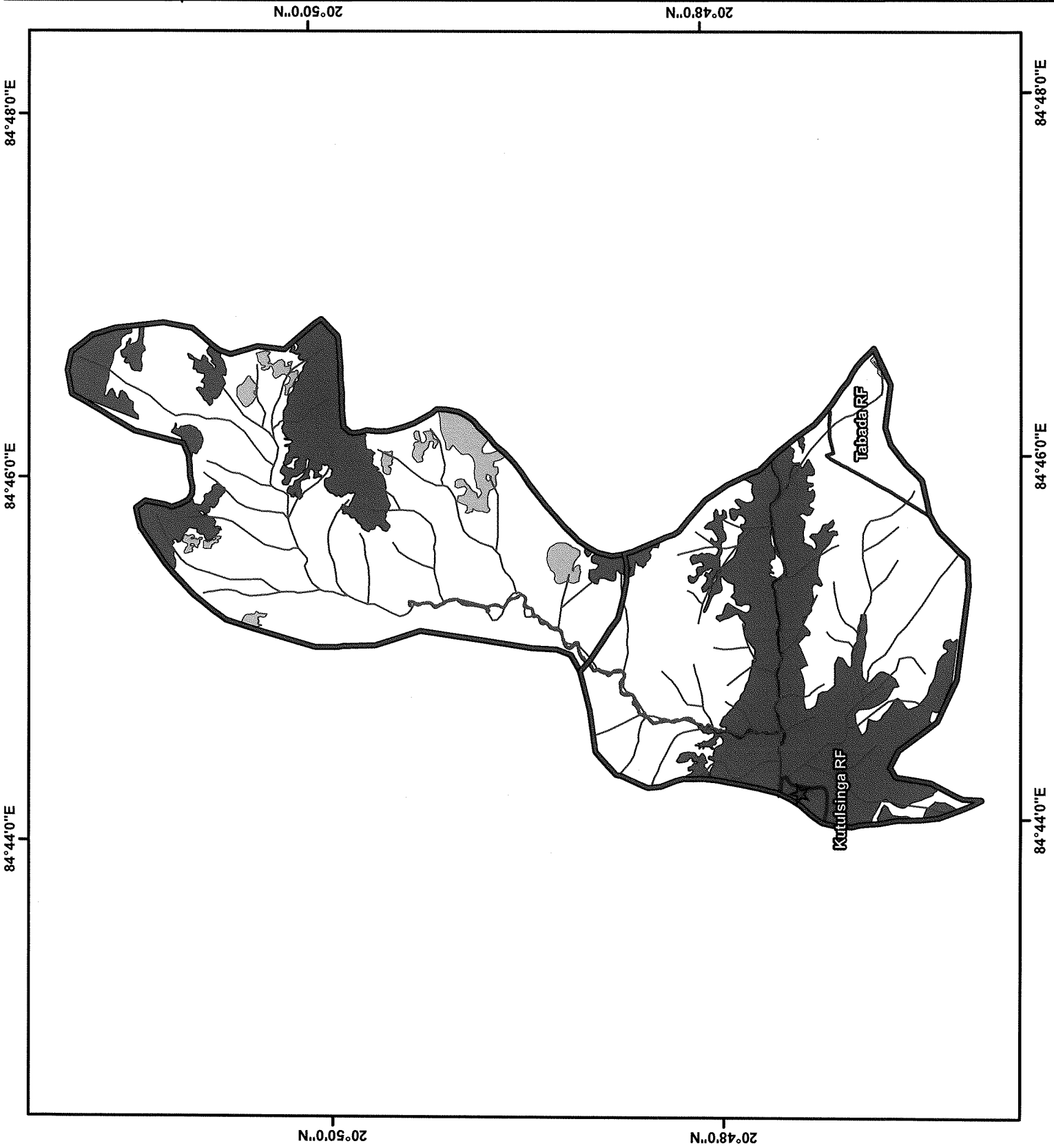
Table-8: Availability of Govt. and forest land

All areas in Ac.

Sl no.	Name of Village	Govt. Land	Forest Land	Gochar Land
1	Gadakhalamundi	133.63	38.98	15.36
2	Khamar	236.93	167.86	19
3	Tumurusinga	296.23	150.46	23
4	Jagadalapur	74.85	23.75	9
5	Satyabadipur	170.25	102.1	14


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**Catchment Area Treatment Plan
Kutulsinga Irrigation Project
Map Showing Proposed Assisted
Natural Regeneration Activity**



6	Kalapatanali	182.76	67.21	15
7	Bidisingbasu	177.28	77.8	14
8	Baradhip	194.49	80.51	17.01
9	Talabahali	791.82	588.6	48
10	Baghuanali	175.39	110.73	11
11	Hatigenja	532.07	404.33	36.92
12	Kantapada	1079.52	628.37	82.96
13	Depur	289.76	177.82	10.5
14	Paikasahi	484.4	111.21	38.34
15	Uchakurum	726.37	241.11	29

As 1079.52 ha of forest land is available in Kantapada villages, but there is no forest growth, it is proposed to block plantation of 50hectors in the village. The detailed estimate is enclosed at **Annexure-2**.

8.3 Fodder land development

To minimize the pressure on forest for grazing, it is suggested to develop fodder land in the watershed.

Table-9: Availability of Gochar land

Sl No	Name of the Village	Population	Gochar Land
1	Godakhalamundia	387	15.36
2	Satyabadipur	38	14
3	Khamar	827	19
4	Baradhip	488	17.01
5	Tumurusinga	428	23
6	Jagadalapur	160	9
7	Paikasahi	1758	38.34
8	Baghuanali	127	11
9	Bidisingbasu	295	14
10	Kalapatanali	502	15
11	Talabahali	535	48
12	Uchakurum	70	29
13	Hatigenja	380	36.92
14	kantapada	1413	82.96
15	Depur	4	10.5

Looking at the availability of Gochar land and population, it is proposed to develop 4 blocks (of 10 ha each) of fodder land development in Kantapada, Hatigenja, Talabahali & Paikasahi villages of watersheds. The detail estimate is given at Annexure-3.

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8.4 Loose boulder wall-gully plugging in small hilly streams

Gully erosion, including ephemeral gully erosion, refers to the cutting of narrow channels resulting from concentration of sheet and rill flow of runoff water. Ephemeral gullies are small channels of approximately 3 to 12 inches deep. Gullies may be one to several feet deep. Gully erosion occurs when rill erosion is neglected. The tiny grooves develop into wider and deeper channels, which may assume a huge size. This state is called 'gully' erosion. Gullies are the most spectacular evidence of the destruction of soil. The gullies usually deepen and widen with every heavy rainfall. They cut up large fields into small fragments and, in course of time, make them out of shape for cultivation.

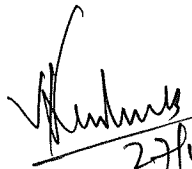
Gully plugging work is required for reduction of runoff velocities within permissible limits and for controlling gully erosion of micro-watersheds. Appropriate gully plugging works would be selected from brush wood check dams, palisading works, gabion structures, sunken pits, etc. A provision is kept for **50** gullies plugging in the streams. The typical Estimate of Gully Plugging is depicted at **Annexure-4.**

8.5 Earthen Check Dam with concrete core Wall – in major drains

Check dams' range in size, shape and cost. It is possible to build them out of easily available materials and even at a very little cost. Decision of building such a dam depends on its location. Essentially a check dam has an earthen dam and masonry spillway.

It cuts the velocity and reduces erosive activity, the stored water improves soil moisture of the adjoining area and allows percolation to recharge the aquifers Spacing between the check dams should be such that water spread of one should be beyond the water spread of the other Height depends on the bank height, varies from 1m to 3m and length varies from less than 3m to 10m. A provision is kept for **5** Masonry Check in the streams. The typical Estimate of earthen check dam with concrete core is depicted at **Annexure-5**

The locations of proposals for all treatments other than ANR activities are depicted in **Plate-14**. The detail year wise cash flow estimate is depicted at **Annexure-6.**


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84°44'0"E

84°46'0"E

84°48'0"E

Plate-14

Catchment Area Treatment Plan
Kutulsinga Irrigation Project
Map Showing Catchment Area
Treatment Activities
other than ANR

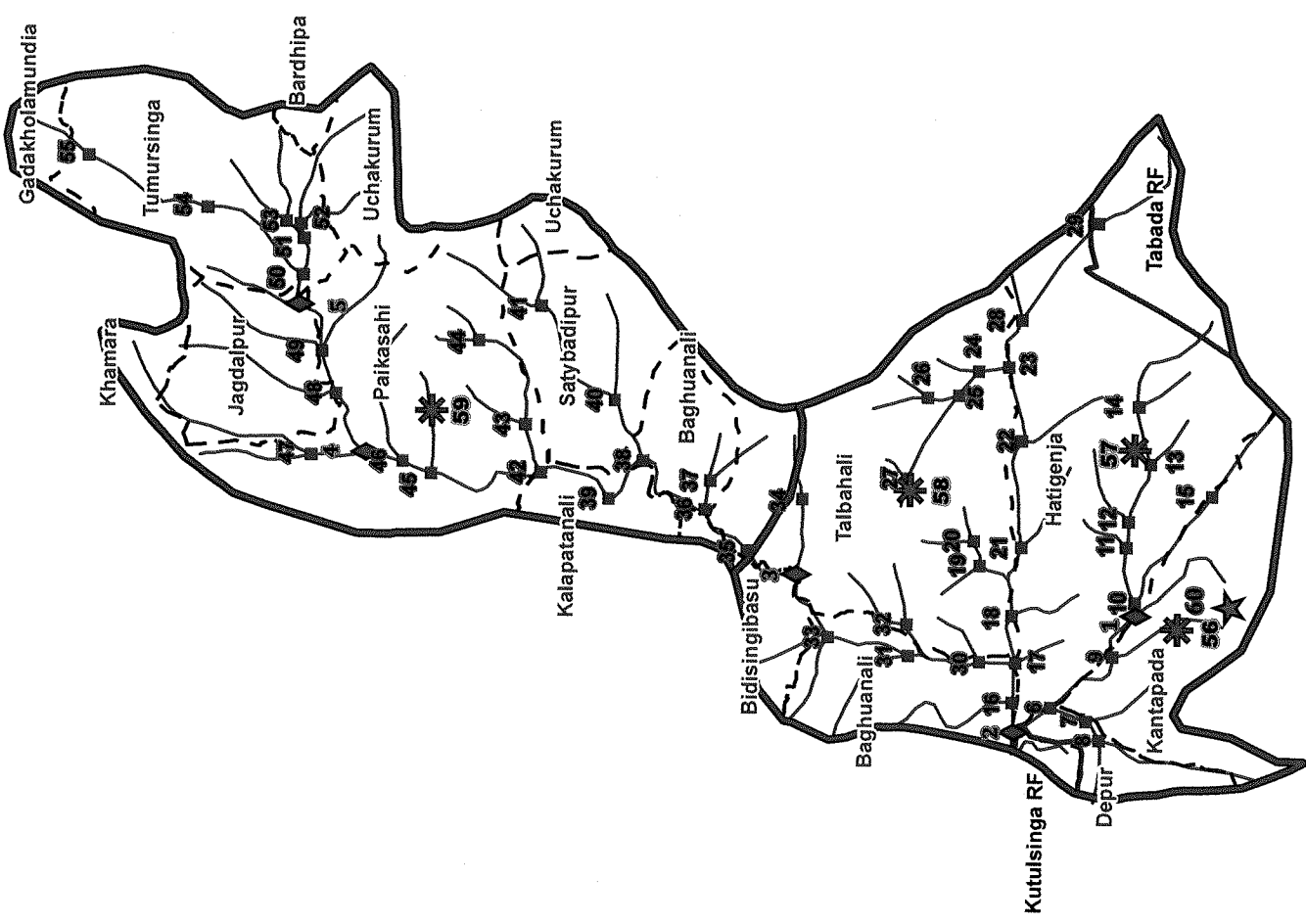
Legend

- Watershed Boundary
- River/Drainage
- Village Boundary
- Reserve Forest

Type of Treatment

- Plantation
- Fodder Land Development
- Gully Plugging
- Check Dam

Point No	Eastng	Northng	Latitude	Longitude
1	265216.866	2300242.408	20° 47' 14.083" N	84° 44' 40.357" E
2	264640.585	2301070.229	20° 47' 40.646" N	84° 44' 13.816" E
3	265552.389	2302501.429	20° 48' 27.662" N	84° 44' 50.863" E
4	266435.744	2305338.161	20° 50' 0.268" N	84° 45' 20.033" E
5	267441.294	2305754.216	20° 50' 14.246" N	84° 45' 54.600" E
6	264620.699	2300818.135	20° 47' 32.525" N	84° 44' 19.473" E
7	264522.285	2300583.218	20° 47' 24.845" N	84° 44' 16.185" E
8	264392.422	2300498.525	20° 47' 22.032" N	84° 44' 11.738" E
9	264951.146	2300399.115	20° 47' 19.056" N	84° 44' 31.097" E
10	265306.403	2300244.445	20° 47' 14.190" N	84° 44' 43.451" E
11	265681.170	2300288.909	20° 47' 15.805" N	84° 44' 56.383" E
12	265855.850	2300269.853	20° 47' 15.265" N	84° 45' 2.429" E
13	266238.868	2300119.767	20° 47' 10.560" N	84° 45' 15.740" E
14	266624.440	2300184.101	20° 47' 12.825" N	84° 45' 29.036" E
15	266009.821	2299719.187	20° 46' 57.436" N	84° 45' 8.016" E
16	264657.794	2301074.438	20° 47' 40.873" N	84° 44' 20.631" E
17	264921.284	2301041.267	20° 47' 39.915" N	84° 44' 29.823" E
18	265238.885	2301059.326	20° 47' 40.646" N	84° 44' 40.723" E
19	265580.714	2301266.762	20° 47' 47.544" N	84° 44' 52.439" E
20	265749.042	2301301.698	20° 47' 48.756" N	84° 44' 58.240" E
21	265699.092	2300981.666	20° 47' 38.331" N	84° 44' 56.668" E
22	266413.593	2300959.737	20° 47' 37.941" N	84° 45' 21.375" E
23	266908.280	2301034.915	20° 47' 40.608" N	84° 45' 38.438" E
24	266886.048	2301238.179	20° 47' 47.205" N	84° 45' 37.572" E
25	266777.248	2301374.746	20° 47' 51.573" N	84° 45' 32.018" E
26	266720.896	2301587.538	20° 47' 58.486" N	84° 45' 31.696" E
27	266180.977	2301736.810	20° 48' 3.094" N	84° 45' 12.961" E
28	267224.050	2300938.339	20° 47' 37.612" N	84° 45' 49.399" E
29	267857.784	2300411.009	20° 47' 20.756" N	84° 46' 11.557" E
30	264935.781	2301285.247	20° 47' 47.851" N	84° 44' 30.137" E
31	264986.881	2301762.181	20° 48' 3.377" N	84° 44' 31.673" E
32	265199.595	2301768.569	20° 48' 3.681" N	84° 44' 39.023" E
33	265126.555	2302297.029	20° 48' 20.825" N	84° 44' 36.242" E
34	266057.057	2302444.676	20° 48' 26.046" N	84° 45' 8.336" E
35	265719.316	2302818.250	20° 48' 38.036" N	84° 44' 56.481" E
36	266002.070	2303090.783	20° 48' 47.023" N	84° 45' 6.124" E
37	266193.184	2303050.689	20° 48' 45.806" N	84° 45' 12.750" E
38	266336.723	2303491.400	20° 49' 0.196" N	84° 45' 17.500" E
39	266900.643	2303731.238	20° 49' 7.880" N	84° 45' 8.877" E
40	266749.250	2303671.412	20° 49' 6.234" N	84° 45' 31.674" E
41	267394.294	2304143.944	20° 49' 21.884" N	84° 45' 53.748" E
42	266274.608	2304177.512	20° 49' 22.469" N	84° 45' 15.022" E
43	266599.240	2304263.952	20° 49' 25.426" N	84° 45' 26.203" E
44	267174.279	2304557.721	20° 49' 35.234" N	84° 45' 45.943" E
45	266283.148	2304901.125	20° 49' 45.993" N	84° 45' 14.968" E
46	266372.393	2305092.900	20° 49' 52.267" N	84° 45' 17.961" E
47	266426.669	2305702.192	20° 50' 12.096" N	84° 45' 19.544" E
48	266836.326	2305523.414	20° 50' 6.470" N	84° 45' 33.794" E
49	267122.486	2305609.716	20° 50' 9.405" N	84° 45' 43.647" E
50	267638.029	2305721.380	20° 50' 13.267" N	84° 46' 1.418" E
51	267883.310	2305710.781	20° 50' 13.033" N	84° 46' 9.904" E
52	267980.400	2305726.111	20° 50' 13.575" N	84° 46' 13.253" E
53	268001.835	2305821.556	20° 50' 16.687" N	84° 46' 13.949" E
54	268104.744	2306341.394	20° 50' 33.630" N	84° 46' 17.258" E
55	268472.664	2307114.709	20° 50' 58.932" N	84° 46' 29.610" E
56	265122.719	2299976.743	20° 47' 5.405" N	84° 44' 37.232" E
57	266335.105	2300222.516	20° 47' 13.943" N	84° 45' 19.017" E
58	266100.165	2301725.385	20° 48' 2.686" N	84° 45' 10.173" E
59	266707.298	2304889.336	20° 49' 45.802" N	84° 45' 29.638" E
60	265264.1756	2299635.077	20° 46' 54.364" N	84° 44' 42.286" E



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84°44'0"E

84°46'0"E

84°48'0"E

Department of Water Resource, ODISHA

9. Cost Estimate

SL	Item	Rate in Rs.	Unit	Physical	Financial (Rs. in Lakh)
Biological Measure					
1	ANR: Enrichment of Plantation/Re-Densification @400 plants/Ha	59389.26	Ha	100	59.39
2	Block Plantation Afforestation including Maintenance @ 1600 (6 months seedlings) plants/Ha	1,78,717.4	Ha	50	178.72
3	Grass land (Fodder land) development including grass reserves over 50.0ha (10 ha one unit)	14,00,000	Ha	4	56.00
Engineering Measure (Water Harvesting Structures)					
4	Loose Boulder wall gully plugging	4852.80	No	50	2.43
5	Earthen Check dam with Concrete Core	2,50,500.00	No	5	12.53
Others					
6	Awareness campaign for farm management, control grazing etc.	-	-	-	5.00
7	Drinking water facility to villagers	-	-	-	5.00
	Total				229.70

**Total cost of Biological, Engineering &
other measure a silt observation at site**

Rs. 229.70 lakh

**Cost for supply of gas connection/solar cooker
the project affected families @5%**

Rs.11.48 lakh


Sub Total **= Rs. 241.18 lakh**

Contingency cost @ 5% **Rs. 12.06 Lakh**

Sub Total **=Rs. 253.24 lakh**

Administrative Expenditure @5% **=Rs.12.66 Lakh**

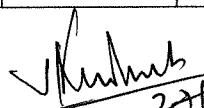
Total **=Rs. 265.91 lakh**


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Annexure-1

Cost Norms for AIDED NATURAL REGENERATION (ANR) @ 400 Plants per Hectare Wage rate Rs. 308.00/day

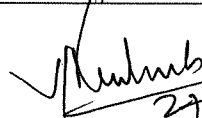
Sl. No.	Item of Work	Preferable period of Execution	Person days	Labour (Rs)	Material (Rs)	Total (Rs)
0th Year						
1	Survey, Demarcation and Pillar Posting, GPS Reading with mapping	Nov/Dec	2	616	0	616
2	Site Preparation	Nov/Dec	2	616	0	616
3	Silvicultural Operation including clearance of weed, climber cutting, high stump cutting, singling of shoots etc	Jan/Feb	5	1540	0	1540
4	Nursery cost (6 months old seedling) part @ Rs 9.45/- seedling (Rs. 6.67 in 0th year + Rs. 2.78 in 1st year) for 440 seedling (400 + 40)	Jan-Mar	11	3388	735	4123
5	Contingency and Unforeseen Expenditures		0	0	165	165
Sub Total			20	6160	900	7060
6	Monitoring & supervision charge 5% of the total cost					353
Grand Total			20	6160	900	7413
1st Year						
1	Nursery cost (6 months old seedling) balance @ Rs. 2.78 for 440 seedlings.	Apr-Jul	5	1540	255	1795
2	Pitting 30 cm cube size	Feb/Mar	12	3696	0	3696
3	Carriage and planting including casualty replacement	Jul/Aug	10	3080	0	3080
4	Complete weeding, Soil working, manuring	Aug/Sep	12	3696	0	3696
5	Cost of Vermi compost 200 gms/plant @ Rs 20/- per kg = Rs 1600.00 and Granular Insecticide 5 gms/ plant @ Rs 80/- per kg = Rs 160.00	Aug/Sep	0	0	1760	1760
6	Cost of Chemical Fertiliser		0	0	648	648


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	Urea 70 gms/plant in two subsequent doses @ Rs 6/- per kg = Rs 168.00					
	NPK 50 gms/ plant @ Rs 24/- per kg = Rs 480.00 as basal dose					
7	Silvicultural Operation involving clearance of weeds, cutting of climbers, singling of shoot etc.	Sep/Oct	15	4620	0	4620
8	Soil conservation measures (staggered trenches of dimension 2m X 0.5m X 0.5m @ 60 nos per ha) or its equivalent	Sep/Oct	20	6160	0	6160
9	Fire line tracing and inspection path	Feb/Mar	3	924	0	924
10	Watch & Ward	Aug-Mar	7	2156	0	2156
11	Contingency and unforeseen expenditure		0	0	319	319
	Sub Total		84	25872	2982	28854
12	Monitoring & supervision charge 5% of the total cost					1442.7
	Grand Total		84	25872.0	2982	30296.70
2nd Year						
1	Casualty Replacement including cost of seedling, carriage and planting.	Jul/Aug	2	616	497.2	1113.2
2	Complete weeding and cultural operations	Sep/Oct	4	1232	0	1232
3	Soil working and manuring	Sep/Oct	4	1232	0	1232
4	Cost of fertilizers and Insecticide	Sep/Oct	0	0	1616	1616
	Vermicompost 200gms/ plant @ Rs 20/- per kg = Rs. 1600.00					
	Granular Insecticides 5 gms/ Plant for 40 plants 200 gms @ Rs 80/- per kg = Rs.16.00					
5	Fire line tracing and inspection path	Feb/Mar	1	308	0	308
6	Soil conservation measures (Renovation of staggered trenches etc)	Sep/Oct	8	2464	0	2464
7	Watch & Ward (Whole Year)	Apr-Mar	7	2156	0	2156


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8	Contingency and unforeseen expenditure		0	0	362	362
	Sub Total		26	8008	2475.2	10483.2
9	Monitoring & supervision charge 5% of the total cost					524.16
	Grand Total		26	8008	2475.2	11007.36
3rd Year						
1	Compete weeding and cultural operations	Aug/Sep	2	616	0	616
2	Soil working	Aug/Sep	2	616	0	616
3	Fire line tracing and inspection path	Feb/Mar	1	308	0	308
4	Watch & Ward (Whole Year)	Apr-Mar	7	2156	0	2156
	Sub Total		12	3696	0	3696
5	Monitoring & supervision charge 5% of the total cost					184.8
	Grand Total		12	3696	0	3880.8
4th Year						
1	Fire line tracing and inspection path	Feb/Mar	1	308	0	308
2	Watch, Ward & Cultural Operations	Apr-Mar	2	616	0	616
	Sub Total		3	924	0	924
3	Monitoring & supervision charge 5% of the total cost					46.2
	Grand Total		3	924	0	970.2
5th Year						
1	Fire line tracing and inspection path	Feb/Mar	1	308	0	308
2	Watch, Ward & Cultural Operations	Apr-Mar	2	616	0	616
	Sub Total		3	924	0	924
3	Monitoring & supervision charge 5% of the total cost					46.2
	Grand Total		3	924	0	970.2
6th Year						
1	Fire line tracing and inspection path	Feb/Mar	1	308	0	308
2	Watch, Ward & Cultural Operations	Apr-Mar	2	616	0	616
	Sub Total		3	924	0	924
3	Monitoring & supervision charge 5% of the total cost					46.2
	Grand Total		3	924	0	970.2



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7th Year						
1	Fire line tracing and inspection path	Feb/Mar	1	308	0	308
2	Watch, Ward & Cultural Operations	Apr-Mar	2	616	0	616
	Sub Total		3	924	0	924
3	Monitoring & supervision charge 5% of the total cost					46.2
	Grand Total		3	924	0	970.2
8th Year						
1	Fire line tracing and inspection path	Feb/Mar	1	308	0	308
2	Watch, Ward & Cultural Operations	Apr-Mar	2	616	0	616
	Sub Total		3	924	0	924
3	Monitoring & supervision charge 5% of the total cost		0	0	0	46.2
	Grand Total		3	924	0	970.2
9th Year						
1	Fire line tracing and inspection path	Feb/Mar	1	308	0	308
2	Watch, Ward & Cultural Operations	Apr-Mar	2	616	0	616
	Sub Total		3	924	0	924
3	Monitoring & supervision charge 5% of the total cost					46.2
	Grand Total		3	924	0	970.2
10th Year						
1	Fire line tracing and inspection path	Feb/Mar	1	308	0	308
2	Watch, Ward & Cultural Operations	Apr-Mar	2	616	0	616
	Sub Total		3	924	0	924
3	Monitoring & supervision charge 5% of the total cost					46.2
	Grand Total		3	924	0	970.2


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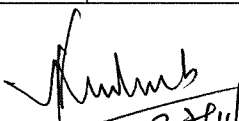
Abstract

Year	Person Days	Labour (Rs)	Material (Rs.)	Monitoring & supervision charge 5% of the total cost	Total Cost (Rs)
0th Year	20	6160	900	353	7413
1st Year	84	25872	2982	1442.7	30296.7
2nd Year	26	8008	2475.2	524.16	11007.36
3rd Year	12	3696	0	184.8	3880.8
4th Year	3	924	0	46.2	970.2
5th Year	3	924	0	46.2	970.2
6th Year	3	924	0	46.2	970.2
7th Year	3	924	0	46.2	970.2
8th Year	3	924	0	46.2	970.2
9th Year	3	924	0	46.2	970.2
10th Year	3	924	0	46.2	970.2
TOTAL	163	50204	6357.2	2828.06	59389.26

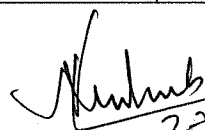

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COST NORM FOR BLOCK PLANATION @ 1600 PLANTS PER HECTARE WAGE RATE Rs 308.00/day(6 Months Seedling)

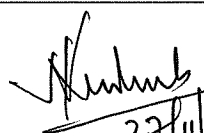
SL NO	ITEMS OF WORK	Preferable period of Execution	Person Days	Labour cost@Rs.308.00/- per day	Material Cost (Rs)	Total Cost (Rs)
1	2	3	4	5	6	7
0th year (Advance work) pre-planting operation						
1	Survey, demarcation and pillar posting	Nov/Dec	2	616	0	616
2	Site preparation	Nov/Dec	12	3696	0	3696
3	Alignment and stacking of pits	Jan/Feb	2	616	0	616
4	Digging of pits(30 cm cube)	Feb/Mar	40	12320	0	12320
5	Nursery cost (6 months old seedling)part@Rs.12.43/- seedling (Rs.8.67 in 0th year +Rs.3.76 in 1st year) for 1760 seedlings(1600+160)	Jan-Mar	44	13552	2939	16491
	Sub Total		100	30800	2939	33739
6	Monitoring & Supervision charge 5% of the total cost					1686.95
	Total		100	30800	2939	35425.95
1st year/planting year						
7	Nursery cost(6 months old seedling) balance@ Rs.3.76 for 1600 seedlings.	Apr-June	21.5	6622	593	7215
8	Fencing	May/June	38	11704	8560	20264
	For an average of 250 meters/ha @ Rs.76.80/- per meter for bamboo thorn fencing			0		0
9	Carriage & planting, casualty replacement and application of insecticides, manure etc.	Jul/Aug	21	6468	0	6468
10	Cost of insecticide and fertilizer (a) NPK@50gms/plant as basal dose=80kg@Rs.24/-per kg=Rs.1920.00. (b)Urea @70gms/plant in two subsequent doses@Rs.6/- per kg=Rs.672/-	Jul/Aug	0	0	3232	3232


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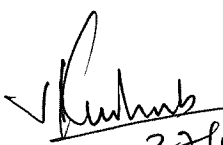
	(c) Granular insecticide (Themet, Forate etc.) @ 5 gms/plant @ Rs.80/- per kg = Rs.640/-			0		0
11	1st weeding (complete weeding)	Aug/Sep	7	2156	0	2156
12	Manuring urea 35 gm	Aug/Sep	5	1540	0	1540
13	2nd weeding (complete weeding)	Sep/Oct	5	1540	0	1540
14	Soil working (50cms.radius around plants) & manuring urea 35gms per plant	Sep/Oct	7	2156	0	2156
15	soil conservation measures in the form of staggered trenches of size 2m x 0.5m x 0.5m @ 30 nos. per ha	Sep/Oct	10	3080	0	3080
16	Fire line tracing & Inspection path	Feb/Mar	3	924	0	924
17	watch & ward	Aug-Mar	7	2156	0	2156
Sub Total			124.5	38346	12385	50731
18	Monitoring & Supervision Charge 5% of the total cost					2536.55
Total			124.5	38346	12385	53267.55
2nd year Maintenance						
19	Casualty replacement (10%) with nursery cost	Jul/Aug	4	1232	1988.8	3220.8
20	Weeding (complete weeding)	Sep/Oct	6	1848	0	1848
21	Cost of fertilizer (NPK @ 70 gms/plant for 1000 plants) (Rs.24/- per kg & insecticide @ 5gms/plant for 160 plants 800gms @ Rs.80/- per Kg)		0	0	2752	2752
22	Repair and maintenance of Bamboo fence including material cost	May/June	20	6160	5080	11240
23	Soil working (50 cms. Radius around plants)	Oct/Nov	7	2156	0	2156
24	Application of fertilizer & insecticide	Sep/Oct	4	1232	0	1232
25	Fire line tracing (2 m. wide fire line over 400 m long)	Feb/Mar	3	924	0	924
26	watch & ward	Apr-Mar	15	4620	0	4620
Sub Total			59	18172	9821	27993
27	Monitoring & Supervision Charge 5% of the total cost					1399.65
Total			59	18172	9821	29392.65


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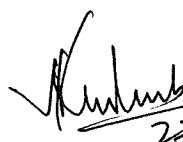
3rd year Maintenance						
28	weeding and application of fertilizer	Aug/Sep	7	2156	0	2156
29	Cost of fertilizer(NPK@ 50gms/plant)@Rs.24/- per kg		0	0	1920	1920
30	Repair and maintenance of Bamboo fence including material cost	May/June	20	6160	1000	7160
31	soil working(50cms.radius around plants)& application of fertilizer	Oct/Nov	7	2156	0	2156
32	Fire line tracing (2 m. wide fire line over 400 m length) & cultural operation	Feb/Mar	3	924	0	924
33	watch & ward	Apr-Mar	15	4620	0	4620
Sub Total			52	16016	2920	18936
34	Monitoring & Supervision Charge 5% of the total cost					946.8
Total			52	16016	2920	19882.8
4th year Maintenance						
35	Fire line tracing (2 m. wide fire line over 400 m length) & cultural operation	Feb/Mar	3	924	0	924
36	watch & ward	Apr-Mar	15	4620	0	4620
Sub Total			18	5544	0	5544
37	Monitoring & Supervision Charge 5% of the total cost					277.2
Total			18	5544	0	5821.2
5th year Maintenance						
38	Fire line tracing (2 m. wide fire line over 400 m length) & cultural operation	Feb/Mar	3	924	0	924
39	watch & ward	Apr-Mar	15	4620	0	4620
Sub Total			18	5544	0	5544
40	Monitoring & Supervision Charge 5% of the total cost					277.2
Total			18	5544	0	5821.2
6th year maintenance						
41	Fire line tracing (2 m. wide fire line over 400 m length) & cultural operation	Feb/Mar	3	924	0	924
42	watch & ward	Apr-Mar	15	4620	0	4620
Sub Total			18	5544	0	5544
43	Monitoring & Supervision Charge 5% of the total cost					277.2
Total			18	5544	0	5821.2
7th year Maintenance						


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44	Fire line tracing (2 m. wide fire line over 400 m length) & cultural operation	Feb/Mar	3	924	0	924
45	watch & ward	Apr-Mar	15	4620	0	4620
Sub Total			18	5544	0	5544
46	Monitoring & Supervision Charge 5% of the total cost					277.2
Total			18	5544	0	5821.2
8th year Maintenance						
47	Fire line tracing (2 m. wide fire line over 400 m length) & cultural operation	Feb/Mar	3	924	0	924
48	watch & ward	Apr-Mar	15	4620	0	4620
Sub Total			18	5544	0	5544
49	Monitoring & Supervision Charge 5% of the total cost					277.2
Total			18	5544	0	5821.2
9th year Maintenance						
50	Fire line tracing (2 m. wide fire line over 400 m length) & cultural operation	Feb/Mar	3	924	0	924
51	watch & ward	Apr-Mar	15	4620	0	4620
Sub Total			18	5544	0	5544
52	Monitoring & Supervision Charge 5% of the total cost					277.2
Total			18	5544	0	5821.2
10th year Maintenance						
53	Fire line tracing (2 m. wide fire line over 400 m length) & cultural operation	Feb/Mar	3	924	0	924
54	watch & ward	Apr-Mar	15	4620	0	4620
Sub Total			18	5544	0	5544
55	Monitoring & Supervision Charge 5% of the total cost					277.2
Total			18	5544	0	5821.2
Grand Total			461.5	142142	28065	178717.4


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Abstract					
Year	Person Days	Labour 308.00/- per day(Rs)	Material (Rs)	Monitoring & Supervision Charge 5% of the total cost	Total Cost (Rs)
0 th Year	100	30800	2939	1686.95	35425.95
1 st Year	124.5	38346	12385	2536.55	53267.55
2 nd Year	59	18172	9821	1399.65	29392.65
3 rd Year	52	16016	2920	946.8	19882.8
4 th Year	18	5544	0	277.2	5821.2
5 th Year	18	5544	0	277.2	5821.2
6 th Year	18	5544	0	277.2	5821.2
7 th Year	18	5544	0	277.2	5821.2
8 th Year	18	5544	0	277.2	5821.2
9 th Year	18	5544	0	277.2	5821.2
10 th Year	18	5544	0	277.2	5821.2
TOTAL	461.5	142142	28065	8510.35	178717.4


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Annexure-3**Cost estimates of Grassland Development Including Grass Reserves for one unit (10 Ha.)****Rupees in Lakh**

S L	Item	CPR, Gochar land / community land / waste land which need treatment of soil
1. Capital Investment		
A	Demarcation of boundary, fencing/ (trench / brushwood / barbed wire)	0.75
B	Land Development (10 hectares) @10 lakhs per ha. (including soil treatment and weeding)	1
C	Farm sheds – for equipment, seed, manure, and office	1.5
D	Purchase of agricultural implements	0.5
E	Creation of irrigation facilities: wells, pumps, power line, water tank, pump room, pipelines etc.	3.75
	Sub- Total	7.5
2. Recurring Expenditure		
A	Wages of supervisory staff	0.2
B	Seeds, fertilizer/ manure, insecticides	0.4
C	Cultivation charges	1
D	Irrigation electricity / fuel charges	0.3
E	Maintenance of Store/dead stock	0.3
F	Maintenance of Store/dead stock	0.3
	Sub-Total	2.5
	Grand Total	10
	Add for inflation of 4 years @10% per annum = 10x 4x 10% =	4.00
	Total	14.00

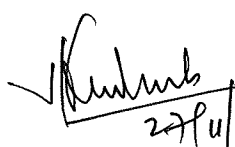
As per Guideline of Dept. of Animal Husbandry and Dairying (2016)


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Annexure-4**Gully with 1.3 m width, 0.6 m bottom width and depth 0.6 m**

Sl. No	Details of work	Man days	Rate	Amount in Rs.
1	Survey, alignment, demarcation	1	308.00	308.00
2	Earth work excavation in stony earth mixed with gravel within initial lead and lift Edging out of gully $2 \times 0.5 \times 0.85 \times 2.25 \times 0.6 = 1.15$ Foundation for stone packing $1 \times 2.3 \times 1.8 \times 0.3 = 1.24$ D/S guard wall $1 \times 1.3 \times 0.5 \times 0.6 = 0.39$ Side wall $2 \times 2.13 \times 0.5 \times 0.3 = 0.64$ Total = 3.42	1.74	308.00	535.92
3	a. Dry stone packing in the foundation of structure U/S dumping (deflected by 45 deg.) $1 \times \{(1.3+2.2)/2\} \times 0.45 \times 0.3 = 0.24$ Head wall and D/S dumping $1 \times 1.3 \times 0.9 \times 0.3 = 0.35$ Apron $1 \times 1.3 \times 0.9 \times 0.3 = 0.35$ Side walls $2 \times 3.95 \times 0.5 \times 0.33 = 1.19$ D/S guard wall $1 \times 1.3 \times 0.5 \times 0.6 = 0.39 \text{ m}^3$ b. Dry stone packing in super structure U/S dumping $1 \times \{(3.2+2.3)/2\} \times 0.45 (0.45+0)/2 = 0.27$ D/S dumping $1 \times 2.3 \times 0.45 \times (0.45+0.2)/2 = 0.33$ Head wall $1 \times 2.3 \times 0.45 \times 0.45 = 0.47$ Apron $1 \times 0.9 \times 1.3 \times 0.15 = 0.18$ Side walls $2 \times 3.95 \times 0.5 \times 0.3 = 1.30$ Total (a+b) = 5.07 m ³	2.6 MD Material 5.07 m ³	308.00 488.40	808.80 2476.19
4	Earth work in hard soil for side bund of 10m length in both side of structure $2 \times 10 \times \{(1.05+0.45)/2\} \times 0.3 = 4.5 - 3.42 = 1.08$ i.e excavated earth in the foundation will be adjusted for the side bund	0.6 MD	308.00	184.80
5	Fine dressing and turfing locally available grass within initial lead and lift both side slopes $2 \times 10 \times 0.42 = 8.40$ Top $1 \times 10 \times 0.45 = 4.50$ For 2 no. bunds $2 \times 12.90 = 25.80$ sq m	0.8 MD	308.00	246.40
6	Vetiver plantation with locally collected vetiver sleeves in D/S of the structure with Spacing (0.23x 0.23) sq m over 1.3 mt span and 1.0mt width of 3 rows including foliar spraying with Urea. No. of sleeves required = $(2.3/0.23) \times 3 = 30$ nos.	0.2 MD	308.00	61.60
	Sub Total			4621.71
7	Contingencies and unforeseen charges (5%)			231.09
	Total			4852.80

Note: Labour rate as per Gazette no. S.R.O. No. 6100/2020 dated 21st October 2020 and material & conveyance cost as per schedule of rates (Works Dept. GoO)

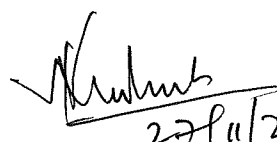

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Annexure-5**Earthen Check dam, 10 m with Concrete Core wall**

Labor cost			
Ordinary Labour	310 man-days	308.00/-	95,480.00/-
Skilled Labour (Mason etc.)	15 man-days	398.00/-	5970.00/-
Total			1,01,450.00/-
Material Cost			
Cement	230 bags	305.00/-	70,150/-
Sand	15 truck	1370.00/-	20,550/-
Brick	2500 Nos.	7.50/-	18,750/-
Aggregate (40 mm)	5 truck	6000	30,000/-
Bamboo	60 nos.	160/-	9,600/-
Total			1,49,050/-

Total Cost: 1,01,450.00+ 1,49,050.00=Rs.2,50,500.00/-


Note: Labour rate as per Gazette no. S.R.O. No. 6100/2020 dated 21st October 2020 and material & conveyance cost as per schedule of rates (Works Dept. GoO)


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Year wise cash Flow

Annexure-6

Sl	Item	0 th Year	1 st Year	2 nd Year	3 rd Year	4 th Year	5 th Year	6 th Year	7 th Year	8 th Year	9 th Year	10 th Year	Total
1	ANR: Enrichment of Plantation/Re-densification (@400 Plants/Ha)	7.41	30.30	11.01	3.88	0.97	0.97	0.97	0.97	0.97	0.97	0.97	59.39
2	Block Plantation Afforestation including maintenance (@ 1600 plants/ha (6 months seedlings)	17.71	26.63	14.70	9.94	2.91	2.91	2.91	2.91	2.91	2.91	2.91	89.36
3	Fodder land development per 10ha	14	14	14	14	0	0	0	0	0	0	0	56
4	Loose Boulder wall gully plugging	0	0	2.43	0	0	0	0	0	0	0	0	2.43
5	Earthen Check dam with Concrete Core	0	0	12.53	0	0	0	0	0	0	0	0	12.53
6	Awareness campaign for farm management, control grazing etc.	0	0	5	0	0	0	0	0	0	0	0	5
7	Drinking Water Facility and socio-economic development to Villagers	0	0	2.5	2.5	0	0	0	0	0	0	0	5
	Total cost of Biological, Engineering measure	39.13	70.93	62.16	30.32	3.88	3.88	3.88	3.88	3.88	3.88	3.88	229.70
	Cost for supply of gas connection/solar cooker to the project affected families @ 5%	1.96	3.55	3.11	1.52	0.19	0.19	0.19	0.19	0.19	0.19	0.19	11.48
	Sub Total	41.08	74.48	65.26	31.84	4.07	4.07	4.07	4.07	4.07	4.07	4.07	241.18
	Contingency cost @ 5%	2.05	3.72	3.26	1.59	0.20	0.20	0.20	0.20	0.20	0.20	0.20	12.06
	Sub Total	43.14	78.20	68.53	33.43	4.28	4.28	4.28	4.28	4.28	4.28	4.28	253.24
	Administrative Expenditure @5%	2.16	3.91	3.43	1.67	0.21	0.21	0.21	0.21	0.21	0.21	0.21	12.66
	Total	45.29	82.11	71.95	35.10	4.49	4.49	4.49	4.49	4.49	4.49	4.49	265.91


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