CATCHMENT AREA TREATMENT PLAN (CATP)

IN LIEU OF DIVERSION OF 153.938 HA. FOREST LAND FOR CONSTRUCTION OF KUTULISINGHA IRRIGATION PROJECT IN ATHMALLIK FOREST DIVISION OF ANGUL DISTRICT

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1. Introduction

The study of erosion and sediment yield from catchment is of utmost importance as the deposition of sediment in reservoir reduces its capacity, thus affecting the water available for the designated use. The eroded sediment from catchment when deposited on streambeds and banks causes braiding of reservoir reach. The removal of top fertile soil from catchment also adversely affects the agricultural production.

The catchment area treatment involves the understanding of the erosion characteristics of the terrain and suggesting remedial measures to reduce the erosion rate. The main aim of the catchment area treatment plan is to rejuvenate various potential and degraded ecosystems in the catchment area for longevity of the reservoir storage capacity.

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 and its utility in maintaining the ecosystem health. The plan addresses issues such as prevention of gully erosion, enhancing the forest cover for increasing soil holding capacity; and arresting total sediment flow in the reservoir and flowing waters.

1.1 Objectives of the CATP

The main aim of the Catchment Area Treatment Plan is to rejuvenate various potential and degraded ecosystems in the catchment area for of the reservoir storage capacity. For this purpose, this action plan has been prepared with the following objectives:

i. Soil conservation through biological and engineering solutions to reduce sediment load in the reservoir
ii. Ecosystem conservation through improvement in water retaining properties of soil and increase in vegetative cover
iii. To fulfill the fuel and fodder requirements of local people
iv. Integration of the CAT Plan with social and economic activities of the local population through employment generation and community participation

1.2. Brief Description of the KutulisinghaIrrigation Project

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% i.e 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 is reserved for riparian use at the downstream & upstream as per suggestion of Central Water Commission. The Catchment area of Kutulsinga Irrigation project is enclosed at ***Plate-1*** superimposed on SOI Topo sheet.

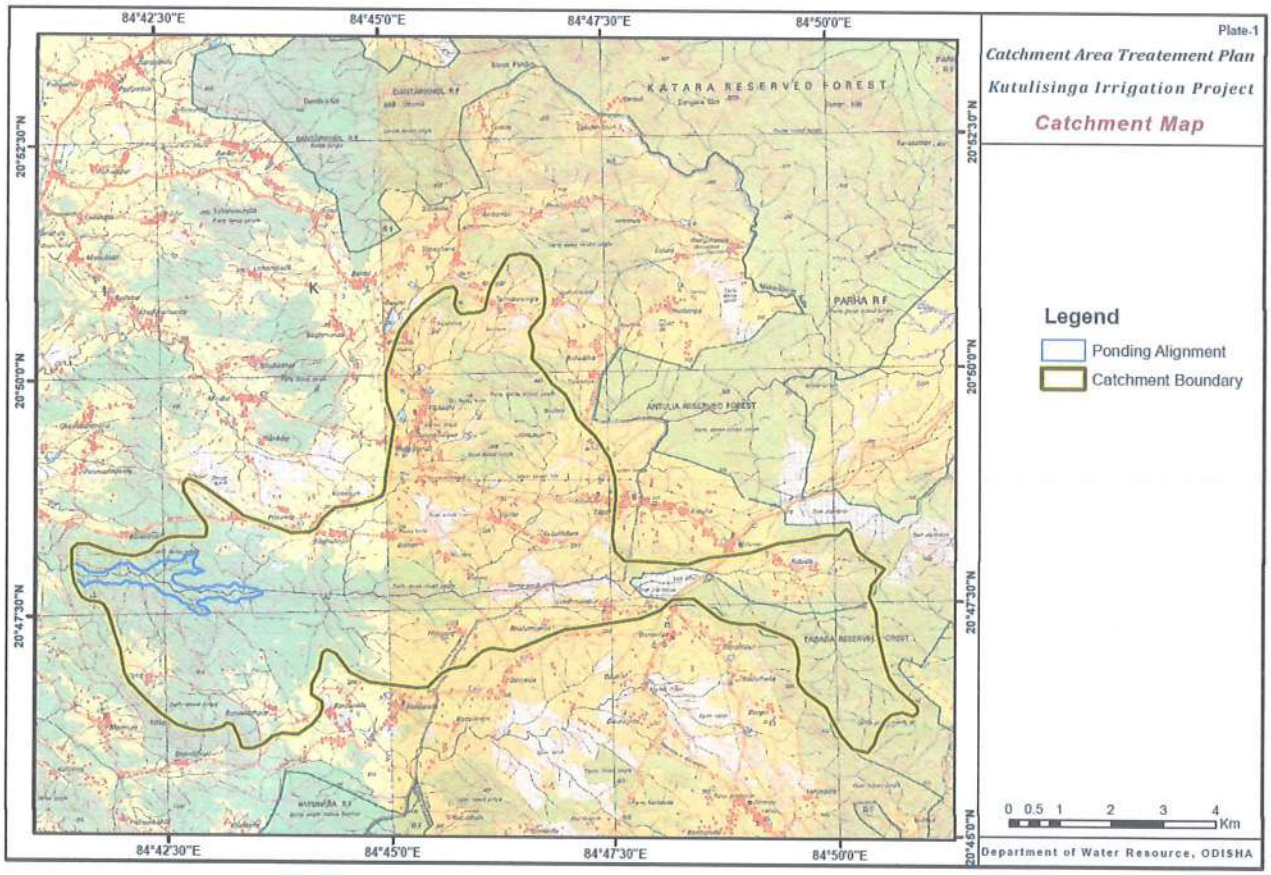


Figure 1 Catchment Area of the Reservoir

1.2.1 Irrigation planning

The project comes under Athmallik 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 cultivation is less, 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.

1.2.2 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 contouring 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 are expected to 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.

1.2.3 Reservoir Simulation Study

Period of Simulation is 1977-78 to 2005-06 (hydrological year). First of all, sediment analysis is carried out with reference to l. 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 Kutulisinghamedium 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.CA. as annual irrigation.

1.3 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,

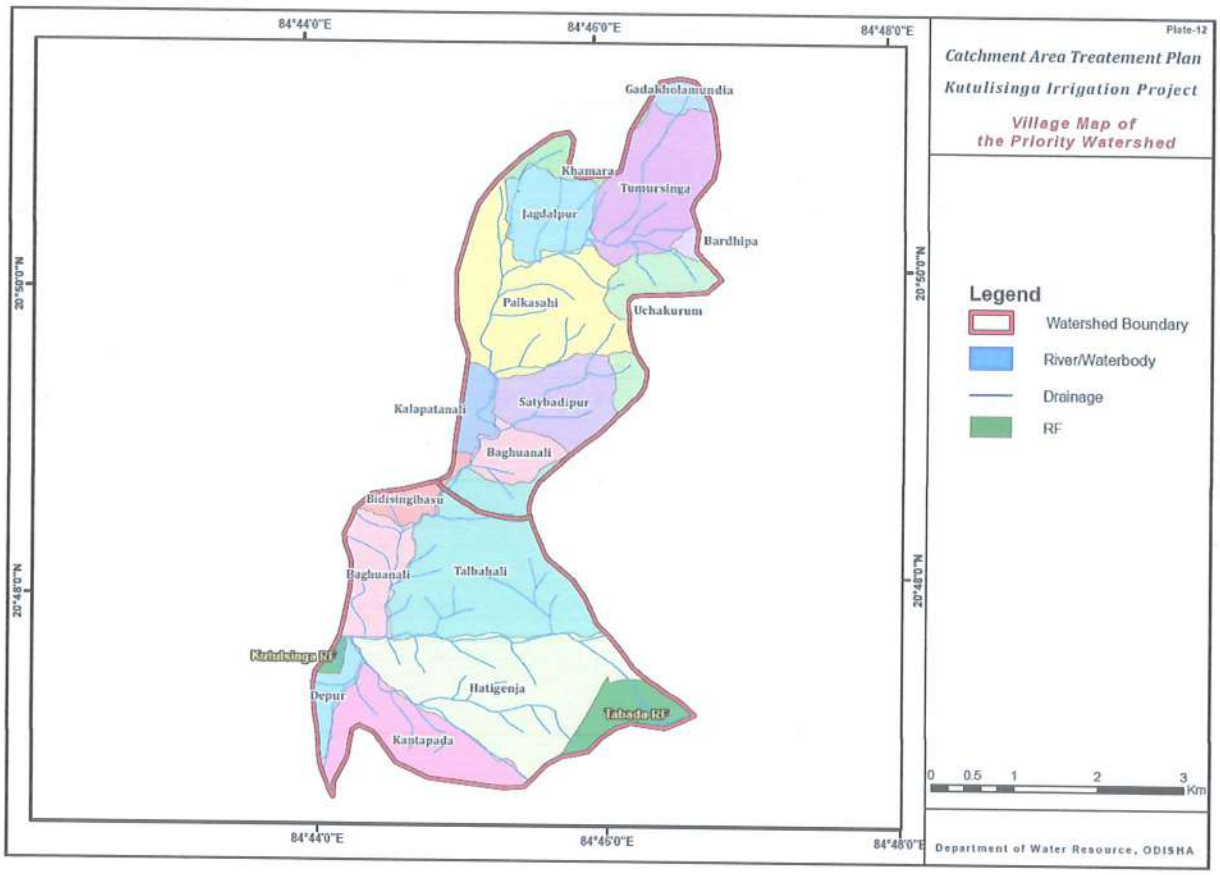


Figure 2 Village Map of Priority Watersheds

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

1.4Forest & Non-Forest land involved in the project

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	Athmallik	Taleipathar	20.680	8.369	7.930	3.212	**28.610**	**11.581**
2		Arkhakuda	0.190	0.077	0.740	0.299	**0.930**	**0.376**
3		Nuaarakhakuda	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		Thakurgarh	0.500	0.202	1.960	0.793	**2.460**	**0.995**
14		Kutulisinga RF	320.29	129.620	0.000	0.000	**320.29**	**129.620**
		Total Area	**380.38**	**153.938**	**63.300**	**25.616**	443.68	179.554

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.

2. Identification of Degraded Areas in the Catchment

Several factors determine the erosivity of a given landmass. The functional role of each factor is summarized below.

The catchment boundary of the Kutulisingha Dam is delineated using Survey of India (SoI) topographic sheets F45S9 and F45S13, based on an analysis of contours and drainage patterns. The drainage map of the project is provided in ***Plate-2.***

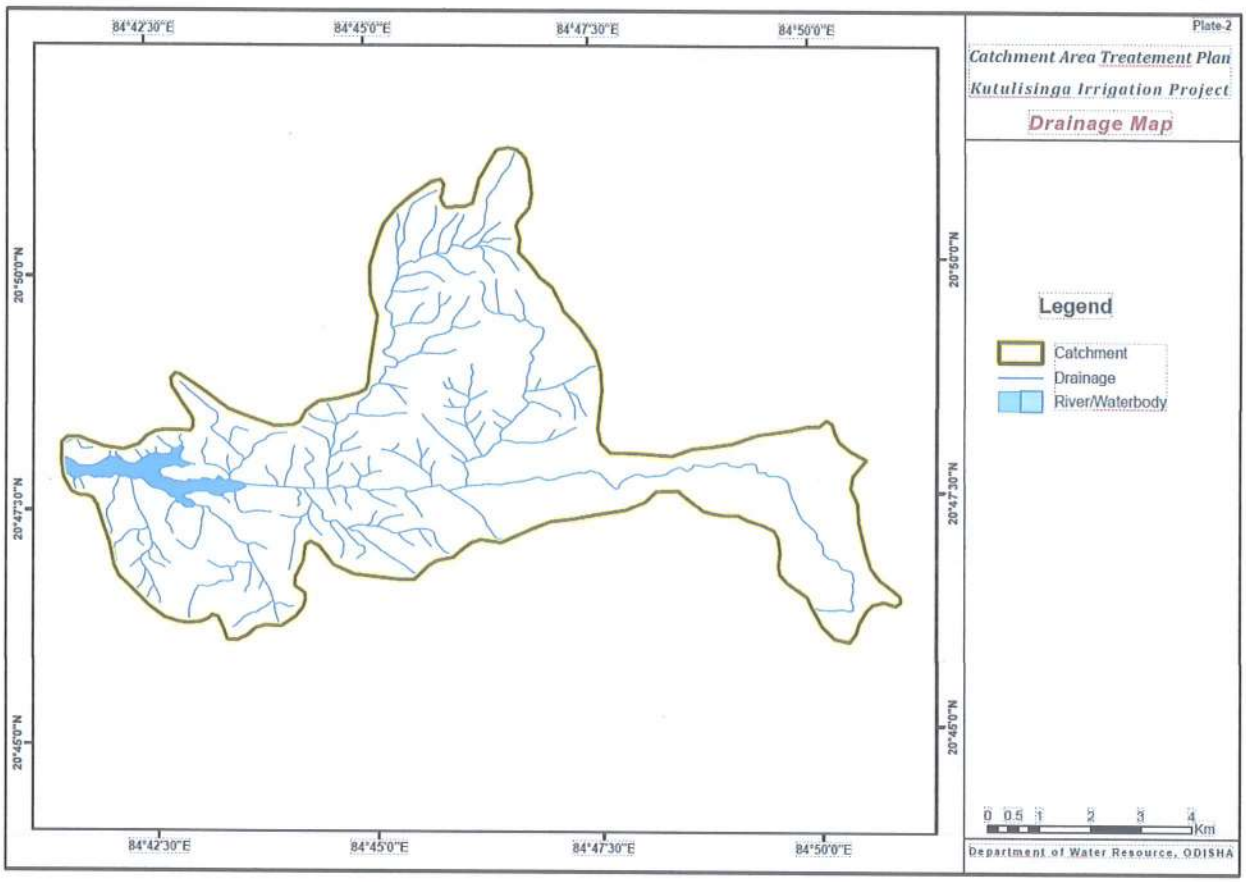


Figure 3 Drainage Map of the Catchment Area

Since the catchment area is relatively small, the Catchment Area Treatment Plan (CATP) has been developed at the micro-watershed level instead of the watershed level. The micro-watersheds are delineated using information from the Watershed Atlas of India, the Land Use Survey of India (SLUSI) website, and micro-watershed boundaries obtained from the Watershed Mission of Odisha. The micro-watershed map is provided in ***Plate-3***.

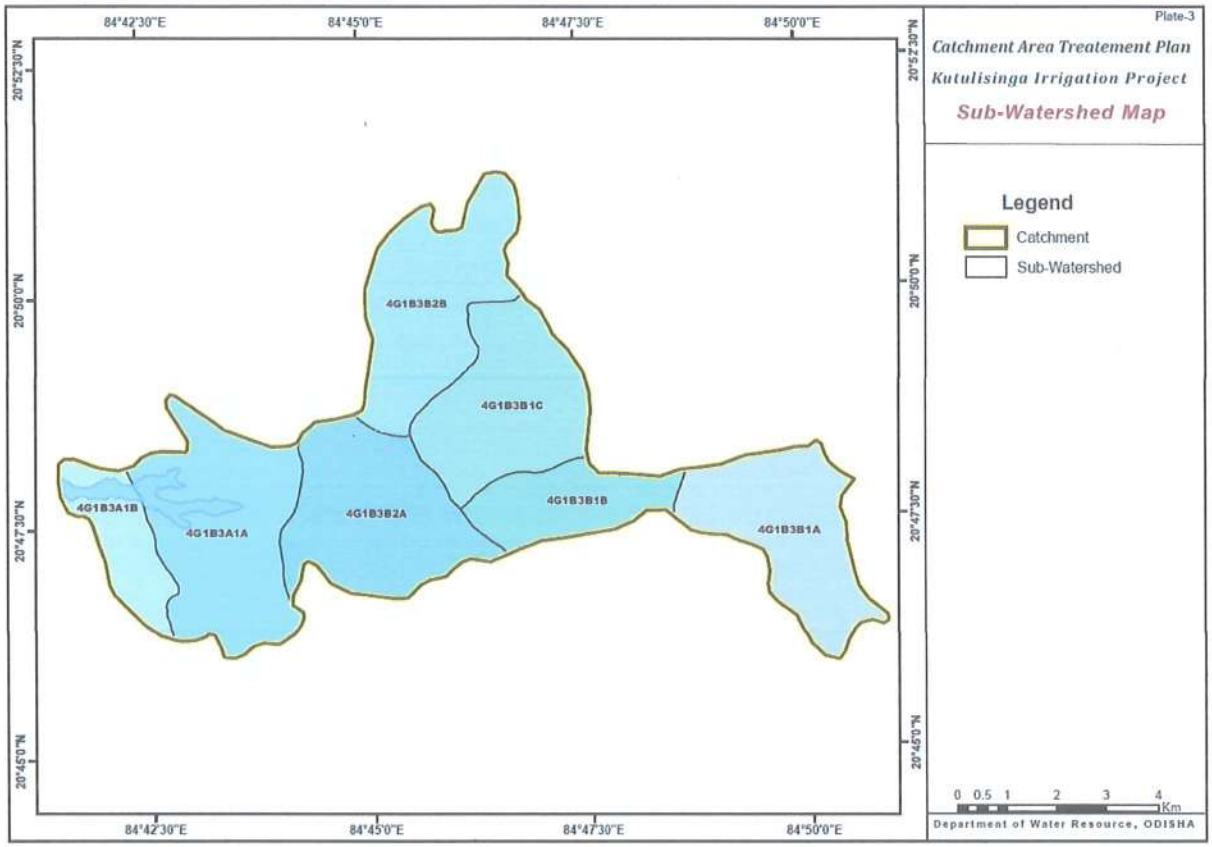


Figure 4 Micro Watersheds in the Catchment Area

2.1. Physiography &Slope

The Slope map was derived from contours shown on SoI 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-2** and the contour & slope map is enclosed at ***Plate-4 & 5*** respectively.

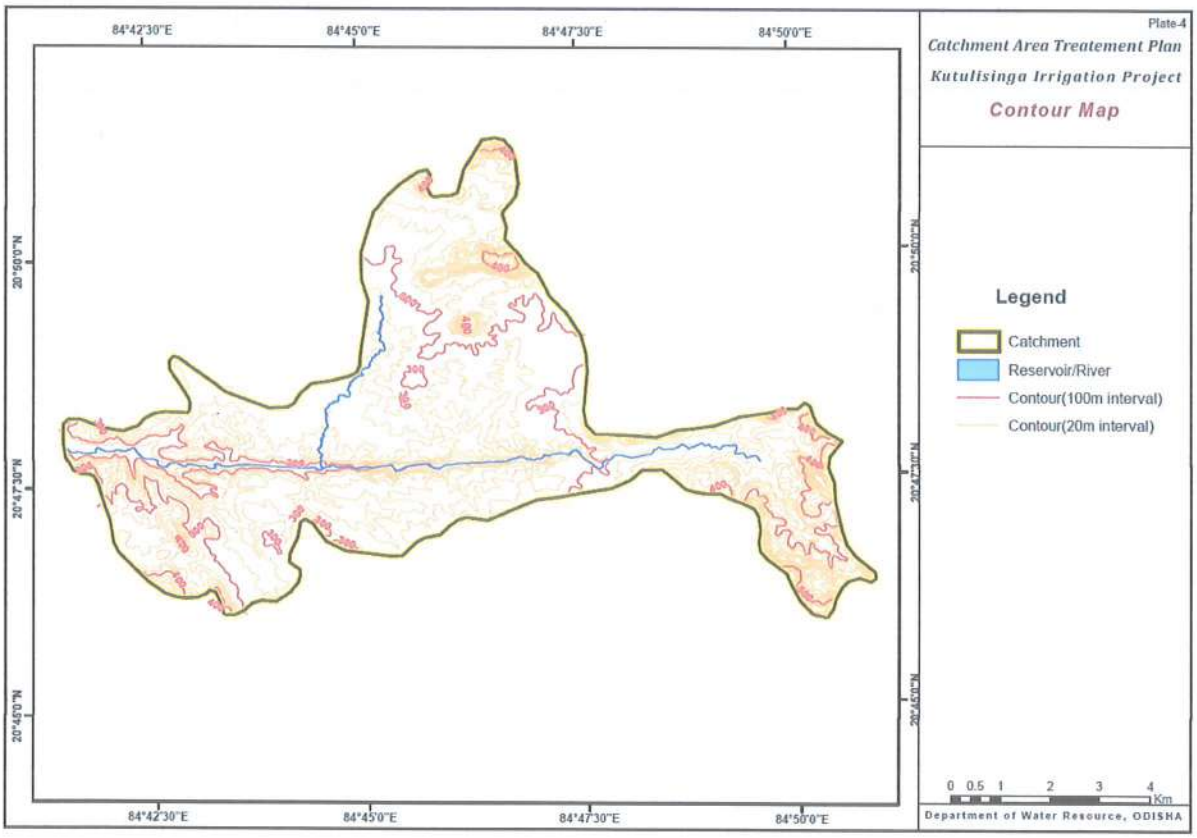


Figure 5 Contour Map of the Catchment Area

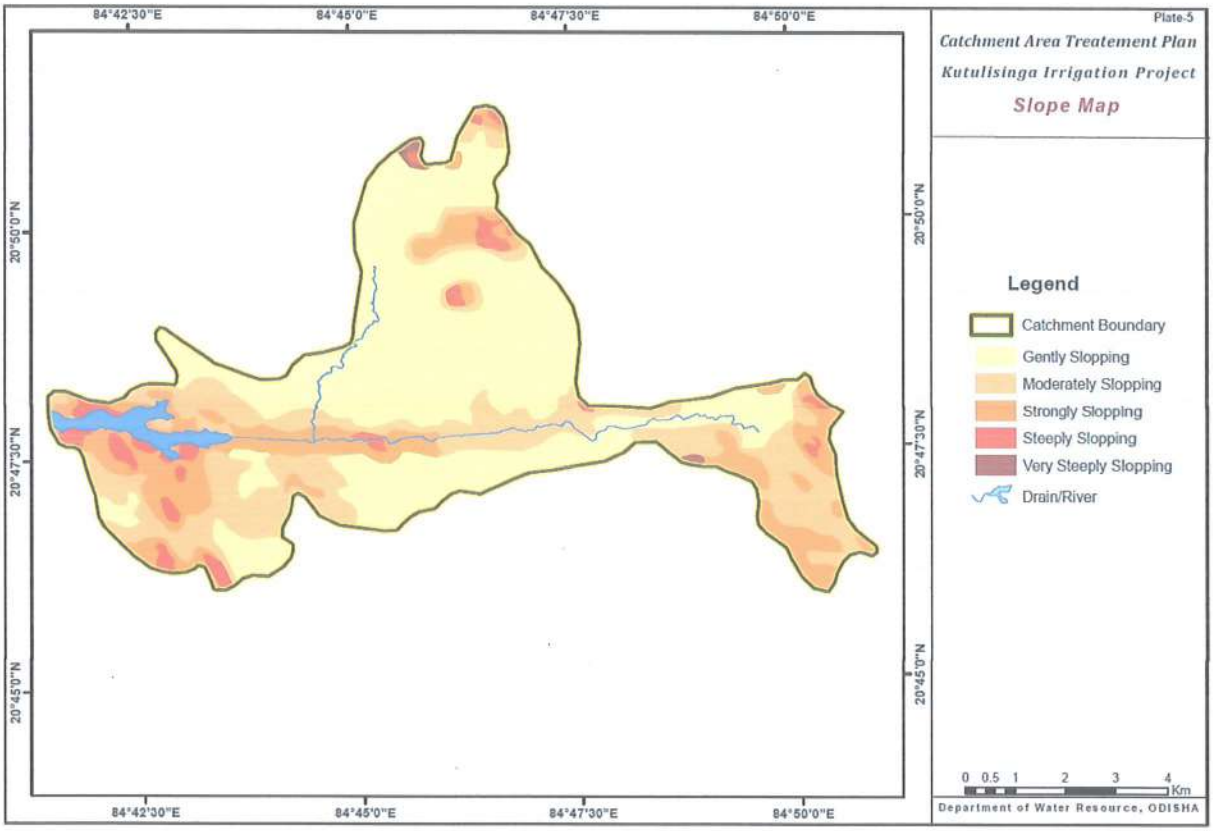


Figure 6 Slope Map of the Catchment Area

Table-2: 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**

2.2. Land Use/ Land Cover

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 below.

Satellite: IRS-P6

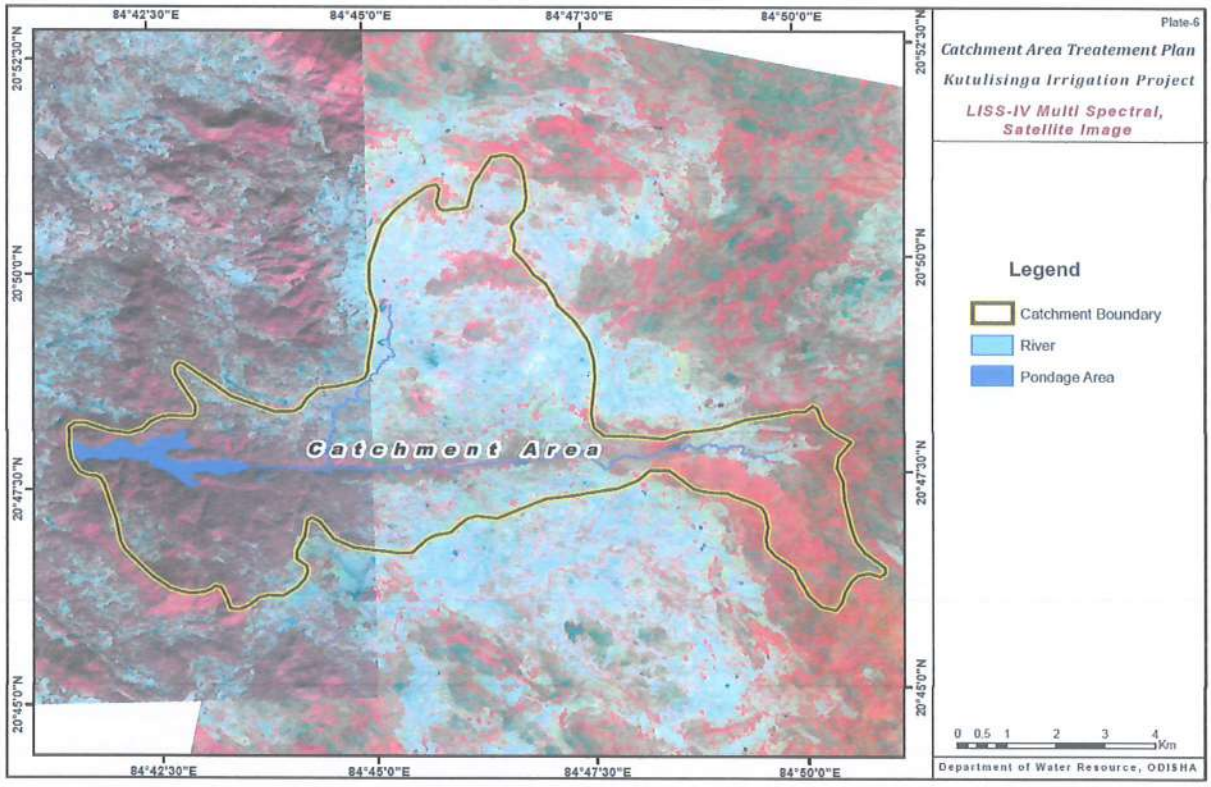
Sensor: LISS-IV MX (Multi Spectral)

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-3*** and the map is enclosed at ***Plate-7***.

Figure 7 Satellite Image of the Catchment Area

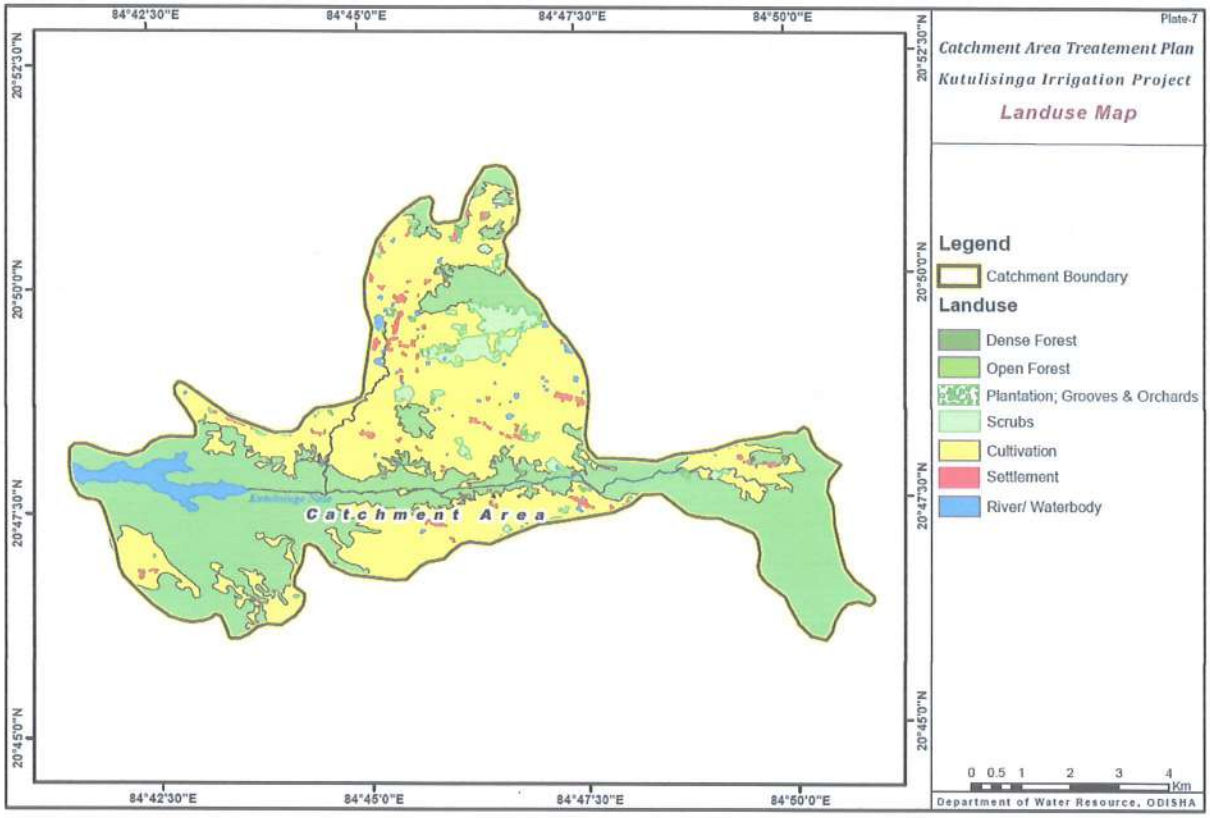


Figure 8 Land Use Map of the Catchment Area

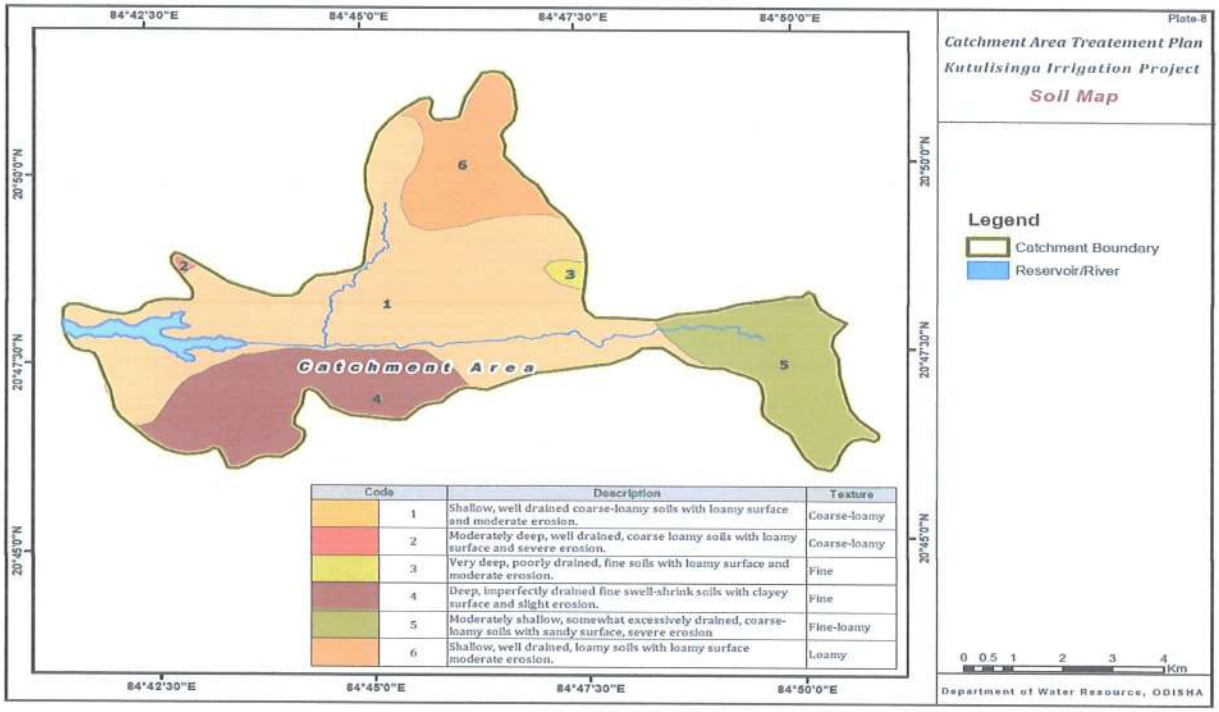
Table-3: Area falling under different Land Use

Description	Area in Km2	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**

2.3. Soil Parameters

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-4***.



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

Figure 9 Soil Map of the Catchment Area

Table-4: Area falling under different soil category

Code	*Description*	*Texture*	*Area in km²*	*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
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**

2.4Climatic Factors

2.4.1 Rainfall erosivity

The rainfall factor, an index unit, is a measure of the erosive force of a specific rainfall. This is determined as a function of the volume, intensity and duration of rainfall and can be computed from a single storm, or a series of storms to include cumulative erosivity from any time period. Raindrop/splash erosion is the dominant type of erosion in barren soil surfaces.

The soil loss is closely related to rainfall partly through the detaching power of raindrop striking the soil surface and partly through the contribution of rain to runoff. R value is low in the areas of low degree of slope which imply that flat areas would increase the water pounding on the surface, thus protecting soil particles from being eroded by rain drops.

The most part of rain fall is received from South – West Monsoon,which occurs during the period from June to October and extending up to November. About 80% of precipitation occurs during these months. The average, maximum and minimum rainfall are 1990 mm and 797mm respectively.

2.4.2. Soil Erodibility Factor

Different soil types are naturally resistant and susceptible to more erosion than other soils and are function of grain size, drainage potential, structural integrity, organic content and cohesiveness. Erodibility of soil is its resistance to both detachment and transport. Because of thick forested nature of the watershed, detailed field surveys of soils in the area were not possible.

3. Prioritization of Micro Watershed falling in the Catchment area

Prioritization of the sub-watersheds falling in the free/directly draining catchment is done in thefollowing manner:

a) Preparation of a framework of sub-watersheds through systematic delineation and codification;

b) Rapid reconnaissance survey leading to the generation of a map indicating erosionintensity mapping units (EIMUs);

c) Assignment of weightage values to various mapping units based on relative silt yield;

d) Assignment of maximum delivery ratios to various erosion intensity mapping units and assessment of adjusted delivery ratios for different sub-watersheds;

e) Computing silt yield index for individual sub-watersheds;

f) Grading of sub-watersheds into very high, high, medium, low and very low priority categories.

3.1. Assignment of Erosion Weightage Values (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.

3.2. Assignment of Delivery Ratio (D)

Delivery ratios are 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 are 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.

3.3.Computation of Silt Yield Index (SYI)

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 of a particular sub-watershed is calculated using following empirical formula:

$$SYI = \frac{\sum (Ai \times Wi \times Di) \times 100}{Aw}$$ [where i = 1 to n (n is the No. of EIU)]

Ai = Area of i^{th} unit (EIU)
Wi = Weightage value of the i^{th} unit EIU
Di = Delivery Ratio of the i^{th} unit EIU
Aw = Total area of Sub-watershed

3.4. Categorization of Micro Watershed based into various priority categories

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 into different categories based on their SYI. The values of SYI as given below are used to categorize sub-watersheds into various priority categories.

Priority category	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-5***

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

Area under high and very high categories is proposed to be treated under this CATP. 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.

4. Treatment Measures

The Catchment Area Treatment Plan includes a combination of engineering, biological, and socio-economic measures tailored to address soil erosion, enhance vegetation cover, and improve community livelihoods. Biological measures focus on enhancing natural regeneration through Aided Natural Regeneration (ANR) techniques and the development of fodder lands. These initiatives aim to restore degraded areas, improve biodiversity, and provide fodder resources to reduce grazing pressure on forests.

Soil Moisture Conservation (SMC) measures include the construction of various check dams and trenches based on site-specific needs. Loose Boulder Check Dams (LBCD), Wire Mesh Check Dams (WMCD), Concrete Check Dams (CCD), and Continuous Contour Trenches (CCT) are planned to control soil erosion, retain moisture, and recharge groundwater. These structures play a critical role in reducing siltation and improving water availability for agricultural and ecological needs.

Socio-economic measures focus on community engagement and capacity building. Awareness campaigns will educate farmers on sustainable practices, such as controlling grazing, proper farm management, and discouraging the burning of crop residues. The campaigns will also promote water conservation through farm ponds and encourage the adoption of suitable cropping patterns. To enhance livelihoods, vocational training programs will be organized for youth and women, offering skills in tailoring, food processing, and vermicomposting. Exposure visits to industries will also be conducted to provide hands-on experience. Additionally, the provision of LPG and CNG distribution will reduce dependency on forest resources for fuelwood, contributing to forest conservation.

Given that 81.92% of the catchment area is agricultural land, special emphasis will be placed on educating farmers about sustainable agricultural practices and controlled grazing. The Forest Department will also monitor wildlife and forest species in adjacent areas to assess the effectiveness of these measures. For this purpose, an inflatable motorboat will be procured to facilitate surveillance and monitoring activities in the catchment area.

4.1 Biological Measures

4.1.1 Aided Natural Regeneration

Aided Natural Regeneration @200 is suggested in 250 ha of open forests available within the watersheds.

4.1.2. Fodder land development

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

Table-8: 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 sites to be treated are depicted in ***Plate-14***. The detail estimate is given at ***Annexure-I***.

4.2. Soil Moisture Conservation Measures

Soil moisture conservation measures encompass a variety of structural and vegetative strategies. The structural approach integrates across the entire micro-watershed, spanning from upstream catchments to downstream interventions command areas. These interventions are categorized into upstream, middle, and downstream areas within the micro-watershed.

Gully plugging, a common drainage line treatment, is planned upstream along river/nallah parts. These activities involve installing barriers across gullies to decrease runoff velocity, retain sediment, and mitigate gully erosion in the micro-watershed. Gully plugging works include barriers and optional downstream and upstream aprons, with structures like Loose Boulder Check Dam (LBCD) and Wiremesh Check Dam (WMCD) serving as barriers. Water harvesting structures, such as check dams constructed with embankments, are planned in the downstream sections of micro-watersheds. Continuous Contour Trenches (CCT) will also be implemented to manage water runoff, enhance soil moisture, and mitigate downstream flooding, while simultaneously reducing soil erosion.

4.2.1. Loose Boulder Check Dam (LBCD)

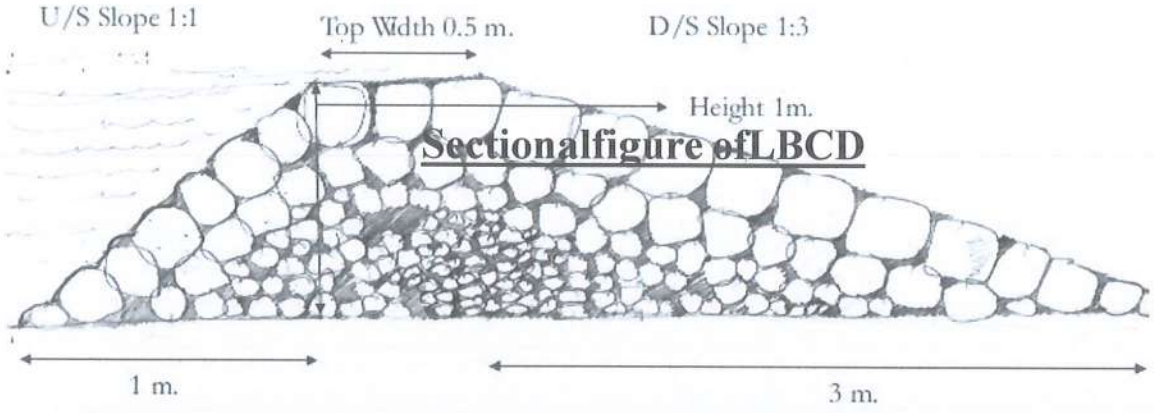
Drainage line treatment measures often incorporate Loose Boulder Check Dams (LBCDs), structures crafted from loose stones and boulders in upper reach gullies. LBCDs serve to reduce water runoff velocity, capture silt and soil, fostering vegetation in the upstream areas. Typically composed of boulders with a 6–12-inch diameter, these structures are constructed in a series along a drainage line, dividing the overall catchment into smaller sections. Ideally, LBCDs are situated on the upstream side of watersheds with smaller catchment areas (approximately 2-3 ha) and a drainage slope of 30-40 percent. This construction is feasible in areas where boulders are readily available. LBCDs, arranged in a series, transform the longitudinal gradient from a steep slope to a succession of flat steps with low drops.

Advantages of Loose Boulder Check Dams include erosion control, sediment retention, natural aesthetics, flexibility, adaptability, habitat preservation, cost-effectiveness, maintenance ease, and low environmental impact

Selection Criteria:

The following criteria shall be followed in the selection and construction of boulder check dam

- It shall be provided for minimum catchment area of even less than 5 ha.
- The height of the check dam in the middle of the stream should be 1m above ground level.
- It shall be provided where the bed slope is below 1 in 5.



Sectionalfigure ofLBCD

Design and Layout

1. Design and Dimensions:

- The boulder check dam, while not serving as a harvesting structure, is typically maintained at a height ranging from 1.2 to 2.5 meters above the gully.
- The length of the check dam equals the waterways plus an additional 0.50 meters on both sides, embedded in the embankment.
- The foundation depth below the stream bed varies between 0.30 to 0.75 meters.
- The top width is set at 0.5 to 1 meter.
- A more gradual downstream slope is adopted to minimize the impact of water flowing over the dam.
- The height of the dam embedded in the embankment exceeds the height in the middle of the stream, ensuring a gradual slope for safe water flow without endangering the embankments.
- Adequate length and width of a stone apron are essential on the downstream side to prevent scour.

2. Slope Considerations:

- Downstream slope is intentionally kept more gradual to mitigate the effects of water flowing over the dam.
- A gradual slope facilitates safe water flow without causing harm to the embankments.

3. Stone Apron for Scour Prevention:

- Sufficient length and width of a stone apron are necessary on the downstream side to effectively prevent scour.

4. Distance Between Check Dams:

- The distance between two successive check dams is determined by the gradient or slope of the stream.
- In flat slope conditions, a greater distance between check dams is required, and vice versa.
- The maximum water storage by one boulder check may extend up to the toe of the upper boulder check dam.
- Distances below this threshold would be deemed uneconomical.

Construction procedure of LBCD:

1. **Optimal Boulder Selection:** Use angular stones rather than round ones to enhance interlocking and stability within the boulder check dam structure. Angular stones provide better grip, reducing the risk of displacement and enhancing the overall durability of the check dam.

2. **Size Considerations:** Avoid using small stones weighing less than a kilogram, as they are prone to wash away easily. Larger boulders, especially those placed on the outer side of the check dam, contribute to better resistance against erosion and water flow.
3. **Profile Alignment:** Construct the check dam according to the specified layout, ensuring that the boulders are arranged in horizontal layers. Attention must be paid to maintaining the designed upstream and downstream slopes to optimize the dam's effectiveness in water flow control.
4. **Embankment Integration:** Embed the foundation of the check dam into both embankments securely to ensure stability and prevent potential shifts during water flow or soil erosion.
5. **Layered Construction:** Build the check dam in horizontal layers, paying meticulous attention to the placement of larger boulders on the outer side. This layering technique enhances the structural integrity and resilience of the check dam against the force of flowing water.
6. **Embankment Height Differential:** Keep the embankment higher than the middle section of the check dam to prevent water from cutting through the embankments, ultimately avoiding the risk of check dam collapse. This precaution is crucial for the long-term effectiveness of the structure.
7. **Pre-Monsoon Completion:** Ensure the construction of the boulder check dam is completed before the onset of the monsoon season to mitigate potential disruptions and challenges posed by heavy rainfall. A timely completion is vital for the overall success and stability of the check dam.
8. **Downstream Anchoring:** Anchor the largest boulders on the downstream side by digging up to a depth of 0.25m. This anchoring method enhances the stability of the check dam, preventing downstream erosion and potential displacement of boulders.
9. **Porous Material Composition:** Acknowledge that boulder check dams are composed of highly porous materials, making them suitable for porous soil. While they may not
10. hold water for an extended period, their design is ideal for promoting groundwater recharge in porous soil conditions.
11. **Stream Bed Preparation:** Clear the bed of the stream at the base of the check dam to a depth of 0.25m, removing mud and sand. This preparation ensures a solid foundation for the check dam, reducing the risk of settlement and enhancing its overall performance in water flow control.

4.2.2. WireMeshCheckDams(WMCD):

A Wire Mesh Check Dam is designed to be strategically positioned across drainage lines to retain runoff and diminish water velocity. Ideally, these structures feature a top width of one meter, an upstream slope of 1:1, and a downstream slope of 1:3, ensuring effective water management. To enhance durability and impede water flow, these check dams are encased in Wire Mesh, prolonging their functionality over an extended period. The advantages of Wire Mesh Check Dams include longevity, increased water resistance, minimal maintenance requirements (approximately once every 4/5 years), and the provision of lateral strength to the overall structure. These attributes make Wire Mesh Check Dams a sustainable and reliable solution for water retention and erosion control.

Wire Mesh Check Dams, similar to LBCD but secured with zinc-coated GI wire (8-10 gauge, 3 - 4 mm), share common objectives of reducing surface flow velocity. This aids in minimizing soil erosion, preventing siltation downstream, enhancing ground water recharge, and extending flow duration. Positioned in the middle or lower reaches of a watershed, typically covering catchment areas of 20-50ha, these gabion structures, must be carefully designed. The top should never surpass embankment heights to prevent overtopping, necessitating prior assessment of peak flow. The primary focus is on embankment stability, and though designed to check velocity, water seepage through boulders allows minimal storage. When properly assembled, these structures act as cohesive units, with proper weaving ensuring resistance to displacement and maintaining integrity against the flow.

Gabion Structure

Gabion structures are of small stone and wire dams constructed across the supply/irrigation channel with a catchment area of 50-00 ha. They are also constructed to reinforce highly erodible stream embankments.

The main aim of constructing gabion structures is to reduce the velocity of water flowing through the supply/irrigation channel. By reducing the velocity of runoff, gabion structures help in

- Reduction in soil erosion,
- Trapping silt, which reduces the rate of siltation in water harvesting structures in the lower reaches of the watershed.
- Increasing recharge of groundwater.
- Increasing the duration of flow in the drainage line. Therefore, the capacity of the water harvesting structures created downstream on the drainage line is utilized more effectively and fully as they get many more refills.
- The biomass and debris flowing with the runoff water of first rain of rainy season is arrested in the wire mesh and chock the water passing through the stones by the provision of wire mesh, resulting in the storage of water in the upstream side of the gabion.

Selection Criteria:

- The minimum independent catchment area for a gabion structure is 5 ha.

- The embankment should be stable and free from erodible material; otherwise the construction cost will increase.
- For maximizing storage in the structure, the bed slope of the upstream portion should be low. The flatter the upstream slope, the more will be the storage.
- The height of side embankments from the bed of the stream must be at least equal to the sum of the depth of peak flow in the stream and the designed height of the structure. (For example, if the height of the embankments is 6m and the depth of peak flow is 4 meters, then the height of the gabion must not exceed 2 meters. Otherwise, water will jump over the sides. Hence, observation of the peak flows is imperative before a gabion structure is planned).

Construction of a Gabion Structure

a) First, all boulders must be collected on the location site. For the Headwall, a 1m wide and 0.6m deep trench should be dug across the stream bed from embankment, to embankment. Foundation of similar depth should also be dug for the area demarcated for the apron and the sidewalls. For the headwall extension the embankments are cut the appropriate depth.
b) Before the foundation trench is filled, lengths of wire mesh are placed vertically at three places.
- The upstream edge of the foundation
- Where the headwall ends and the apron begins, and
- Against the downstream edge of the apron.

c) At all three places the wire mesh runs along the entire length of the structure. Everywhere, 0.15m of the wire mesh is folded along the bed of the trench so that the mesh can be embedded under the boulders. After that the trench is filled with boulders up to ground level. Then, the wire mesh is laid over the entire surface and tied to the mesh which has been embedded under the boulders. The headwall as well as the sidewalls should be constructed as boxed of 1 to 2m length and 1m height.
d) First the four vertical faces of these boxes are erected with wire mesh which is tied to the wire mesh in the section below as well as the section alongside. Then the boxes are filled with boulders and covered at the top with wire mesh. This wire mesh is tied to each of the vertical faces on all four sides. Such boxes are filled up in succession till the structure is complete.
e) To increase impermeability of the structure, a reverse filter should be constructed on its upstream face. This device is made by placing layers of small boulders, gravel sand and mud against the structure.

However, the order of placement of this material is exactly the opposite of the arrangement in a normal filter. The boulders are placed closest to the structure, with grave, sand and mud being placed successively away from it. The reason for the reverse order is that we want the finest material to come into contact with water first. Following the normal filter scheme would have allowed water to pass unchecked through the boulders and coarser material on the outer surface. Even the used cement or fertilizer bags filled with fine sand may be placed against the gabion structure.

The following points to be considered while constructing gabion structure.

- Do not build a gabion structure where the embankment is highly erodible or is of

insufficient height.

- Do not build a gabion structure at a point on the stream, below which the stream drops sharply.
- Locate the gabion structure where the channel width is relatively low.
- Locate the structure where the bed-slope of the channel in upstream of the structure is low.
- Care must be taken that the boulders are placed compactly against each other so that they do not slide or move under the impact of water.
- Similar boulders must be placed in the interior part of these boxes while the larger ones must be placed on the outside.
- Even the smallest boulder should be bigger than the gap in the wire mesh.
- The wire mesh must be stretched rigid so that there is no bulging or sagging.
- The wire used for tying the wire mesh sections must be of the same strength as the wire used in the wire used in the wire mesh. It could either be of the same gauge or of a thinner gauge plied and twisted together.
- For height above 2m, the Headwall must be made as a series of steps sloping on the downstream side to impart stability to the structure.

4.2.3. Concrete Check Dams (CCD):

Cement concrete check dams are highly effective practice to reduce flow velocities in channels and waterways in plain areas. They create impounding of water in the upstream of dam, to be used for irrigation, domestic, animal and other purposes. The structures facilitate the infiltration of water into sub surface strata and recharging of ground water. By creating a barricade for waterflow, there will be increased availability of water in a stream over a calendar year.

Site Selection:

The selection of suitable sites for the construction of check dams in various parts of the stream is crucial for their effective functioning. The following criteria are considered for the upper, middle, or lower part of the stream:

- Ensure the presence of a sufficient catchment area at the axis of the check dam.
- Seek locations with a straight and narrow firm bank, avoiding curves or meandering portions. The stream bed should be 5 to 15 meters wide and at least 1 meter deep.
- Prefer sites with high and firm foundation conditions at the axis of the proposed dam. Rocky or hard soil conditions make the designed section of the dam economical.
- Ensure the availability of space for impounding water upstream, considering:
- A fetch generally exceeding 300 meters, indicating a river slope of 1:150 or areas with good storage potential and perennial subsurface flow.
- High flood levels (HFL) that do not inundate private or cultivable land. Locations that are flatter upstream or below a junction of 2-3 tributaries typically provide suitable sections.
- The selected site should have a sufficient thickness of permeable soil or weathered material to facilitate the recharge of stored water within a short span of time.
- The area should have a gentle slope, contributing to effective water flow regulation.

- Ideally, the total catchment area of the stream should fall within the range of 40 to 100 hectares.
- Preferably locate check dams in areas where proper bunds are available, enhancing the overall stability and effectiveness of the structures

Construction methodology and Design

- Fix the length of the check dam based on the available stream width or known discharge quantity
- Determine the depth of the foundation where a hard stratum is available or below the maximum scour level to ensure stability.
- Provide a flexible/rigid apron on the downstream side of the check dam to prevent erosion and enhance stability.
- Generally, no aprons are required on the upstream side of the weir. However, it is desirable to provide a puddle clay apron to control excessive seepage below the dam wall.
- Ensure that the length of the wing walls is sufficient to completely encase the stream/canal bund.
- Splay the upstream and downstream side wing walls generally at 1 in 3 and 1 in 5, respectively, to optimize stability and effectiveness.

4.2.4. Continuous Contour Trench (CCT):

The continuous contour trenches help to control water from flooding downstream which helps in saving water and channeling it in the desired direction. The water that percolates into the trenches improves soil moisture. The trenches prevent soil erosion as the water flow is arrested at each contour. The silt that has accumulated in the trenches can be collected and reused in the farm land. Overtime, the trenches support in improving bio-diversity due to the availability of moisture and top soil run off.

A continuous contour trench is dug at a right angle to the slope and along the contour lines. Doing so stops the water flowing down hill in its tracks by the trenches, and water percolation into the soil below is facilitated. Trenches are dug along the contour lines (perpendicular to the slope of the land) in the site for a depth of around 1.5 to 2 feet. The distance between each trench depends on the slope of the terrain. More the slope, closer the trenches are made.

The detail year wise cash flow estimate is depicted at ***Annexure-II.***

4.3 Socio Economic Measures

The socio-economic measures under the catchment area treatment plan of the Kutulisingha Irrigation Project focus on community engagement, capacity building, and promoting sustainable livelihoods. These initiatives aim to reduce pressure on natural resources, improve agricultural practices, and empower local communities, thereby fostering a more sustainable ecosystem.

1. Community Awareness Campaigns

One of the primary components of the plan is to raise awareness among farmers and community members about sustainable practices. Awareness campaigns will focus on educating farmers about controlling grazing, proper farm management, and discouraging harmful practices such as the burning of crop residues, which negatively impact soil health and air quality. These campaigns will also emphasize water conservation strategies, including the construction of farm ponds to capture rainwater and reduce surface runoff.

2. Promotion of Livelihood Opportunities

To enhance socio-economic resilience, the plan includes vocational training programs aimed at youth and women. These programs will offer skills in tailoring, food processing, and vermicomposting, enabling participants to develop alternative income streams.

3. Exposure Visits and Skill Development

Exposure visits to relevant industries and institutions will be organized to provide participants with hands-on experience and to bridge the gap between theoretical knowledge and practical application.

4. Energy Alternatives and Forest Conservation

Another critical aspect of the plan is reducing dependency on forest resources for fuelwood. The provision of clean energy alternatives, such as LPG and CNG distribution, will significantly reduce the need for firewood collection from nearby forests. This shift will not only contribute to forest conservation but also improve indoor air quality and health outcomes for households, particularly women who traditionally bear the burden of collecting and using firewood.

5. Focus on Agricultural Land Management

Given that 81.92% of the catchment area is agricultural land, special emphasis will be placed on educating farmers about sustainable agricultural practices. Controlled grazing will be promoted to prevent overgrazing and land degradation. Additionally, farmers will be trained in soil conservation techniques, integrated pest management, and organic farming methods to maintain soil health and enhance crop productivity.

5. Monitoring

The monitoring of the implementation of the Catchment Area Treatment Plan (CATP) will be a critical aspect to ensure that all activities are executed effectively and in accordance with prescribed standards. The Forest Department will serve as the primary implementing agency, overseeing the execution of plantation, soil and moisture conservation (SMC) measures, and other ancillary works. All departmental guidelines and technical specifications will be strictly adhered to, ensuring consistency and alignment with broader conservation goals.

Regular inspections and progress reviews will be conducted at various stages of implementation. Field officers will be responsible for on-ground supervision and will submit periodic reports detailing the status of plantation activities, SMC interventions, and community engagement efforts. These reports will be compiled and evaluated at the divisional level to track progress against the approved targets. Additionally, a system of geo-tagging will be introduced to monitor plantation sites, enabling real-time tracking and transparency.

6. Period and Schedule of Implementation

The implementation of the Catchment Area Treatment Plan (CATP) will be spread over a flexible period of 10 years, allowing for adaptive management based on field conditions, progress, and emerging needs. The phased approach will ensure that activities are implemented strategically, with priority given to areas prone to erosion and degradation. The timeline will remain dynamic to accommodate any modifications required due to climatic factors, community feedback, or directives from regulatory bodies.

Funding for the CATP will be facilitated by the user agency, which will deposit the requisite funds after obtaining Stage-1 clearance or as directed by the Ministry of Environment, Forest, and Climate Change (MoEF&CC). The release of funds will be linked to the progress of activities, ensuring that financial resources are available at critical junctures for smooth implementation. This phased funding mechanism will also allow for periodic assessments and realignments of the plan, ensuring that it remains on track and achieves the intended objectives.

Soil and moisture conservation (SMC) activities will commence simultaneously with the construction of the dam to mitigate soil erosion and control runoff. These activities will include the construction of contour trenches, check dams, and other erosion control measures in vulnerable areas. Early initiation of SMC works is essential to stabilize the catchment and enhance the dam's efficiency by reducing siltation. The schedule will be regularly updated based on site conditions and the pace of dam construction, ensuring synergy between the two processes for optimal results

7. Cost Estimate

SL	Item	Rate in Rs.	Unit	Physical	Financial (Rs, in Lakh)
A. Biological Measures					
1	Enrichment of Plantation/Re-densification (ANR plantation @200 plants per Ha) with Fencing and Watering for commencement year of 2027-28 as per One Time Cost Norm.	13,23,160	Ha	250	1487.37
2	Grass land (Fodder land) development including grass reserves over 40.0ha (10 ha one unit)	1,90,000	Ha	40	76.00
B. Soil Moisture Conservation Measures					
3	(LBCD) Loose Boulder Check Dam, (WMCD) Wire Mesh Check Dam, (CCD) Concrete Check Dam, (CCT) Continuous Contour Trench	38,900	Ha	1500	583.50
C. Socio-Economic Measures					
4	Awareness campaigns for farm management, control grazing etc.	-	LS	-	10.00
5	Capacity building for youths and women (industrial exposure visits, vocational training courses- tailoring, food processing, vermicomposting, etc.)	-	LS	-	100.00
6	CNG and LPG Distribution	-	LS	-	15.00
D. Ancillary Costs					
7	Cost for 1 no. of Inflatable motorboat for patrolling of the Reservoir for the preservation of forests & wildlife (Including the costs of maintenance and driver)	-	LS	-	20.00
	Total				**2291.87**

Total costs of Biological, Engineering measure, Socio-economic Measure and Ancillary costs **= Rs.2,291.87 Lakhs**

Contingency @5% = Rs. 114.59 Lakhs

Sub Total = Rs.2,406.46 Lakhs

Escalation cost @ 20% = Rs. 481.29 Lakhs

Total =Rs.2887.76 Lakhs

Superintending Engineer
Angul Investigation Division
Angul

Divisional Forest Officer
Athmallik Division

SMC

17/12/24

DIVISIONAL FOREST OFFICE * ATHMALLIK DIVISION * 4883 18-12-24

e-mail

STATE FOREST HEADQUARTERS, ODISHA,
OFFICE OF THE PRINCIPAL CHIEF CONSERVATOR OF FORESTS & HoFF
PLOT NO.GD-2/12 ARANYA BHAWAN, CS PUR, BHUBANESWAR-751023.

Memo No. 25413 /10F (CAMPA) 20/2024
Dated, Bhubaneswar the 17th December, 2024

To

The Divisional Forest Officer,
Angul/Athmallik/Dhenkanal/Athgarh/Khordha/Nayagarh/
Phulbani/Balliguda/Boudh/Ghumsur(South)/Rairakhol/Bargarh/
Balasore(WL)/Kalahandi(N)/Kalahandi(S)/Khariar/Sunabeda(WL)/
Koraput/Jeypore/Nabarangpur/Malkangiri Division.

Sub: Release of funds for implementation of SMC works under CAMPA APO 2024-25.

Ref: This office Memo No. 22721 dated 12.11.2024.

With reference to the above, an amount of **Rs. 8.9976 Cr** (Rupees Eight Crore ninety nine lakh seventy six thousand only) is hereby allotted and released for implementation of SMC works as per the statement enclosed. The expenditure is to be charged under the budget head **22-2406-04-103/789/796-3364-91348-NPV.** You are requested to take necessary action according to the physical target intimated vide this office memo under reference and submit the accounts in time.

Further, this is to inform that the guidelines for execution of SMC works issued vide this office Memo No. 25403 dated 17.12.2024 (copy enclosed) is to be followed scrupulously during APO 2024-25.

Encl: As above

Chief Executive Officer
State Authority, CAMPA

Memo No. 25414 Dt. 17-12-2024

Copy forwarded to all Regional Chief Conservator of Forests for information and necessary action in continuation to this office Memo No. 22722 dated 12.11.2024 & Memo No.25404 dated 17.12.2024.

Chief Executive Officer
State Authority, CAMPA

Division-wise Physical & Financial Target of SMC Works & Release of funds under CAMPA APO 2024-25 (Rs. in Lakh)

SL No	Circle	Division	Revised Target @ 0.38900 Lakh/ Ha		Funds released now (100%)	Budget Head 22-2406-04-103/789/796-3364-91348- NPV
			Physical (in Ha.)	Fin		
1	Angul	Angul	100	38.90	38.90	103
2		Athmallik	100	38.90	38.90	103
3		Dhenkanal	100	38.90	38.90	103
4		Athgarh	113	43.96	43.96	103
Total			413	160.66	160.66	
5	BBSR	Khurda	100	38.90	38.90	103
6		Nayagarh	100	38.90	38.90	103
Total			200	77.80	77.80	
7	Berhampur	Phulbani	150	58.35	58.35	103
8		Baliguda	150	58.35	58.35	103
9		Boudh	100	38.90	38.90	103
10		Gh.South	100	38.90	38.90	103
Total			500	194.50	194.50	
11		Rairakhol	100	38.90	38.90	789
12		Bargarh	150	58.35	58.35	789
Total			250	97.25	97.25	
13	Baripada	Balasore WL	100	38.90	38.90	789
Total			100	38.90	38.90	
14	Bh.patna	Kalahandi(N)	100	38.90	38.90	796
15		Kalahandi (S)	100	38.90	38.90	796
16		Khariar	100	38.90	38.90	796
17		Sunabeda WL	100	38.90	38.90	796
Total			400	155.60	155.60	
18	Koraput	Koraput	150	58.35	58.35	103
19		Jeypore	100	38.90	38.90	796
20		Nabarangpur	100	38.90	38.90	796
21		Malkangiri	100	38.90	38.90	796
Total			450	175.05	175.05	
Grand Total			2313	899.76	899.76	

Chief Executive Officer
State CAMPA Authority

Annexure-I

REFORESTATION SCHME

UNDER CATCHMENT AREA TREATMENT PLAN

OVER 250 HA IN THE CATCHMENT AREA OF KUTULISINGHA IRRIGATION PROJECT IN ATHMALLIK FOREST DIVISION.

(50,000 Seedlings)

Prepared By

Divisional Forest Officer,
Athmallik Forest Division

Chapter I

1 BRIEF NOTE ON THE PROPOSED FOREST DIVERSION PROPOSAL AND THE CATCHEMET AREA TREATMENT PLAN

The Kutulisingha Irrigation Project is a significant water resource development initiative focused on enhancing agricultural productivity in the region through assured irrigation. The core component of the project involves the construction of an earth dam measuring 323.00 meters in length and 39.15 meters in height. A central ogee-type gated spillway, 33.00 meters in length, will regulate the outflow of water. The catchment area at the dam site covers approximately 83.30 square KM, which receives a maximum annual rainfall of 2728.50 mm. The Net Dependable Yield (NDY) of the catchment is estimated at 1995.09 hectare-metres, based on a 75% dependability criterion. An analysis of 29 years of hydrological data indicates an average water utilization efficiency of 71.86%. The project is designed to irrigate a total Cultivable Command Area (CCA) of 2540 hectares, comprising 2158 hectares during the Kharif season and 1015 hectares in Rabi, through two main canals—11.344 km (approx.) on the left and 13.04 km on the right. Importantly, 20% of the water has been reserved for riparian use both upstream and downstream, in line with the Central Water Commission's recommendations.

A mandatory component for any irrigation or hydroelectric project involving diversion of forest land is the formulation of a comprehensive Catchment Area Treatment Plan (CATP). This plan is vital for conserving the ecological integrity of the project's catchment area and mitigating any potential environmental impacts. The CATP encompasses site-specific biological and engineering interventions aimed at conserving soil, retaining moisture, and managing the local water regime effectively. Among the biological measures prescribed under the CATP, one of the most impactful is the reforestation of open forest patches within the catchment. These efforts not only stabilize the soil and improve groundwater recharge but also enhance local biodiversity. To this end, the Divisional Forest Officer (DFO), Athmallik has prepared a Reforestation Scheme under the CATP that proposes the plantation of 50,000 seedlings. This afforestation drive will focus on indigenous tree and shrub species, including rare and medicinal plants, to enrich the existing vegetation cover and promote ecological resilience in the region. This plantation initiative is expected to play a key role in maintaining the long-term environmental sustainability of the Kutulisingha Irrigation Project.

Chapter II

2 DETAILS OF LAND IDENTIFIED FOR REFORESTATION

2.1 Details of the land identified for Reforestation

Reforestation activities are proposed to be carried out within the catchment area of the reservoir, specifically in the jurisdiction of Dhandatopa Range under Athmallik Forest Division. A total area of 250 hectares has been demarcated for this purpose. The area falls within Athmallik Tahasil of Angul District. The identified sites will be taken up under Assisted Natural Regeneration (ANR) with a planting density of 200 seedlings per hectare. These sites have been carefully selected to ensure ecological compatibility and ease of accessibility, and are located in degraded forest patches that require enrichment for improving vegetative cover and ecosystem services.

2.2 Climatic Condition

The region experiences a tropical climate characterized by three distinct seasons: summer, monsoon, and winter. The average annual rainfall ranges between 120 cm and 150 cm, which is generally sufficient to support natural vegetation and plantation growth. The summer season extends from March to June, with temperatures soaring up to 45°C, while the winter season lasts from November to February, with relatively mild conditions. The monsoon season occurs between July and September and contributes the bulk of the annual precipitation. These climatic conditions make the area suitable for native tree species under the ANR model, with proper moisture management during dry spells.

2.3 Extent of Biotic Pressure

The proposed plantation site is subject to significant biotic pressure, primarily in the form of uncontrolled grazing by livestock from adjacent villages. This pressure poses a major threat to the successful establishment of plantations. Without appropriate interventions, young saplings are likely to be damaged or destroyed. Therefore, protective measures such as chain-link fencing is essential to safeguard the site. Community sensitization and involvement will also be prioritized to reduce anthropogenic interference. These combined efforts will ensure that the plantation is allowed to establish securely, contributing to long-term ecological restoration and improved forest cover in the region.

2.4 Suitability of the identified site for Reforestation

A suitability assessment was conducted using the Decision Support System (DSS) of the Forest Survey of India on the proposed 250-hectare patch. The analysis indicated ample scope for gap plantation under the ANR model. The site has adequate soil depth, appropriate slope, and natural regeneration potential, making it generally conducive for reforestation. In areas where the site conditions are marginal or less favorable, supportive measures such as watering, soil enrichment through vermicompost, and planting of hardy shrub species will be undertaken to enhance survival rates. The overall site is deemed suitable for reforestation, with adaptive planning to address micro-site variations.

Chapter III

3 DELINEATION OF PROPOSED AREA ON SUITABLE MAP

3.1 GPS Coordinates and GPS Map of the Reforestation Site

The area has been demarcated on revenue map showing latitude and longitude of each point.

Sl. No	Patch Name	Latitude	Longitude
1	Patch_1	20.797278	84.794368
2	Patch_1	20.798806	84.791243
3	Patch_1	20.800022	84.790367
4	Patch_1	20.799527	84.792877
5	Patch_2	20.797200	84.786341
6	Patch_2	20.795176	84.781981
7	Patch_2	20.795282	84.777306
8	Patch_2	20.795273	84.775303
9	Patch_2	20.795868	84.770063
10	Patch_2	20.797491	84.770087
11	Patch_2	20.796908	84.772818
12	Patch_2	20.797375	84.773718
13	Patch_2	20.798024	84.776109
14	Patch_2	20.798485	84.782029
15	Patch_2	20.798900	84.786132
16	Patch_2	20.798953	84.786231
17	Patch_2	20.797991	84.786206
18	Patch_3	20.796502	84.759700
19	Patch_3	20.796103	84.754825
20	Patch_3	20.796094	84.753411
21	Patch_3	20.797241	84.743203
22	Patch_3	20.798230	84.741853
23	Patch_3	20.799093	84.746427
24	Patch_3	20.799801	84.749226
25	Patch_3	20.799980	84.750636
26	Patch_3	20.800941	84.755056
27	Patch_3	20.801869	84.758318
28	Patch_3	20.799781	84.756641
29	Patch_3	20.797424	84.759650
30	Patch_4	20.794236	84.741825

Sl. No	Patch Name	Latitude	Longitude
31	Patch_4	20.797106	84.739955
32	Patch_4	20.799690	84.738083
33	Patch_4	20.800553	84.739743
34	Patch_4	20.795718	84.741565
35	Patch_5	20.798459	84.730119
36	Patch_5	20.798659	84.728967
37	Patch_5	20.799532	84.725999
38	Patch_5	20.798979	84.723663
39	Patch_5	20.802923	84.720433
40	Patch_5	20.800736	84.726614
41	Patch_5	20.800828	84.726846
42	Patch_5	20.801313	84.727385
43	Patch_5	20.798654	84.730155
44	Patch_6	20.807118	84.764237
45	Patch_6	20.811474	84.759026
46	Patch_6	20.811542	84.761396
47	Patch_6	20.810073	84.763015
48	Patch_6	20.810585	84.765281
49	Patch_6	20.809537	84.764823
50	Patch_6	20.808880	84.763522
51	Patch_6	20.807913	84.764481
52	Patch_6	20.807927	84.764208
53	Patch_7	20.817592	84.775341
54	Patch_7	20.817931	84.773542
55	Patch_7	20.816233	84.773405
56	Patch_7	20.814956	84.772606
57	Patch_7	20.814403	84.772157
58	Patch_7	20.816200	84.770928
59	Patch_7	20.817709	84.769194
60	Patch_7	20.818408	84.769962
61	Patch_7	20.818550	84.773645
62	Patch_7	20.817937	84.774848
63	Patch_8	20.827947	84.784592
64	Patch_8	20.824416	84.782174
65	Patch_8	20.824835	84.780313
66	Patch_8	20.823432	84.777877
67	Patch_8	20.824859	84.774730
68	Patch_8	20.826322	84.772816
69	Patch_8	20.828231	84.770037
70	Patch_8	20.828681	84.770098
71	Patch_8	20.829958	84.773011
72	Patch_8	20.829700	84.782706
73	Patch_8	20.828145	84.783977
74	Patch_8	20.828663	84.784249

Chapter IV

4. AGENCY RESPONSIBLE FOR Reforestation

4.1 Agency Responsible for the Placement of Funds

The user agency shall provide funds for Reforestation as per the approved scheme.

4.2 Agency Responsible for Execution of Reforestation

Divisional Forest Officer, Athmallik Forest Division will execute and monitor the Reforestation.

Chapter V

5. DETAILS OF PROPOSED REFORESTATION

5.1 Plantation Plan

The Plantation Plan outlines the site-specific strategies for reforestation in the designated 250-hectare area within the catchment zone. The selection of species and site treatment will be guided by ecological considerations, including topography, soil characteristics, fertility, drainage conditions, and proneness to waterlogging. A treatment map will be developed for each site to indicate the plantation boundaries, the spatial arrangement of species, and any supporting soil or water conservation measures. These maps will assist in targeted implementation and post-planting monitoring. The plan will emphasize the planting of indigenous and ecologically appropriate species to ensure the sustainability of the reforestation effort, contributing to ecological restoration and biodiversity enhancement.

5.1.1 Choice of Species

The selection of species is based on edaphic conditions, microclimatic variations, and ecological compatibility with the catchment landscape. Native species that are drought-resistant, climate-resilient, and capable of thriving in the given site conditions have been prioritized. The list includes fruit-bearing and multipurpose trees that can provide ecological benefits while supporting local livelihoods in the long term. Although the species listed are recommended, field officers are authorized to exercise discretion in choosing other suitable indigenous species if needed, depending on ground realities.

1. *Aegle marmelos* (Bela)
2. *Limonia acidissima* (Kaitha)
3. *Artocarpus heterophyllus* (Jackfruit)
4. *Azadirachta indica* (Neem)
5. *Bombax ceiba* (Seemal)
6. *Dalbergia sissoo* (Sissoo)
7. *Dendrocalamus strictus* (Salia Bamboo)
8. *Emblica officinalis* (Amla)
9. *Ficus bengalensis* (Bara)
10. *Gmelina arborea* (Gambhari)
11. *Mangifera indica* (Mango)
12. *Pongamia pinnata* (Karanja)
13. *Syzygium cumini* (Jamu)
14. *Ziziphus mauritiana* (Bara Koli)

5.2 Pre-Planting & Post-Planting Operations

A range of preparatory and maintenance operations will be undertaken to ensure the success of the plantation. These include nursery development for raising planting stock, installation of protective fencing, site clearance, pit digging, planting operations, and regular post-planting care. The operations will be executed in a phased manner following standard silvicultural practices. This holistic approach to pre- and post-planting operations will enhance survival rates and growth performance. Activities will be completed in advance of the planting season and monitored regularly

3.1.1 Raising of Plantation Stock – Nursery

A dedicated nursery will be established to produce quality planting material for the afforestation programme. The nursery will cater to the total planting requirement for 250 hectares, including an additional 10% buffer stock for casualty replacement. The nursery will be equipped with proper irrigation facilities, shaded beds, and compost pits to ensure healthy seedling growth. Standardized protocols for seed treatment, potting, and hardening will be followed to ensure vigorous seedlings are available at the time of planting. The selection of seeds and sowing schedule will be aligned with local climatic conditions to ensure timely availability of planting material during the monsoon season.

3.1.2 Fencing

Fencing is critical for protecting young plantations from grazing and biotic interference, which are major threats to successful regeneration. Iron-link chain fencing will be installed around the entire plantation area, covering a perimeter of approximately 38,000 meters. The fencing will follow the cost norms and technical specifications issued by the PCCF, Odisha, in guidelines dated 08.11.2021 and 01.12.2021. The cost of fencing will be borne by the User Agency. This protective measure will be established prior to planting to ensure that the site remains undisturbed during the crucial initial growth phase, thereby enhancing the survival and establishment of planted seedlings.

3.1.3 Site Preparation and Silvicultural Operation including clearance of weed, climber cutting, high stump cutting, singling of shoots

Prior to planting, comprehensive site preparation will be undertaken to optimize soil conditions and reduce competition from invasive vegetation. Activities include clearance of weeds, climbers, and bushes, along with high stump cutting and shoot singling. These operations will be completed by the end of February to allow for pit digging well before the planting season. Pits of 45 cm x 45 cm x 45 cm will be dug at a spacing that ensures 200 planting spots per hectare. These preparatory steps are essential for enhancing soil aeration, water infiltration, and root penetration, all of which contribute to better seedling performance.

3.1.4 Planting operation

Planting will be carried out in July, coinciding with the onset of the monsoon, to maximize moisture availability for seedling establishment. Seedlings raised in polybags (12 x 10 inches, 300 gauge) will be carefully handled to preserve the root-soil ball during transplanting. The seedling will be planted such that the root collar sits slightly below ground level, followed by firm soil compaction to secure the plant. A slight mound will be created around the collar to prevent waterlogging and promote drainage.

3.1.5 Casualty Replacement

Post-planting, the entire site will be inspected thoroughly in the same sequence as the original plantation. Any gaps or seedling casualties identified during this exercise will be promptly filled with healthy replacements from the nursery stock. This replacement will be carried out during the same planting season to maintain uniformity and ensure even canopy development.

3.1.6 Weeding & Soil Working

Weeding will begin shortly after seedling sprouting and will be conducted regularly to reduce competition for nutrients, light, and moisture. Soil working, such as loosening the soil around the plant base, will be done simultaneously to improve aeration and root development. These maintenance operations will be scheduled at periodic intervals during the growing season to maintain site hygiene and promote vigorous seedling growth. Special attention will be paid to preventing weed encroachment during the critical establishment phase, especially during the first two years.

3.1.7 Manuring & Insecticide Application

On non-forest sites, organic compost or farmyard manure, if available, will be incorporated into the soil while refilling the pits. Regarding artificial fertilizers, the required minerals and a dosage of 50 grams of patent mixtures such as 'Gromor' or N.P.K. (2:2:1) will be applied in two split doses, with one in August and the other in September.

3.2 Watch And Ward

To ensure the security and health of the plantation, watch and ward services will be deployed continuously for a period of ten years from the date of planting. Local workforce, preferably from the surrounding villages, will be engaged for this purpose, thus generating employment and local support for the project. These personnel will be tasked with preventing unauthorized grazing, theft, or damage to the plantation. Their responsibilities will also include periodic reporting of plant health and assisting in routine maintenance operations.

3.3 Monitoring And Evaluation

The Divisional Forest Officer of Athmallik Forest Division will conduct periodic monitoring and evaluation of the scheme. In accordance with paragraph 2 of Guideline No. 1109/9F-(Misc.)-387/2021 dated 08.11.2021 issued by PCCF (N), the Compensatory Afforestation has been prepared on a "one-time cost norm basis," which separates the CA scheme from wage rate revisions and material cost escalations, simplifying the process for ease of doing business.

The cost norm of the plantation is annexed herewith.

Total Financial Outlay of the 10 years plantation programme with Maintenance.

As Per One Time Cost Norm (for the Year 2027-28).		
	A	
Sl No	**Description**	**Amount**
1	Cost of ANR plantation @200 plants per Ha over 250 Ha. @ Rs.**1,28,829/-** per Ha. with 10 years maintenance (including the nursery cost)	Rs. 3,22,07,250
	Total	**Rs. 3,22,07,250**
	B. Cost of Fencing	
2	Wire mesh Chain link fencing over 250 Ha. (Perimeter of 38,000 mtr.) with 05 years maintenance. @ Rs. **5,61,951/-** per Ha or 250 mtr.	Rs. 8,54,16,552
	Total	**Rs. 8,54,16,552**
	C. Watering	
3	Watering W-III (Solar system fitted with Borewell) over 250 Ha. (Ten units of solar pump set @ Rs. 6,32,380 per set) (approximately)	Rs. 63,23,800
	Total	**Rs. 63,23,800**
	Sub Total	**Rs. 12,39,47,602**
4	**Due to enhance wage rate, Add Escalation 20%**	**Rs. 2,47,89,520**
	Grand Total	**Rs. 14,87,37,122**
(Rupees Fourteen Crore Eighty-Seven Lakhs Thirty-Seven Thousand One Hundred Twenty-Two) only.		

Superintending Engineer
Angul Investigation Division
Angul

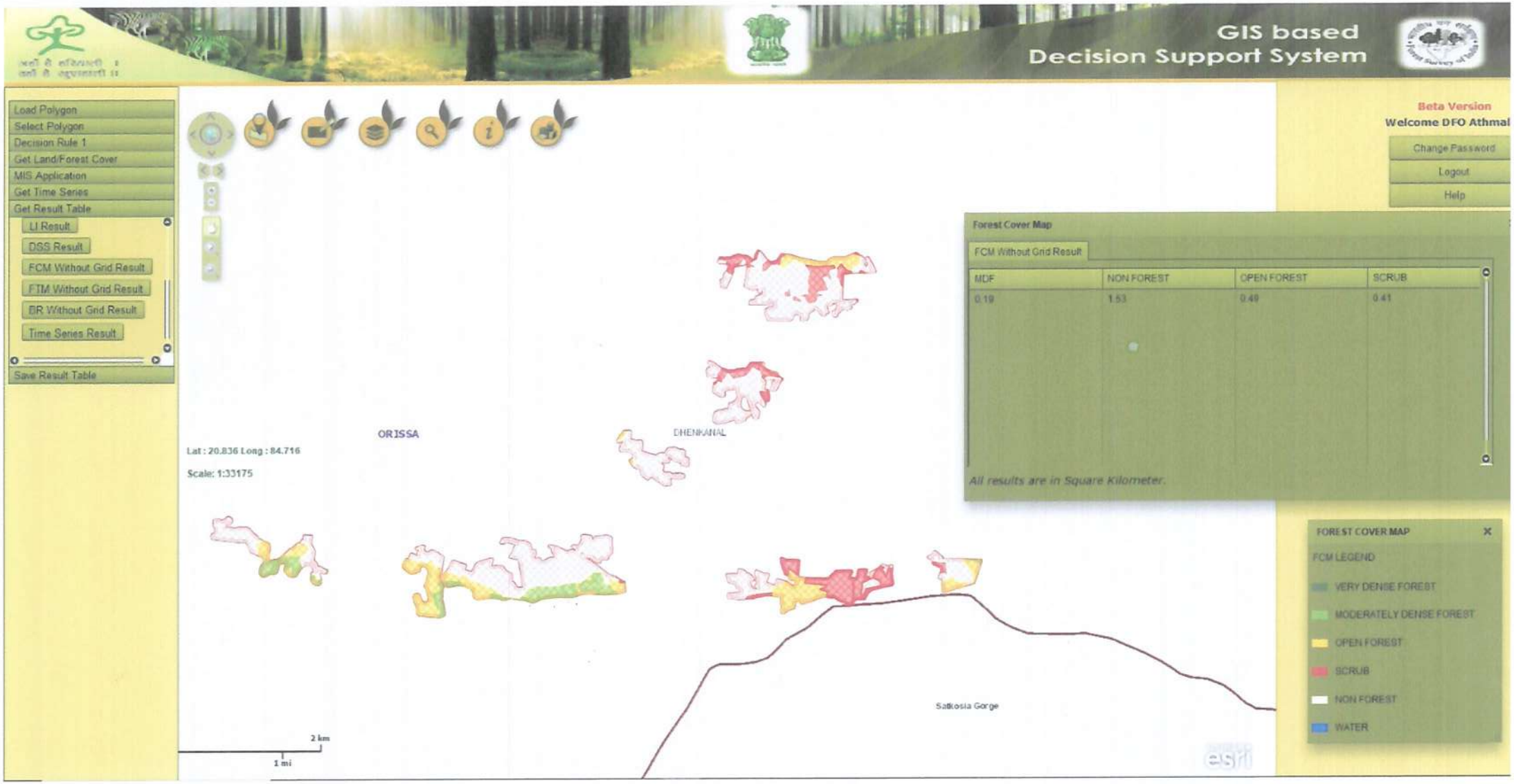
Divisional Forest Officer,
Athmallik Forest Division

CERTIFICATE ON DSS ANALYSIS FOR CA/ACA/PCA

This is to certify that DSS Analysis of land identified for CA/ACA/PCA and subsequent ground truthing have been done. The outcome is as mentioned below:

Sl No.	*Name of Range*	*Name of the Forest Block (RF/PRF/PF/DPF/Revenue Forest)*	*Area identified for CA/ACA/PCA (in ha.)*	*Clarification of identified land (in ha.)*							*Area Suitable for plantation (in ha.)*						*Plantation model (AR/ANR)*	*Remarks*
				Very Dense Forest	*Moderately Dense Forest*	*Open Forest*	*Non-Forest*	*Scrub*	*Water*	*Total*	*Very Dense Forest*	*Moderately Dense Forest*	*Open Forest*	*Non-Forest*	*Scrub*	*Total*		
1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*11*	*12*	*13*	*14*	*15*	*16*	*17*	*18*	*19*
01	Dhandatopa	Reveune Forest	250 Ha	-	19 Ha	49 Ha	153 Ha.	41 Ha	-	262 Ha.	-	19 Ha	49 Ha	153 Ha	41 Ha	262 Ha	ANR @200	-

Divisional Forest Officer,
Athmallik Division.


GIS based
Decision Support System
Load Polygon
Select Polygon
Decision Rule 1
Get Land/Forest Cover
MIS Application
Get Time Series
Get Result Table
LI Result
DSS Result
FCM Without Grid Result
FTM Without Grid Result
BR Without Grid Result
Time Series Result
Save Result Table
Beta Version
Welcome DFO Athmal
Change Password
Logout
Help
Forest Cover Map
FCM Without Grid Result
MDF
NON FOREST
OPEN FOREST
SCRUB
0.19
1.53
0.49
0.41
All results are in Square Kilometer.
ORISSA
DHENKANAL
Lat : 20.836 Long : 84.716
Scale: 1:33175
Satkosia Gorge
2 km
1 mi
FOREST COVER MAP
FCM LEGEND
VERY DENSE FOREST
MODERATELY DENSE FOREST
OPEN FOREST
SCRUB
NON FOREST
WATER
esri

STATE FOREST HEADQUARTERS
OFFICE OF THE PRINCIPAL CHIEF CONSERVATOR OF FORESTS & HoFF, ODISHA
ARANYA BHAWAN, BHUBANESWAR-23.

OFFICE ORDER NO. 1109 /9F –(Misc)-387/2021
Dated, BBSR, the 08th November, 2021.

Sub: One-time Cost Norm for Compensatory Afforestation.

The issue of delay in Compensatory Afforestation (CA) Scheme due to half-yearly wage rate revision has been a cause of concern for a long time. The issue has been examined in detail and it is proposed that the Present Net Cost of the CA scheme spread over 10 years should be realized one time instead of revising the cost norm every time due to wage rate revision. Accordingly the trend of wage rate increase in Odisha from 1998 till 2021 for labour component have been calculated at 5% and the trend in increase in Consumer Price Index from 1998 to 2020 for material component has been calculated at 4.8%. However, in order to maintain uniformity, a trend rise of 5% has been taken into consideration for both labour and material component for preparing the Present Net Cost of the Compensatory Afforestation Scheme in the State.

2. It is therefore, decided to prepare Compensatory Afforestation Scheme on "One time Cost Norm basis" by delinking the CA Scheme to wage rate revision and material cost escalation for easy of doing business. The cost norm for Core Plantation for CA has been kept at par with departmental block plantation norm. In addition, different fencing models as well as different watering provision have been provided for addressing to the site-specific edaphic conditions in the State for preparation of the Compensatory Afforestation Scheme by the Divisional Forest Officers.

3. Accordingly, the following cost norms have been approved and annexed for different components under Compensatory Afforestation Scheme.

SL. No.	Description of the component	Annexure
1	Nursery cost norm for raising 1000 Forestry species (18 Months old)	Annexure -1
2	Nursery cost norm for raising 1000 nos. of Casuarina seedlings (6 Months old)	Annexure -2
3	Nursery cost norm for raising 1000 nos. of Mangrove seedlings (one year old) on sunken bed.	Annexure -3
4	Core Plantation cost norm for Compensatory Afforestation @1000 plants / ha. with 10 years maintenance	Annexure-4
5	Core Plantation cost norm for Compensatory Afforestation @1600 plants/ ha. with 10 years maintenance	Annexure-5
6	ANR cost norm for Compensatory Afforestation @200 plants/ ha.with 10 years maintenance	Annexure-6

7	ANR cost norm for Compensatory Afforestation @500 plants/ ha.with 10 years maintenance	Annexure-7
8	Core Casuarina Plantation cost norm for Compensatory Afforestation @2500 plants/ ha with 5 years maintenance	Annexure-8
9	Mangrove (potted seeding) cost norm for Compensatory Afforestation @ 2500 Plants cost / ha with 10 years maintenance	Annexure-9
10	Mangrove (Hypocotyls) cost norm for Compensatory Afforestation @4445 Plants cost/ ha with 10 years maintenance	Annexure-10
11	Cost Norm for Soil and Moisture Conservation (SMC) works.	Annexure-11

4. The above cost norm shall be the basis for raising the one-time demand for Compensatory Afforestation Scheme by DFO while processing the forest diversion proposals for approval under Forest (Conservation) Act,1980.

5. Since there will be time lag between the preparation of the CA Scheme and execution of the same in the field, the DFOs may, if felt necessary, seek revision of the CA Scheme by Nodal Wing of this office due to change in the site conditions at the time of implementation subject to over all ceiling of the payments already made by the User Agency. However, no additional demand shall be raised during the time of execution of the CA Scheme.

06.11.2021

(S. K. Ratho)
Principal Chief Conservator of Forests & HoFF,
Odisha.

18830 08.11.2021
Memo No._____Dt._____/

Copy forwarded to the Additional Chief Secretary, Govt. of Odisha, Forest, Environment and Climate Change for information and necessary action.

18831 08.11.2021
Memo No._____Dt._____/

6.11.2021
APCCF (Forest Diversion & NO, FC Act)

Copy forwarded to the PCCF(WL) & CWLW, Odisha/ PCCF(KL), Odisha/ Chairman, Biodiversity Board/ Chief Executive, RPRC/ PD,OFSDP/ MD, OFDC Ltd for information and necessary action.

18832 08.11.2021
Memo No._____Dt._____/

APCCF (Forest Diversion & NO, FC Act)

Copy forwarded to the Additional PCCF(Nodal & FC Act)/ PP&A/ ME&IV)/CAMPA O/0 PCCF, Odisha/ CCF (TD), Cuttack for information and necessary action.

18833 08.11.2021
Memo No._____Dt._____/

APCCF (Forest Diversion & NO, FC Act)

Copy forwarded to all RCCFs/ All DFOs (T&WL) for information and necessary action.

APCCF (Forest Diversion & NO, FC Act)

ANNEXURE-6

Base Cost Norms for Compensatory Afforestation through Aided Natural Regeneration (ANR) @ 200 Seedlings/Ha. (18 months old seedling)

WAGE RATE Rs- 311/- PER MANDAY

Sl. No	Items of work	Preferable Period of Execution	No of Mandays	Labour Cost (In Rs.)	Matrial Cost (In Rs.)	Total cost (In Rs.)
	0th Year (Advance work) Pre-Planting Operation					
1	Survey, Demarcation and Pillar posting	Nov/Dec	2	622	0	622
2	Preparation of Treatment Map (Digital Map)	Nov/Dec	1	311	100	411
3	Site preparation	Nov/Dec	2	622	0	622
4	Silvicultural operations including clearance of weed, cutting of climber, High stump cutting, singling of shoots & removal of cut out after drying from the field to blank space.	Jan/Feb	15	4665	0	4665
5	Alignment and stacking for digging of pits	Feb/Mar	0.5	156	0	156
6	Digging of pits (45 cm x 45 cm X 45 cm) in hard and gravelly soil	Feb/Mar	8	2488	0	2488
	Total		**28.5**	**8863.5**	**100.0**	**8963.5**
	1st Year/Planting Year					
1	Refilling of pits by altering the dugout soil of the pits, application of organic compounds/ CDM/ FYM & mixing the same perfectly.	June/Jul	1.5	466.5	1000	1467
2	Transportation of 18 months old polythene bag seedlings in hired truck /tractor from the permanent/Mega nursery to planting site including Loading & unloading. (Average lead of 10 Rkm) & Stacking the seedling @ Rs.6/-/ Seedling. (220 nos.)	Jul/Aug	0	0	1320	1320
3	Watering polythene bag seedlings at stacking site of plantation	Jul/Aug	0.5	155.5	0	156
4	Conveyance of polythene bag seedlings on head load from the stacking site to individual dugout pits within the planting site, applying insecticide, fertilizer & planting after scooping the soil with other applied materials and pressing the soil perfectly around the planted seedling.	Jul/Aug	4.5	1399.5	0	1400
5	Cost of Fertilizer & Insecticide (a)NPK/ Bio-fertilizer @ 50 gms/plant as basal dose = 10kg @ Rs.30/- per kg = Rs. 300.0 (b) Urea/Vermicompost/Mo Khata/any other fertilizer @ Rs. 150.00 (c) Insecticide/ Bio-pesticide @ 5 gms/plant= 1 kg @ Rs.150/- per kg = Rs. 150/-	Jul/Aug	0	0	600	600
6	Casualty Replacement @ 10% (20 nos.)	Jul/Aug	0.5	156	0	156
7	1st weeding & Manuring	Aug/Sept	2	622	0	622
8	2nd Weeding, Soil working (1mt. diametre around the plants) & Manuring	Oct/Nov	3	933	0	933
9	Fire line tracing & Inspection path	Feb/Mar	3	933	0	933
10	Watch & Ward including watering as per requirement	Aug-Mar	8	2488	0	2488
	Total		**23**	**7153**	**2920**	**10073**
	2nd Year Maintenance					

Sl. No	Items of work	Preferable Period of Execution	No of Mandays	Labour Cost (In Rs.)	Matrial Cost (In Rs.)	Total cost (In Rs.)
1	Transportation of 20 seedlings from Nursery to plantation site including loading, unloading & conveyance by Tractor @ Rs.6/- per seedling	Jul	0	0	120	120
2	Planting for casualty replacement	Jul	0.5	155.5	0.0	155.5
3	Cost of Fertilizer & Insecticide- A) Cost of Insecticide/ Bio- pesticide(Themet/ Forate) @ 5 gms/plant = 0.1 Kg @ Rs.150/- per kg = Rs.15/- B) Urea/NPK/Bio-fertilizer/Vermicompost/Mo Khata/any other fertilizer= Rs. 560/-	Jul	0	0	575	575
4	Weeding (Complete weeding), Manuring & Soil working, (1mt. diametre around the plants)	Sep/Oct	4	1244	0.0	1244
5	Fire line tracing (2 m. wide fire line over 400 m long) & Inspection path	Feb/Mar	3	933	0.0	933
6	Watch & Ward including watering as per requirement	Apr/Mar	12	3732	0.0	3732
	Total		**19.5**	**6064.5**	**695.0**	**6759.5**
3rd Year Maintenance						
3	Cost of Fertilizer - Urea/NPK/Bio-fertilizer/Vermicompost/Mo Khata/any other fertilizer= Rs. 560/-	Sep/Oct	0	0	560	560
4	Weeding (Complete weeding), Manuring & Soil working, (1mt. Diametre around the plants)	Aug/Sep	4	1244	0	1244
5	Fire line tracing (2 m. wide fire line over 400 m long) & Inspection path	Feb/Mar	3	933	0	933
6	Watch & Ward including watering as per requirement	Apr/Mar	12	3732		3732
	Total		**19.0**	**5909.0**	**560.0**	**6469.0**
4th Year Maintenance						
1	Fire line tracing (2 m. wide fire line over 400 m long) & Inspection path	Feb/Mar	3	933	0	933
2	Watch & Ward including watering as per requirement	Apr/Mar	12	3732	0	3732
	Total		**15**	**4665**	**0**	**4,665**
5th Year Maintenance						
1	Fire line tracing (2 m. wide fire line over 400 m length) &inspection path	Feb/Mar	3	933.00	0	933
2	Watch & Ward including watering as per requirement	Apr/Mar	12	3732.00	0	3732
	Total		**15.0**	**4665.0**	**0**	**4665**
6th Year Maintenance						
1	Fire line tracing (2 m. wide fire line over 400 m length) &inspection path	Feb/Mar	3	933.00	0	933
2	Watch & Ward including watering as per requirement	Apr/Mar	12	3732.00	0	3732
	Total		**15.0**	**4665.0**	**0.0**	**4665.0**
7th Year Maintenance						
1	Fire line tracing (2 m. wide fire line over 400 m length) &inspection path	Feb/Mar	3	933.00	0	933
2	Watch & Ward including watering as per requirement	Apr/Mar	12	3732.00	0	3732
	Total		**15.0**	**4665.0**	**0.0**	**4665.0**
8th Year Maintenance						

Sl. No	Items of work	Preferable Period of Execution	No of Mandays	Labour Cost (In Rs.)	Matrial Cost (In Rs.)	Total cost (In Rs.)
1	Fire line tracing (2 m. wide fire line over 400 m length) &inspection path	Feb/Mar	3	933.00	0	933
2	Watch & Ward including watering as per requirement	Apr/Mar	12	3732.00	0	3732
	Total		**15.0**	**4665.0**	**0.0**	**4665.0**
9th Year Maintenance						
1	Fire line tracing (2 m. wide fire line over 400 m length) &inspection path	Feb/Mar	3	933.00	0	933
2	Watch & Ward including watering as per requirement	Apr/Mar	12	3732.00	0	3732
	Total		**15.0**	**4665.0**	**0.0**	**4665.0**
10th Year Maintenance						
1	Fire line tracing (2 m. wide fire line over 400 m length) &inspection path	Feb/Mar	3	933.00	0	933
2	Watch & Ward including watering as per requirement	Apr/Mar	12	3732.00	0	3732
	Total		**15.0**	**4665.0**	**0.0**	**4665.0**

Year wise Abstract of Cost Norm (showing seedling cost separately)

Sl. No	Year	No. person days	Labour cost @ Rs. 311/-per day (Rs)	Material Cost (In Rs.)	Monitoring Evaluation, Learning, Documentation and Other Contingency (5%) of (4+5+6)	Cost of Seedlings @Rs.50.31 per seedlings	TOTAL COST
1	2	3	4	5	7	6	8
1	0th year	28.5	8863.5	100	436.50	0.00	9400.0
2	1st year	23.0	7153.0	2920	427.00	11068.00	21568.0
3	2nd year	19.5	6064.5	695	240.50	1006.00	8006.0
4	3rd year	19.0	5909.0	560	231.00	0.00	6700.0
5	4th year	15.0	4665.0	0	135.00	0.00	4800.0
6	5th year	15.0	4665.0	0	135.00	0.00	4800.0
7	6th year	15.0	4665.0	0	135.00	0.00	4800.0
8	7th year	15.0	4665.0	0	135.00	0.00	4800.0
9	8th year	15.0	4665.0	0	135.00	0.00	4800.0
10	9th year	15.0	4665.0	0	135.00	0.00	4800.0
11	10th year	15.0	4665.0	0	135.00	0.00	4800.0
	Total:	**195.0**	**60645.0**	**4275.0**	**2280.0**	**12074**	**79274.0**

Note:

1 Priority must be given to the indigenous local species available nearby to the site of plantation.

2 10 % indigenous fruit bearing trees must be preferred to Plantation.

3 Site specific Soil conservation work like LBCD, Gully Plugging, Staggered Trench, Contour Trench, Graded Bund, etc. may be taken up

4 Chain link fencing can be adopoted in the CA plantation taken up outside the forest area and Bamboo twigs fencing may be prefered to CA plantations taken up in degraded forest area.

5 Watering facilites for procurement of water & watering may be adopted as per the availability of water.

6 The Cost Norm of various items can be changed with the approval of the concerned RCCFs keeping the overall cost norm fixed for each Financial Year

APCCF (Forest Diversion & NO, FC Act)

Matrix for ANR-200 Plants/ Ha

In Rupees

Sl. NO.	Commencement Year	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	XIII	XIV	XV	XVI	XVII	XVIII	XIX	XX	XXI	Total Cost
Base Norm		9400	21568	8006	6700	4800	4800	4800	4800	4800	4800	4800											
1	2021-22	9400	22646	8826	7756	5834	6126	6432	6754	7092	7446	7819											96131
2	2022-23		9870	23778	9267	8144	6126	6432	6754	7092	7447	7818	8210										100938
3	2023-24			10364	24967	9730	8551	6432	6754	7092	7447	7819	8209	8621									105986
4	2024-25				10882	26215	10217	8979	6754	7092	7447	7819	8210	8619	9052								111286
5	2025-26					11426	27526	10728	9428	7092	7447	7819	8210	8621	9050	9505							116852
6	2026-27						11997	28902	11264	9899	7447	7819	8210	8621	9052	9503	9980						122694
7	2027-28							12597	30347	11827	10394	7819	8210	8621	9052	9505	9978	10479					128829
8	2028-29								13227	31864	12418	10914	8210	8621	9052	9505	9980	10477	11003				135271
9	2029-30									13888	33457	13039	11460	8621	9052	9505	9980	10479	11001	11553			142035
10	2030-31										14582	35130	13691	12033	9052	9505	9980	10479	11003	11551	12131		149137

APCCF (Forest Diversion & NO, FC Act)

Year wise cash Flow (in Lakhs)

Annexure-II

Sl	Item	0th Year	1st Year	2nd Year	3rd Year	4th Year	5th Year	6th Year	7th Year	8th Year	9th Year	10th year	Total
1	ANR: Enrichment of Plantation/Re-densification @200 plants per Ha (18 months seedlings) for 250 Ha, i.e., commencement year of 2027-28 as per One Time Cost Norm which also includes Fencing model-II, Watering model-III as well as 20% of escalation cost.	135.21	135.21	135.21	135.21	135.21	135.21	135.21	135.21	135.21	135.21	135.27	1487.37
2	Fodder land development per 10 ha One Unit including grass reserves over 40.00 ha	7.00	6.90	6.90	6.90	6.90	6.90	6.90	6.90	6.90	6.90	6.90	76.00
3	(LBCD) Loose Boulder Check Dam, (WMCD) Wire Mesh Check Dam, (CCD) Concrete Check Dam, (CCT) Continuous Contour Trench	291.75	291.75	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	583.50
4	Awareness campaign for farm management, control grazing etc.	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.00	10.00
5	Capacity building for youths and women (industrial exposure visits, vocational training courses- tailoring, food processing, vermicomposting, etc.)	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	5.00	5.00	100.00
6	CNG and LPG Distribution	15.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	15.00
7	Cost for 1 no. of Inflatable motorboat for monitoring wildlife and forest species on water body with 1 no. of driver for operation	5.00	2.00	2.00	2.00	2.00	2.00	1.00	1.00	1.00	1.00	1.00	20.00
	Total costs of Biological, Engineering measure, Socio-economic Measure and Ancillary costs	**235.21**	**211.16**	**206.16**	**206.16**	**206.16**	**206.16**	**206.16**	**206.16**	**206.16**	**201.16**	**201.22**	**2291.87**
8	Contingency @ 5%	11.76	10.56	10.31	10.31	10.31	10.31	10.31	10.31	10.31	10.06	10.06	114.59
	Sub-Total	**246.97**	**221.72**	**216.47**	**216.47**	**216.47**	**216.47**	**216.47**	**216.47**	**216.47**	**211.22**	**211.28**	**2406.46**
9	Escalation cost @ 20%	49.39	44.34	43.29	43.29	43.29	43.29	43.29	43.29	43.29	42.24	42.26	481.29
	Total	**296.36**	**266.06**	**259.76**	**259.76**	**259.76**	**259.76**	**259.76**	**259.76**	**259.76**	**253.46**	**253.54**	**2887.76**

Superintending Engineer
Angul Investigation Division
Angul

Divisional Forest Officer
Athmallik Division

Annexure-III

Cost estimates of Grassland Development Including Grass Reserves for one unit (10 Ha.)

Rupees in Lakh

SL	*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 9 years @10% per annum = 10x 9x 10% =	**9.00**
	Total	**19.00**

As per Guideline of Dept. of Animal Husbandry, Dairying & Fisheries (2016)

Annexure - III

NATIONAL LIVESTOCK MISSION

OPERATIONAL GUIDELINES

(REVISED AS ON 27.04.2016)







Government of India
Ministry of Agriculture and Farmers Welfare
Department of Animal Husbandry, Dairying & Fisheries
Krishi Bhavan, New Delhi.

Annexure-C-I(B)

Sub-mission: Fodder and Feed Development

Proforma for submitting proposal under the component of "Fodder production from Non-forest wasteland / rangeland / grassland / non-arable land"

(In rupees per ha.)

S. No.	Item	CPR, Gochar land /community land / waste land which need treatment of soil.	CPR, Gocher land / community land / waste land which does not need treatment of soil	Govt. Farm/ Goshala land	Forest land / Grassland in remove area	Individual farmers
Continuing Parameters						
A. Capital Investment						
(a)	Demarcation of boundary, fencing/ (trench / brushwood / barbed wire)	7500	7500	2000	7000	0.00
(b)	Land Development	10000	7500	5000	5000	0.00
(c)	Farm sheds – for equipment, seed, manure, and office	15000	15000	0.00	0.00	0.00
(d)	Purchase of agricultural implements	5000	5000	5000	2500	0.00
(e)	Creation of irrigation facilities: wells, pumps, power line, water tank, pump room, pipelines etc.	37500	30000	25000	7500	0.00
	Sub- Total	75000	65000	37000	22000	0.00
B.	Recurring Expenditure					
i.	Wages of supervisory staff	2000	2000	5000	5000	0.00
ii.	Seeds, fertilizer/ manure, insecticides	4000	4000	6000	6000	12000
iii.	Cultivation charges	10000	5000	6000	6000	12000
iv.	Irrigation electricity / fuel charges	3000	3000	5000	5000	0.00
v.	Maintenance of Store/dead stock	3000	3000	3000	3000	0.00
vi.	Miscellaneous and unforeseen expenses	3000	3000	3000	3000	6000
	Sub-Total	25000	20000	28000	28000	30000
	Grand Total	100000	85000	65000	50000	30000

Note:

a) 75% central assistant will be provided out of above rates for one hectare.

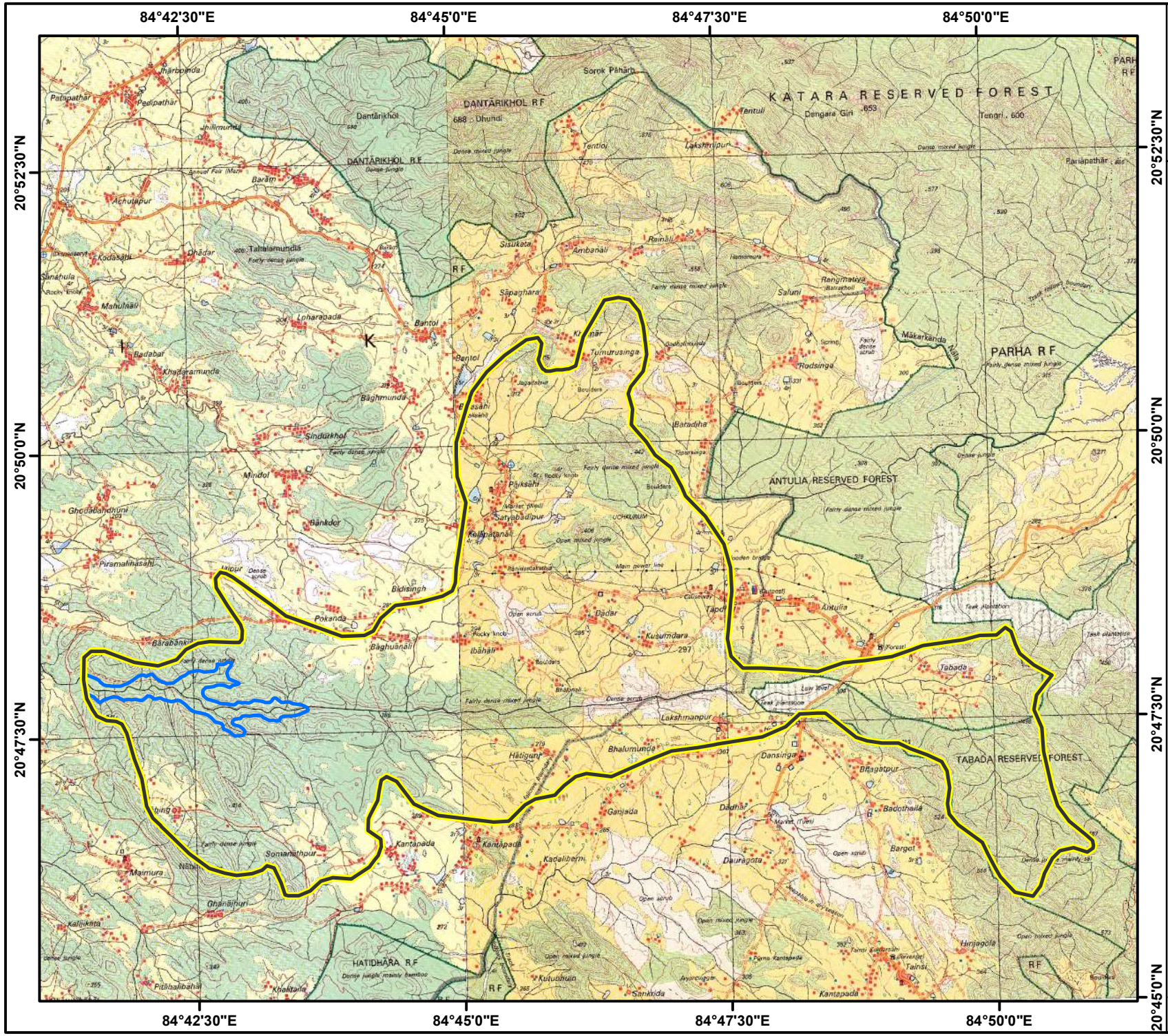
b) Funds for improvement of grasslands by reseeding, import of fodder seeds, transportation, labour wages will be as per rates available at that time of submitting the project proposal.

Plate-1

Catchment Area Treatement Plan

Kutulisinga Irrigation Project

Catchment Map



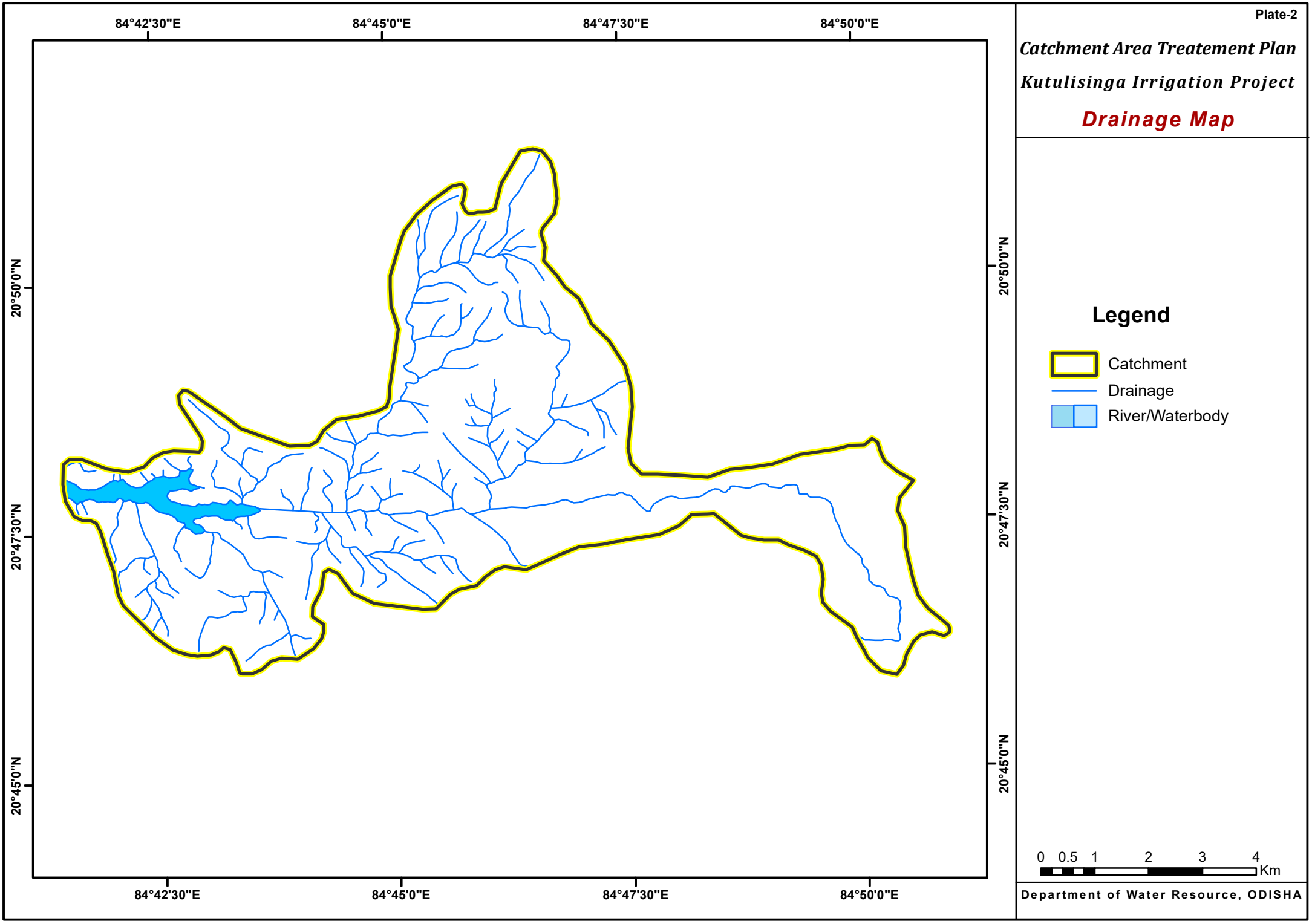
Department of Water Resource, ODISHA

Plate-2

Catchment Area Treatement Plan

Kutulisinga Irrigation Project

Drainage Map



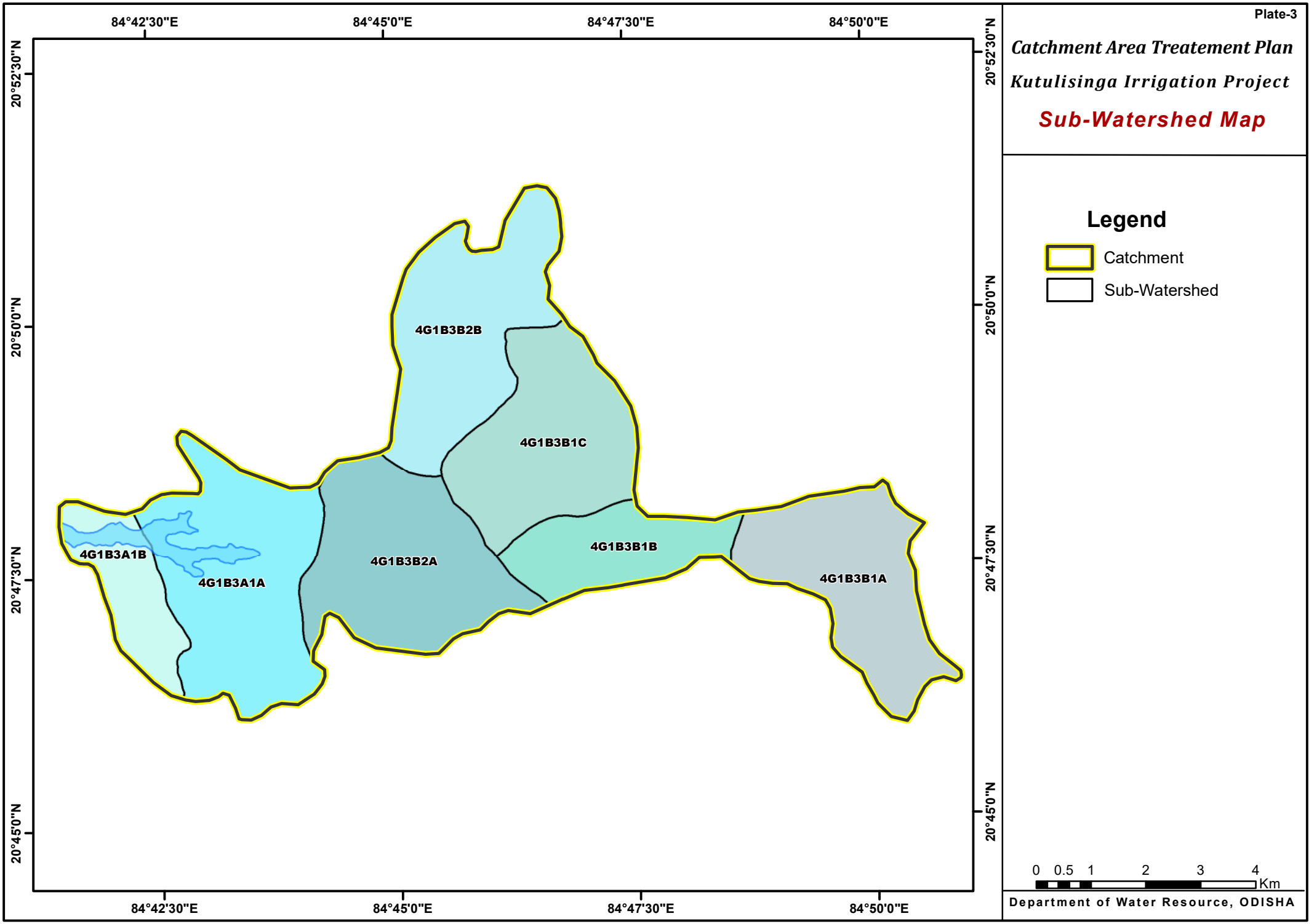
Department of Water Resource, ODISHA

Plate-3

Catchment Area Treatement Plan

Kutulisinga Irrigation Project

Sub-Watershed Map



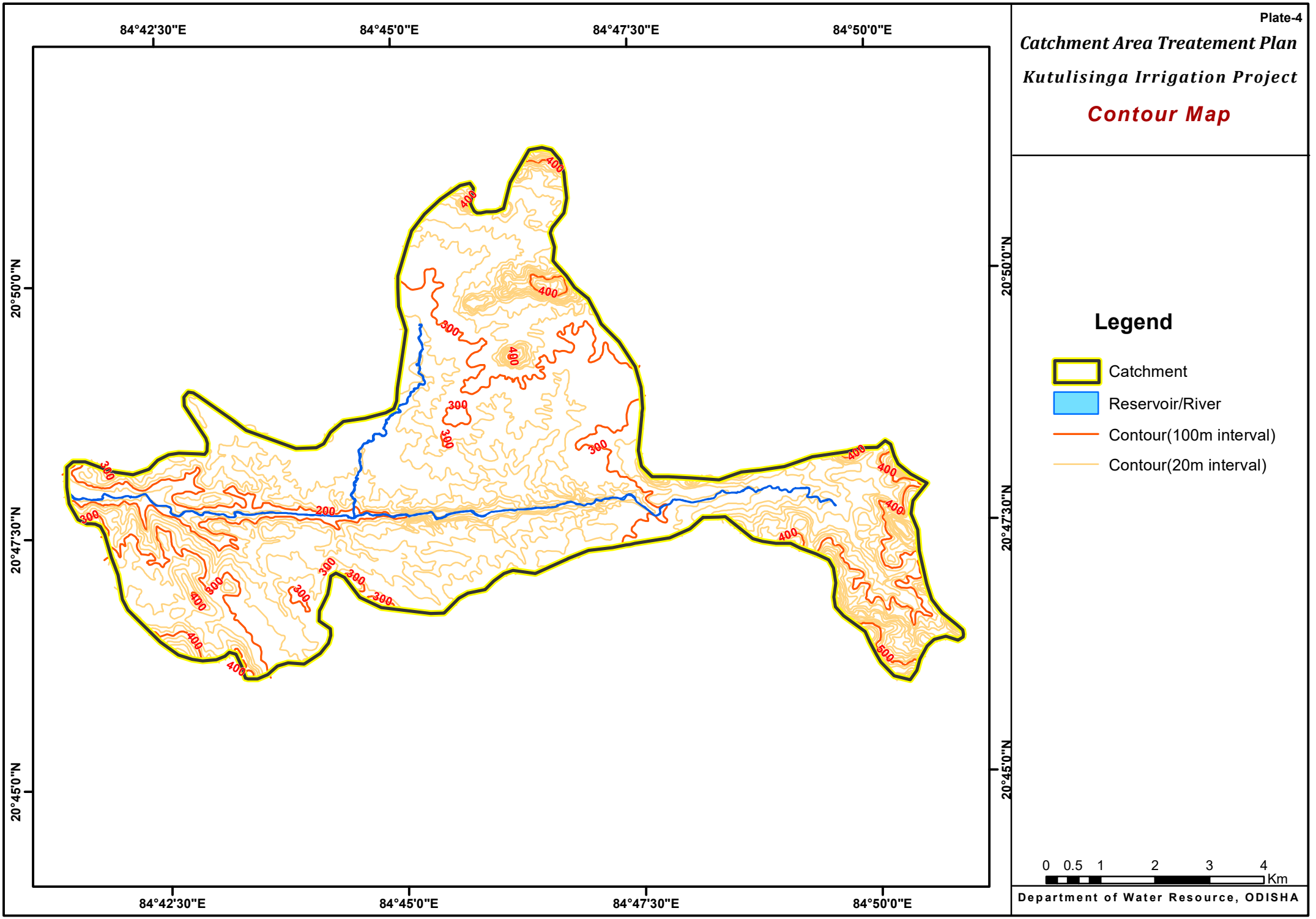
Department of Water Resource, ODISHA

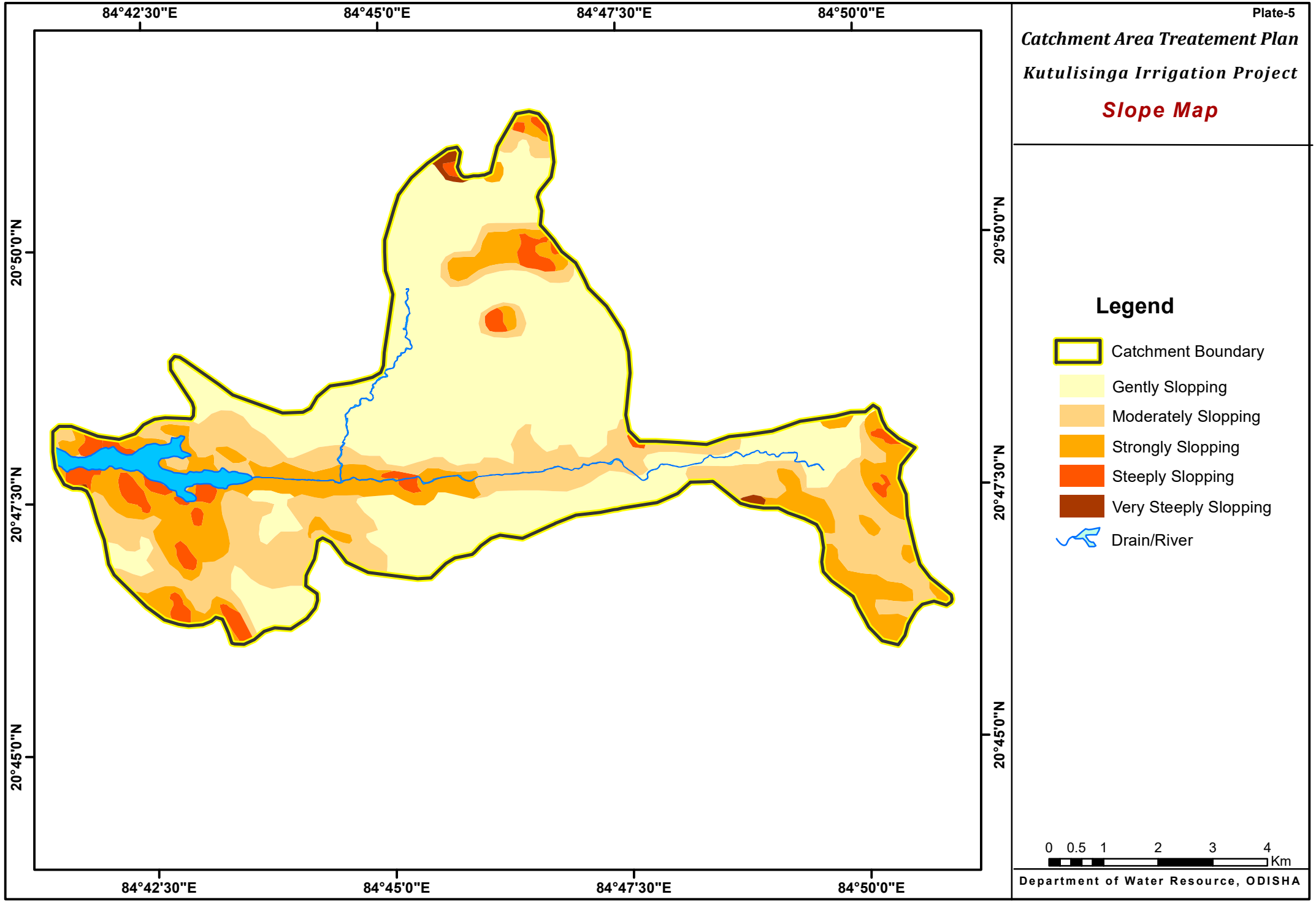
Plate-4

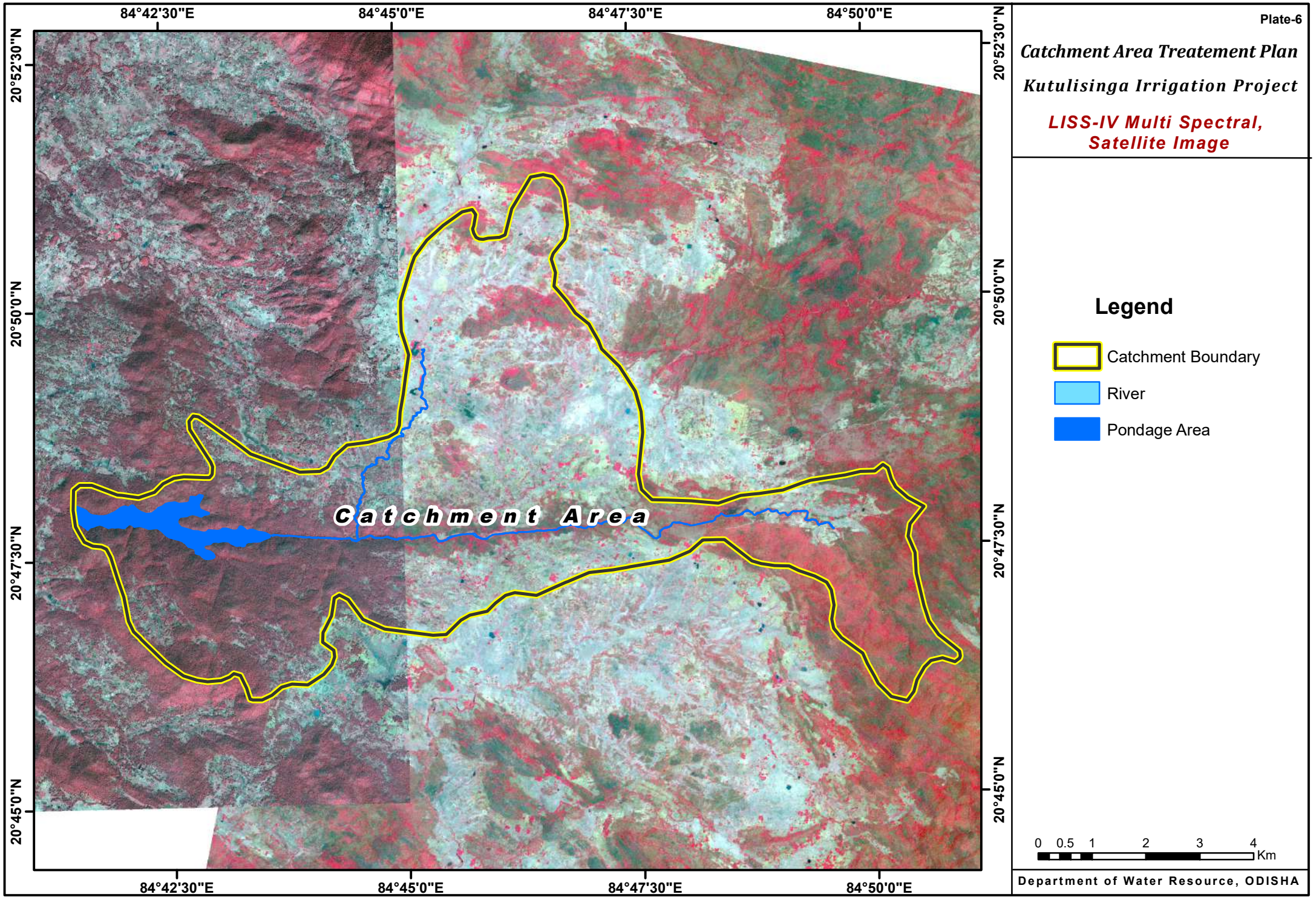
Catchment Area Treatement Plan

Kutulisinga Irrigation Project

Contour Map




84°42'30"E
84°45'0"E
84°47'30"E
84°50'0"E
20°50'0"N
20°47'30"N
20°45'0"N
Plate-5
Catchment Area Treatement Plan
Kutulisinga Irrigation Project
Slope Map
Legend
Catchment Boundary
Gently Slopping
Moderately Slopping
Strongly Slopping
Steeply Slopping
Very Steeply Slopping
Drain/River
0 0.5 1 2 3 4
Km
Department of Water Resource, ODISHA


84°42'30"E
84°45'0"E
84°47'30"E
84°50'0"E
20°52'30"N
20°50'0"N
20°47'30"N
20°45'0"N
Catchment Area
Plate-6
Catchment Area Treatement Plan
Kutulisinga Irrigation Project
LISS-IV Multi Spectral, Satellite Image
Legend
Catchment Boundary
River
Pondage Area
0 0.5 1 2 3 4
Km
Department of Water Resource, ODISHA

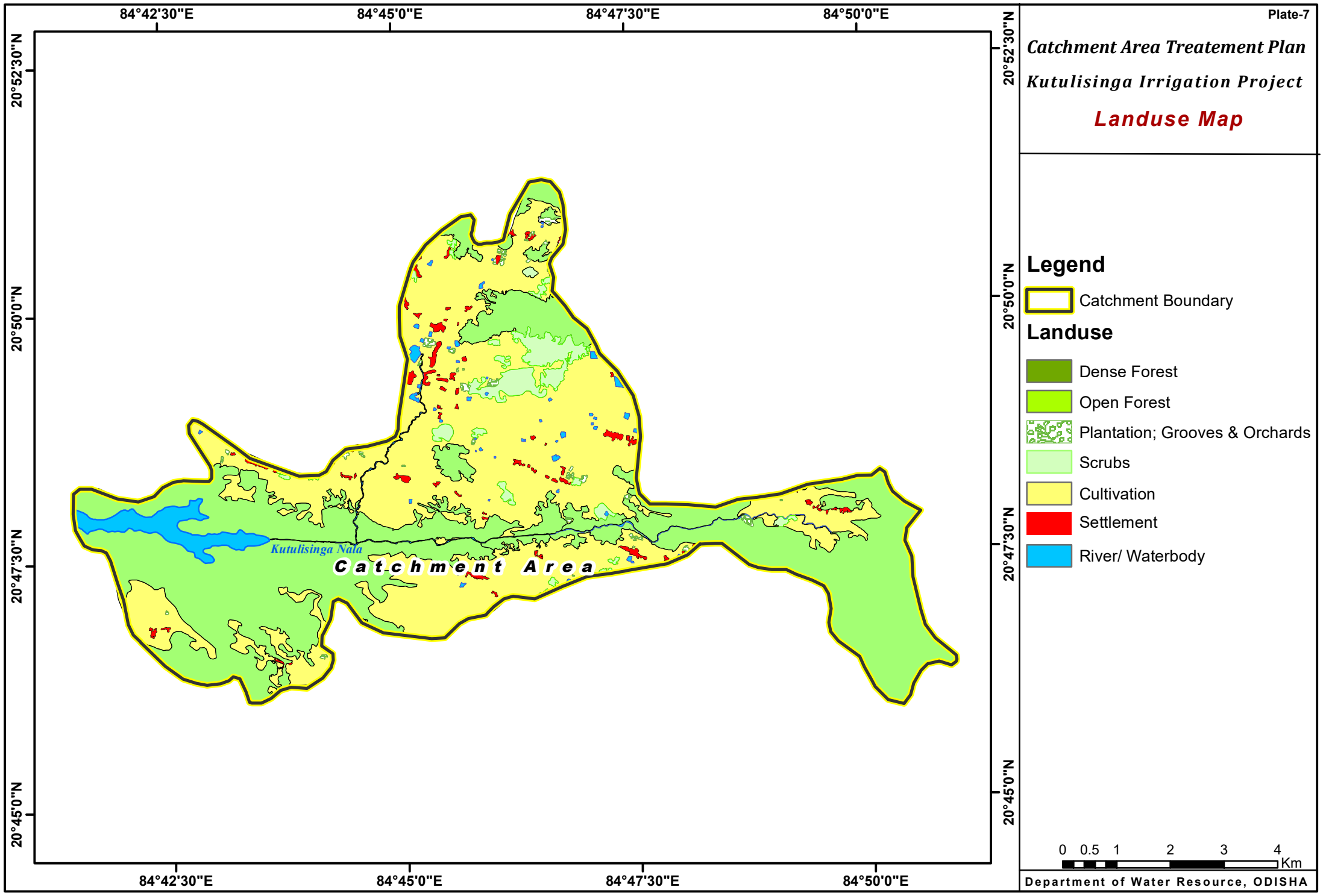


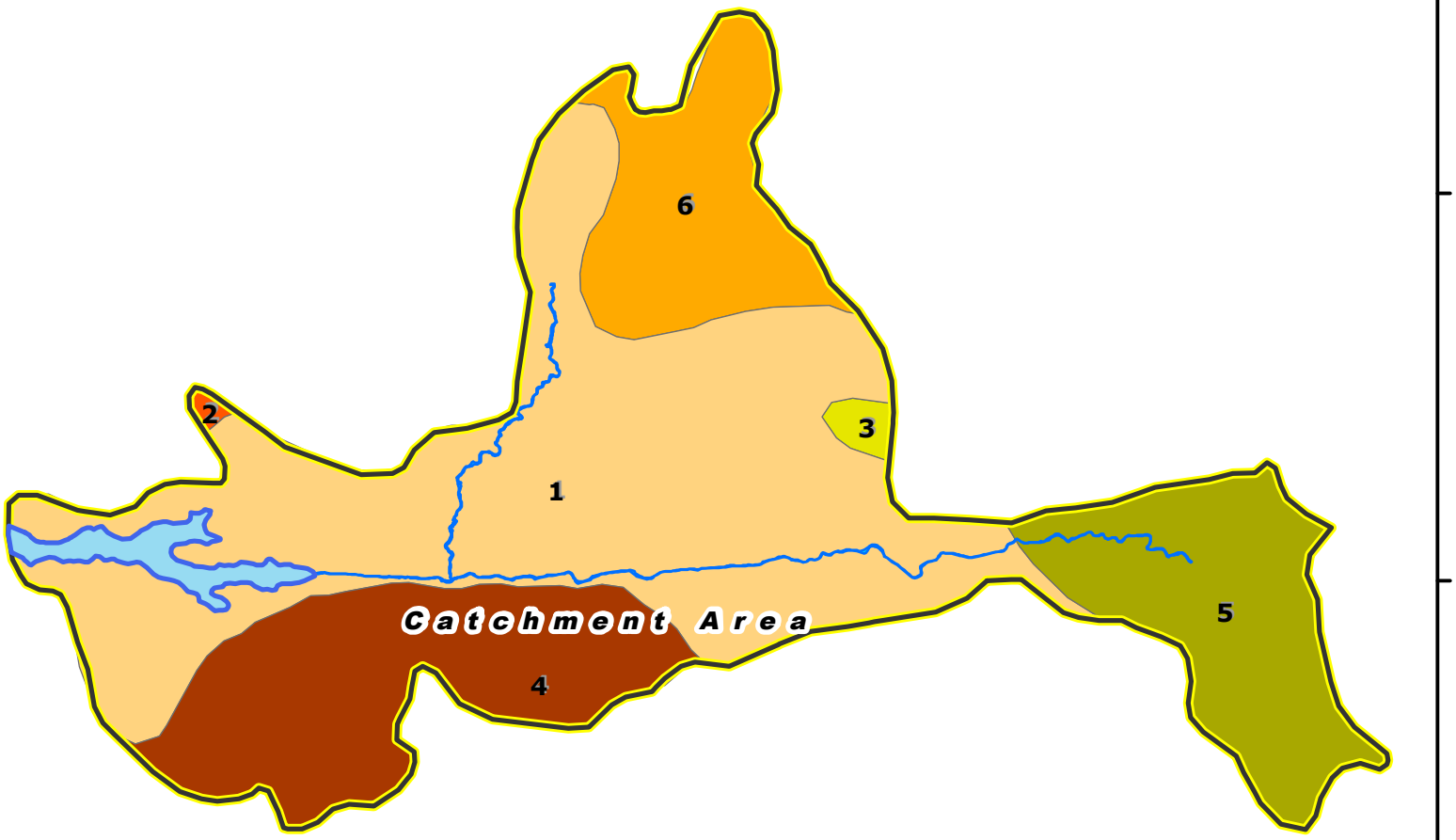
Plate-7
Catchment Area Treatement Plan
Kutulisinga Irrigation Project
Landuse Map
84°42'30"E
84°45'0"E
84°47'30"E
84°50'0"E
20°52'30"N
20°50'0"N
20°47'30"N
20°45'0"N
Kutulisinga Nala
Catchment Area
Legend
Catchment Boundary
Landuse
Dense Forest
Open Forest
Plantation; Grooves & Orchards
Scrubs
Cultivation
Settlement
River/ Waterbody
0 0.5 1 2 3 4
Km
Department of Water Resource, ODISHA

Plate-8

Catchment Area Treatement Plan

Kutulisinga Irrigation Project

Soil Map



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

Legend

- Catchment Boundary
- Reservoir/River

0 0.5 1 2 3 4 Km

Department of Water Resource, ODISHA

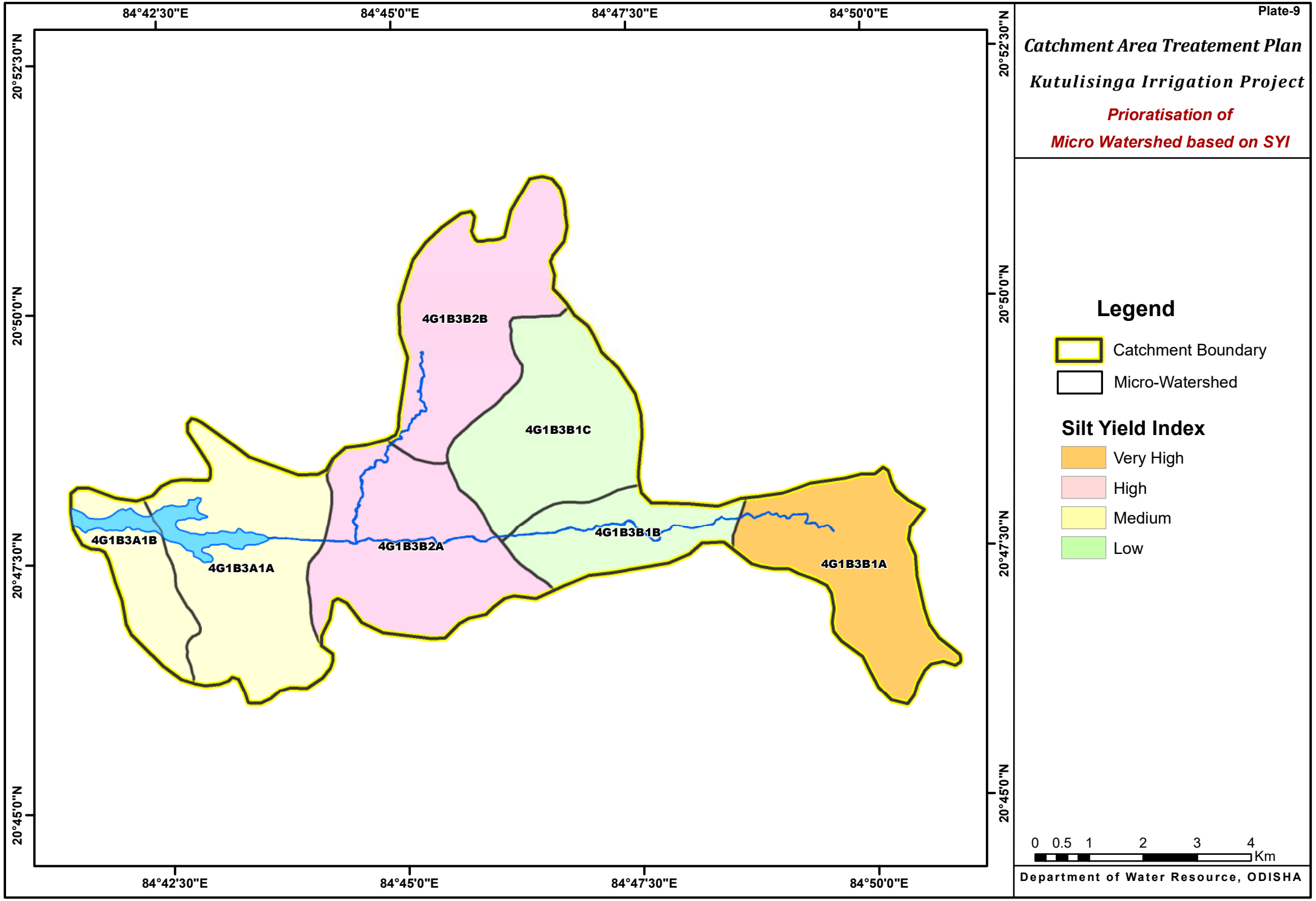


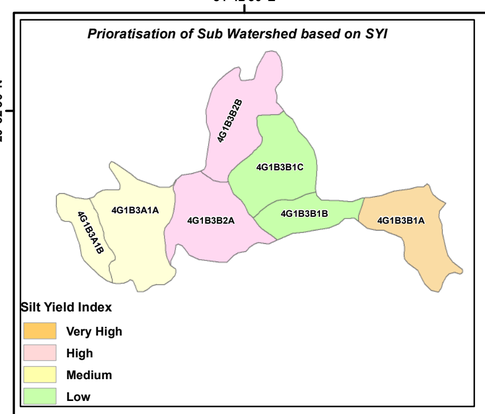
Plate-9
Catchment Area Treatement Plan
Kutulisinga Irrigation Project
Prioratisation of
Micro Watershed based on SYI
84°42'30"E
84°45'0"E
84°47'30"E
84°50'0"E
20°52'30"N
20°50'0"N
20°47'30"N
20°45'0"N
4G1B3B2B
4G1B3B1C
4G1B3A1B
4G1B3A1A
4G1B3B2A
4G1B3B1B
4G1B3B1A
Legend
Catchment Boundary
Micro-Watershed
Silt Yield Index
Very High
High
Medium
Low
0 0.5 1 2 3 4
Km
Department of Water Resource, ODISHA

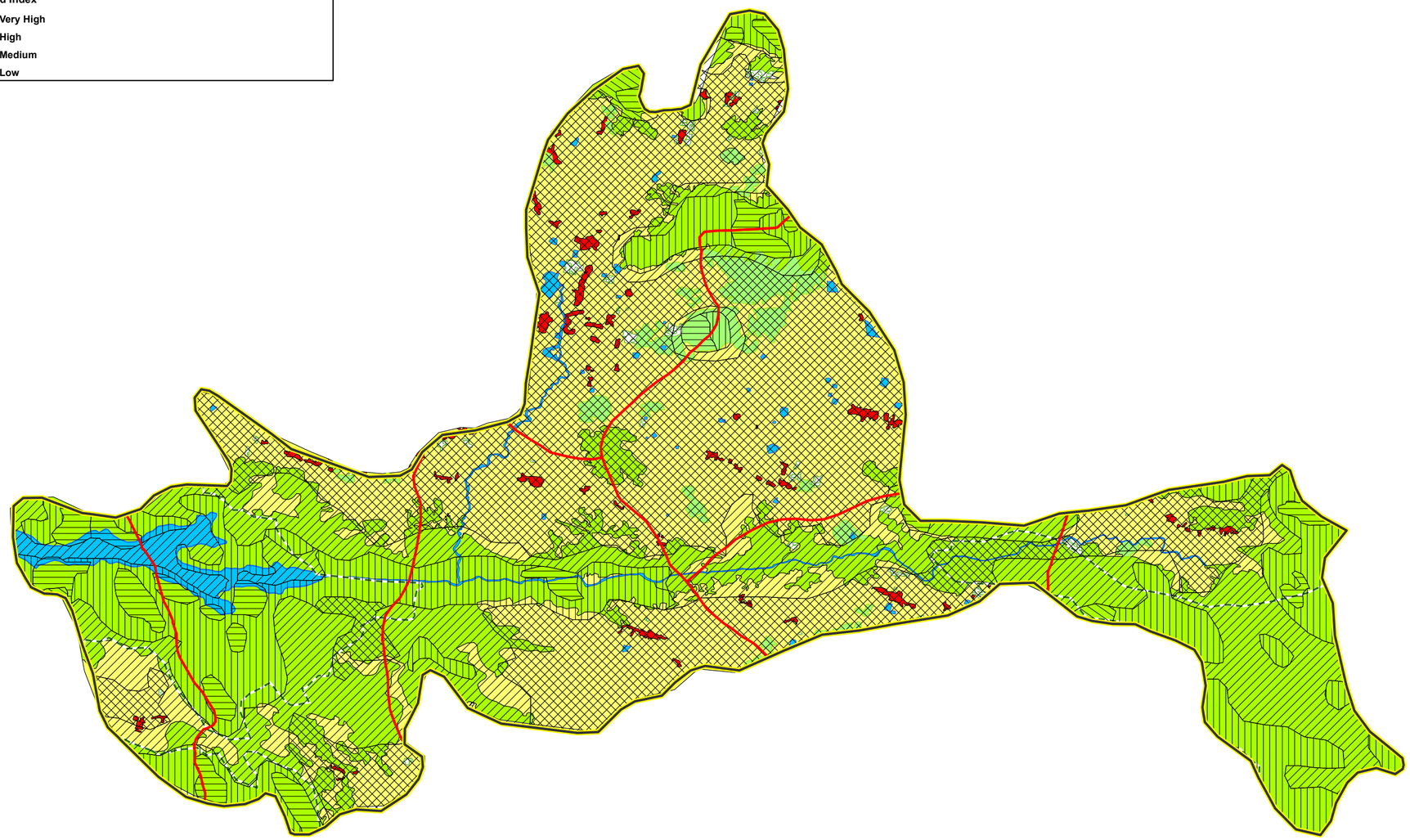
Plate-10

Catchment Area Treatement Plan

Kutulisinga Irrigation Project

Detail Map for Preparation of Treatment Plan





Legend

- Catchment Boundary
- Sub-Watershed Boundary
- Forest

Slope

- Gently Slopping
- Moderately Slopping
- Strongly Slopping
- Steeply Slopping
- Very Steeply Slopping

Landuse

- Moderate Dense Forest
- Open Forest
- Plantation; Grooves & Orchards
- Scrubs
- Forest Blank
- Cultivation
- Settlement
- River/ Waterbody
- Others

0 0.5 1 2 3 4 5 Km

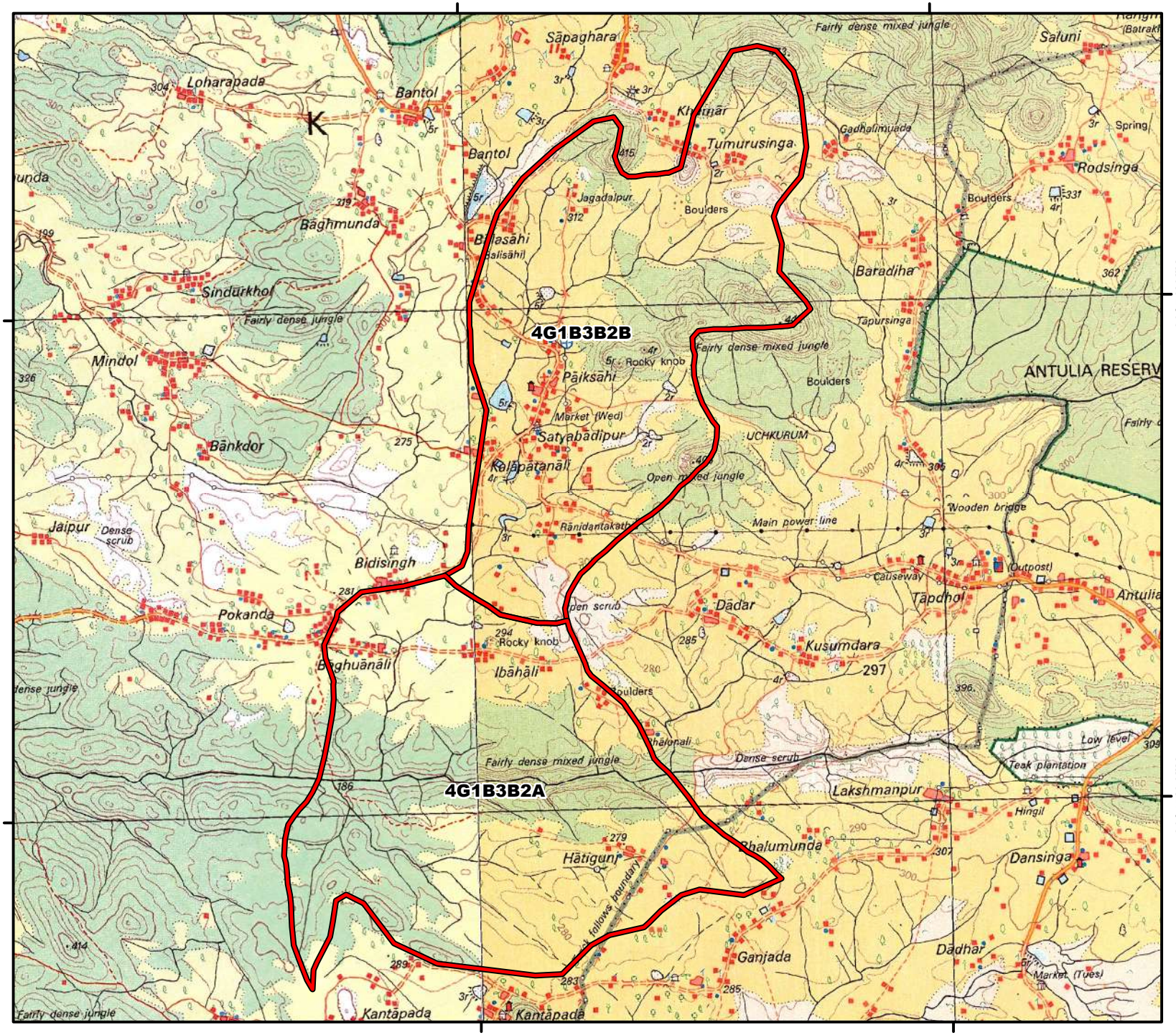
Department of Water Resource, ODISHA

Plate-11.a

Catchment Area Treatement Plan

Kutulisinga Irrigation Project

Topographic Map of the Priority Watershed



Legend

Sub-Watershed Boundary

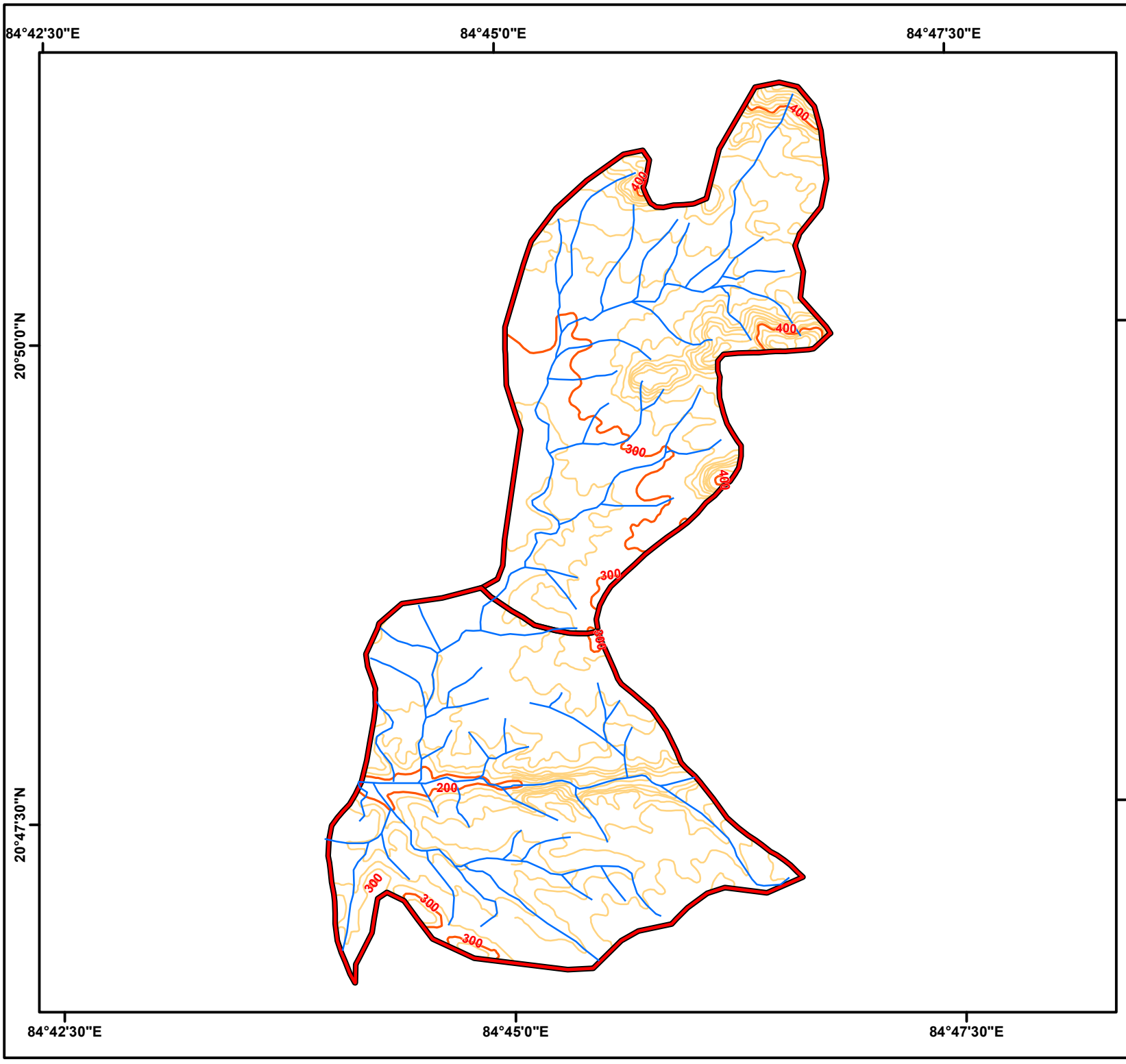
Department of Water Resource, ODISHA

Plate-11.b

Catchment Area Treatement Plan

Kutulisinga Irrigation Project

Drainage & Contour Map of the Priority Watershed



Legend

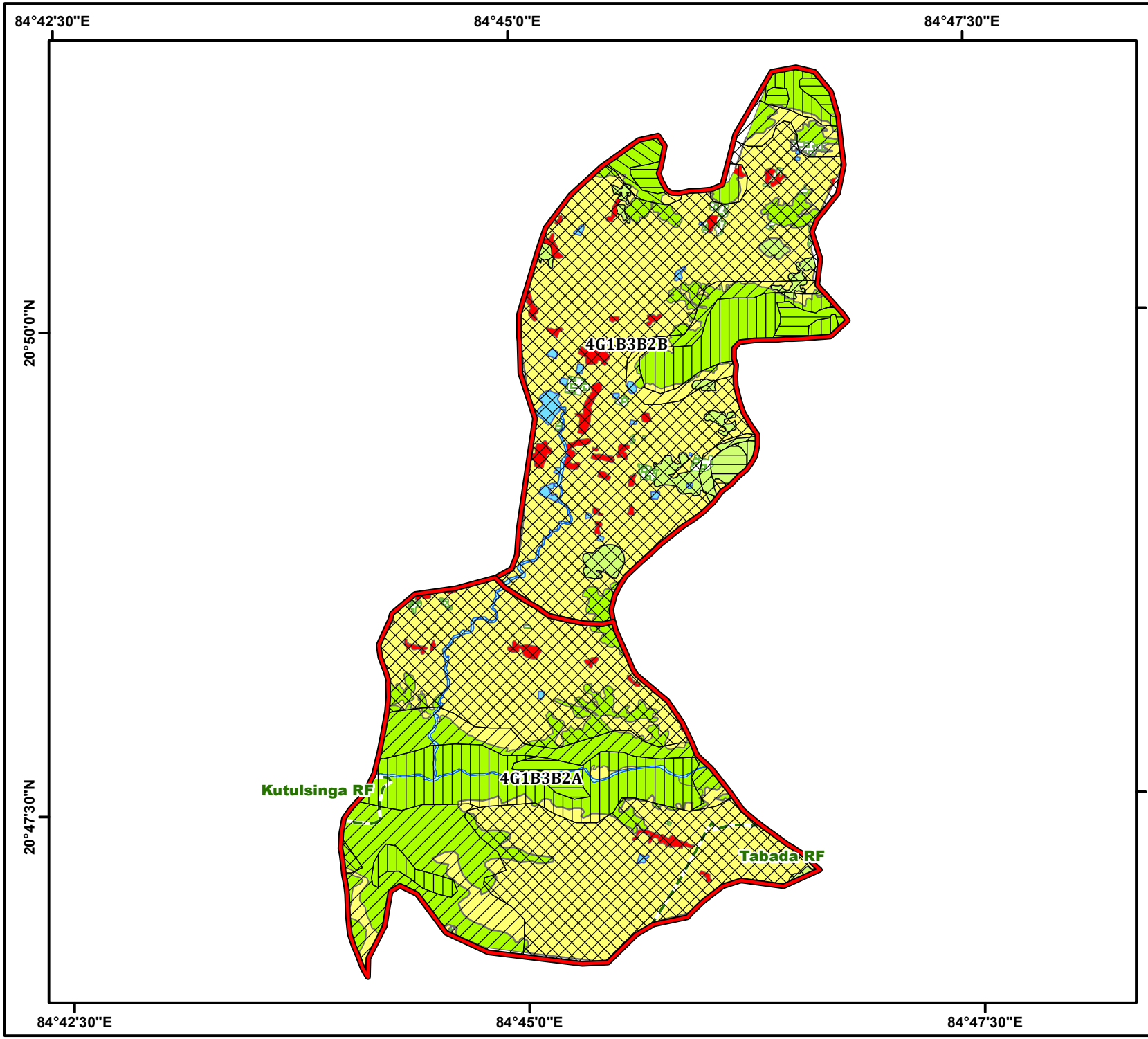
- Sub-Watershed Boundary
- River/Drainage
- Contour(100m interval)
- Contour(20m interval)

0 0.5 1 2 3 Km

Department of Water Resource, ODISHA

Plate-11.c

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



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

0 0.5 1 2 3 Km

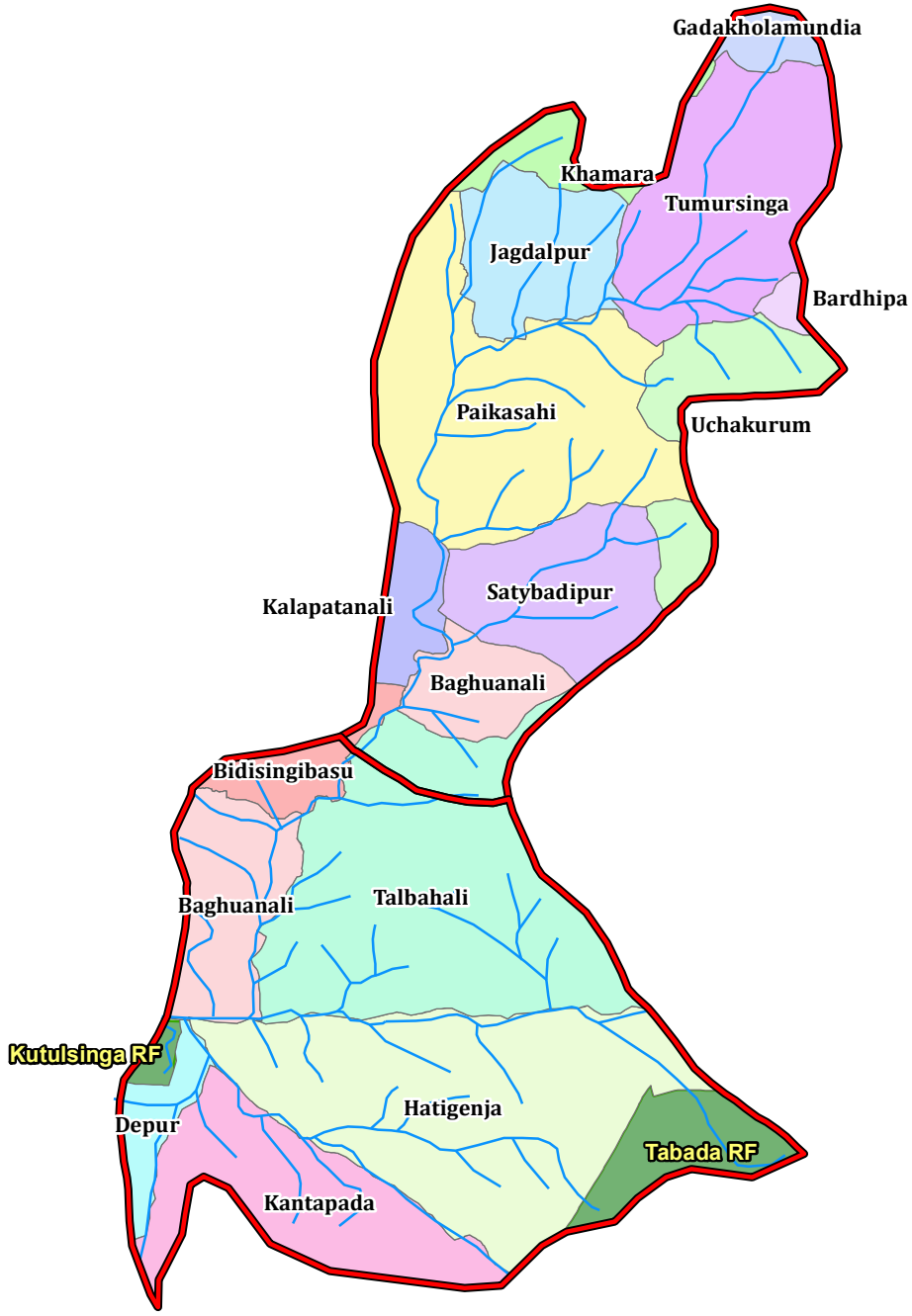
Department of Water Resource, ODISHA

Plate-12

Catchment Area Treatement Plan

Kutulisinga Irrigation Project

Village Map of the Priority Watershed



84°44'0"E 84°46'0"E 84°48'0"E

20°50'0"N

20°48'0"N

Legend

- Watershed Boundary
- River/Waterbody
- Drainage
- RF

0 0.5 1 2 3 Km

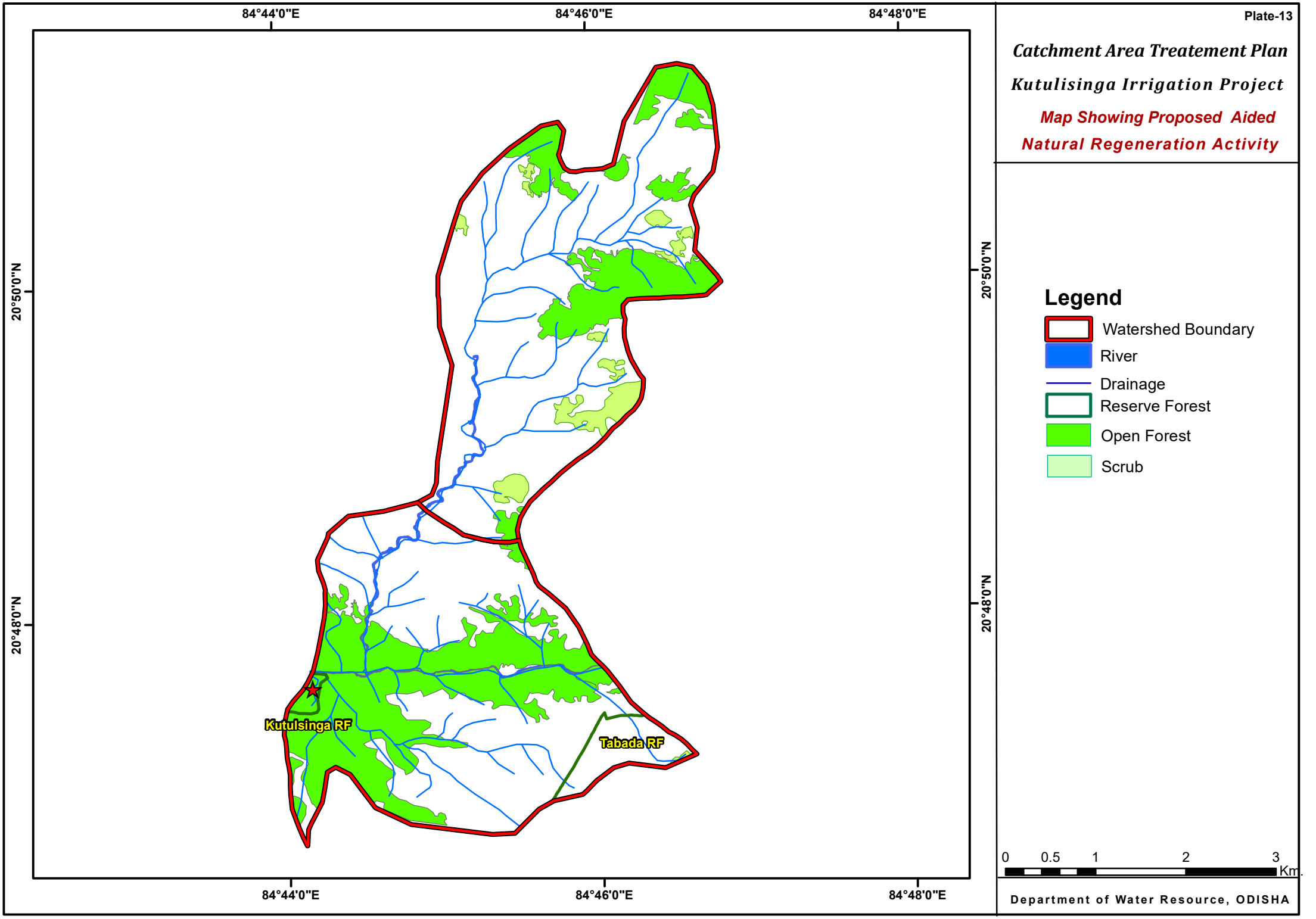
Department of Water Resource, ODISHA

Plate-13

Catchment Area Treatement Plan

Kutulisinga Irrigation Project

Map Showing Proposed Aided Natural Regeneration Activity



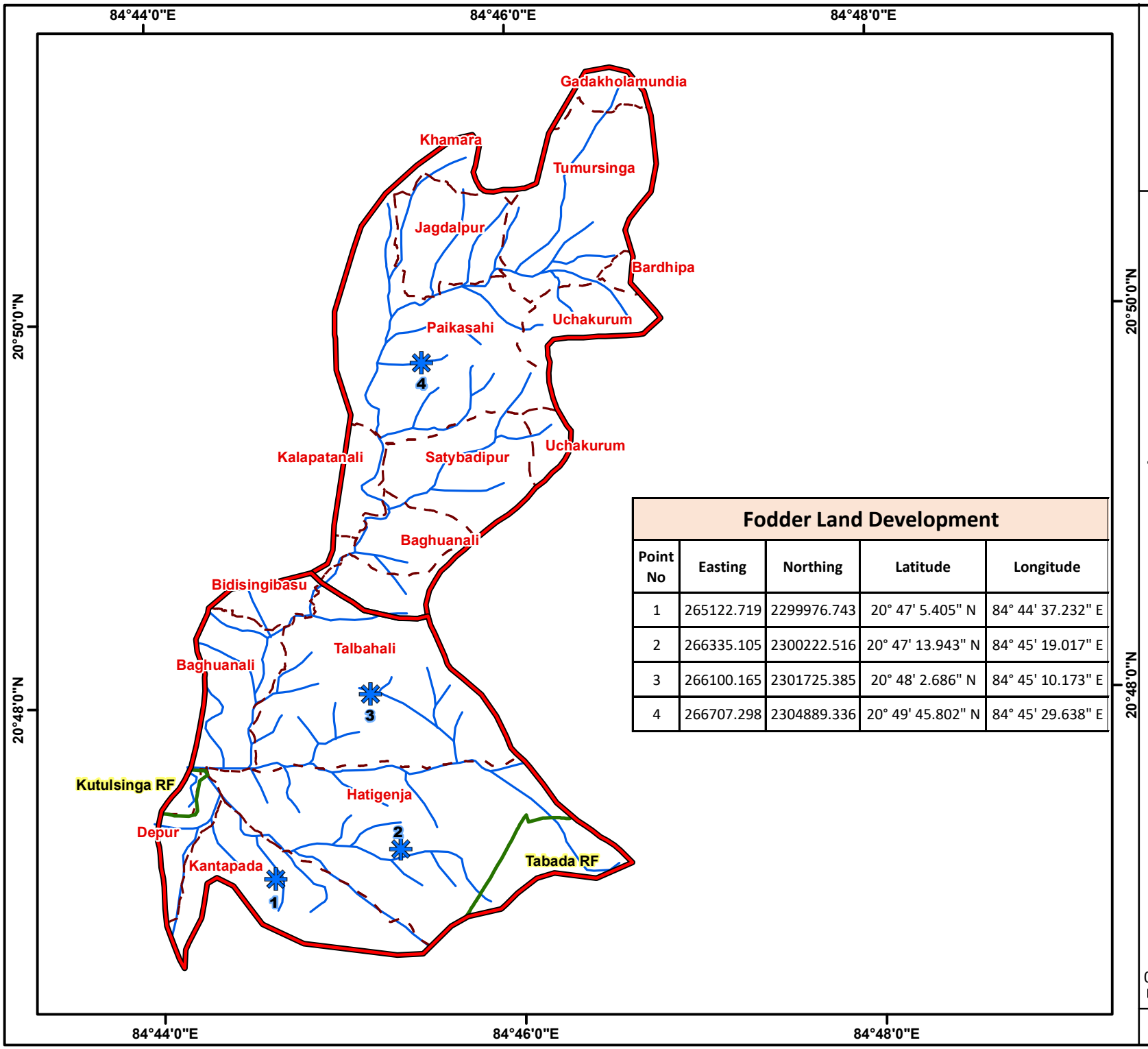
Department of Water Resource, ODISHA

Plate-14

Catchment Area Treatement Plan

Kutulisinga Irrigation Project

Map Showing Catchment Area Treatement Activities other than ANR



Fodder Land Development

Point No	Easting	Northing	Latitude	Longitude
1	265122.719	2299976.743	20° 47' 5.405" N	84° 44' 37.232" E
2	266335.105	2300222.516	20° 47' 13.943" N	84° 45' 19.017" E
3	266100.165	2301725.385	20° 48' 2.686" N	84° 45' 10.173" E
4	266707.298	2304889.336	20° 49' 45.802" N	84° 45' 29.638" E

Legend

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

Type of Treatement

- Fodder Land Developement

0 0.5 1 2 3 Km

Department of Water Resource, ODISHA