GOVERNMENT OF MADHYAPRADESH

Water Resources Department

Apchand Medium Tank Scheme Irrigation Project

Catchment Area Treatment Plan Amount Rs.142.27 Lakhs

Distt. Sagar Block Sagar

APCHAND MEDIUM IRRIGATION PROJECT SAGAR

CATCHMENT AREA TREATMENT PLAN

(COST Rs.142.27 Lakhs)

CHIEF ENGINEER

WATER RESOURCES DEPARTMENT

SAGAR,M.P.

Contents

CATCHMENT AREA TREATMENT PLAN

CATCHMENT AREA TREATMENT PLAN

1.1 Introduction

It is a well-established fact that reservoirs formed by dams on rivers area subjected to sedimentation. The process of sedimentation embodies the sequential processes of erosion, entrainment, transportation, deposition and compaction of sediment. 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 river reach. The removal of top fertile soil from catchment also adversely affects the agricultural production and growth of plants another crucial factor that adds to the sediment load and which contributes to soil degradation is grazing pressure.

The lack of proper vegetal cover is a factor to cause degradation and thereby results in severe run off/soil erosion, and subsequently premature siltation of the reservoir. Thus, a well-designed Catchment Area Treatment (CAT) Plan is essential to ameliorate the above-mentioned adverse cause and process of soil erosion. The catchment area treatment involves the understanding of the erosion characteristics of the terrain and suggesting remedial measures to reduce the erosion rate. For this reason, the catchment of the directly draining rivers, streams, tributaries, etc. are treated and the cost is included in the project cost.

The pre-requisite for a watershed management is the collection of multipronged data e.g., geology, geomorphology, topography, soil, land use/land cover, climate, hydrology, drainage pattern, etc. The multi-pronged data generated from various published sources and actual data collected from these watersheds on the above-mentioned parameters forms the basis of the Action Plan for Catchment Area Treatment is presented here.

Catchment Area Treatment (CAT) plans for the free draining catchment area of the proposed project has been prepared for areas with high soil erosion intensity. The CAT Plan targets towards overall improvement in the environmental conditions of the region. All the activities are aimed at treating the degraded and potential areas with severe soil erosion. The plan provides benefits due to biological and engineering measures and its utility in maintaining the ecosystem health. The plan with objectives 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.

1.2 Objectives

Integrated watershed management plan minimizes the sedimentation of reservoir. 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. For this purpose, the action plan has been prepared with the following objectives:

1. To facilitate the hydrological functioning of the catchment and to augment the quality of water of the river and its tributaries.
2. Conservation of soil cover and to arrest the soil erosion, floods and siltation of the river along with its tributaries and consequent reduction of siltation in the reservoir of the project.

3 Rehabilitation of degraded forest areas through afforestation and facilitating natural regeneration of plants.
4 Mitigation of landslide, landslip and rock falls.
5 Soil conservation through biological and engineering measures to reduce sediment load in river and tributaries, incidentally improving the quality of water.
6 Ecosystem conservation resulting from increased vegetal cover and water retaining properties of soil.

1.3 Catchment Area

Apchand Medium Tank Scheme is a minor irrigation rises on Gadheri River in the Block Sagar Range Dhana of South Sagar DIvision in the Sagar district , of Madhya pardesh at Apchand village block Sagar elevation on 485m. Geographical coordinate's origination are at north latitude 23°47'5.88"N and East longitude 78°59'46.05" E. The side can be located on the Topo Sheet No 55I13 River Gadheri flows in a generally north to south direction for a total length of 14.5 km away to join the Sonar River. The forest area boundary in the catchment as per the forest proposal is about 66.755 Sq.KM & about 1.4902 Sq. K.M is in the submergence.

1.4 Free Draining Catchment

CAT Plan has been formulated for free draining catchment i.e. up to the proposed Apchand Medium Project on Gadheri River block Sagar. Free draining catchment area for this CAT Plan is 66.755 sq km. As per nomenclature contained in water atlas of india , edition 1993, the free draining catchment under the study area lies in water resources Region- (Dhasan-Ken) Basin Catchment 5D4. River basin of Yamuna

The basin characteristics watershed are illustrated in Table 1.1 the satellite imagery of the free daring catchment is presented in Figure 1.1 The intercepted catchment area is 66.755 Sq.Km. Net Catchment area of project is 66.755 Sq.Km. Also illustrated in **Table 1.1**

The basin characteristics of different sub-watersheds are illustrated in **Table 1.1 and the mosacic map of watershed location is shown** in **Figure 1.2.**

Table – 1.1: Apchand Medium Project Area Details

S.No	Particulars	Value
1	Gross catchment Area	66.755 Sq.km
3	Designed flood (Estimated SPF)	1249.89 Cumecs
4	Net 75% dependable yield	18.23 MCM
5	Full reservoir level (FRL)	462.900 .M
5	Tank Bund level (TBL)	465.400 M

Table 1.2: Basin Characteristics of Different Sub-watersheds

S.No.	watersheds	Total catchment area (SqKM)
1	5D4	66.755
	Total	66.755

CATMENT AREA OF APCHAND MEDIUM IRRIGATION PROJECT

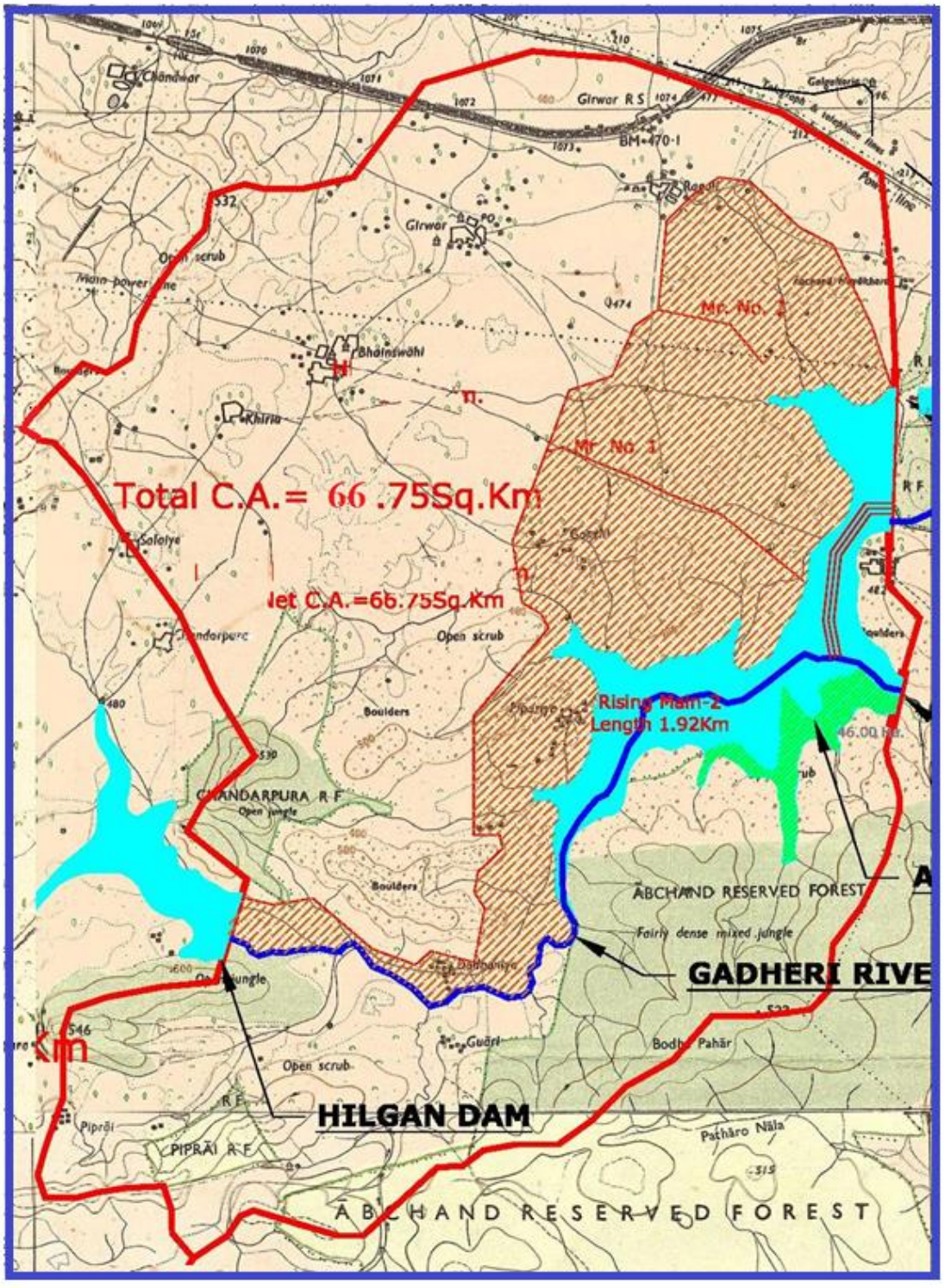

Figure 1.1: FCC Map of Catchment Area

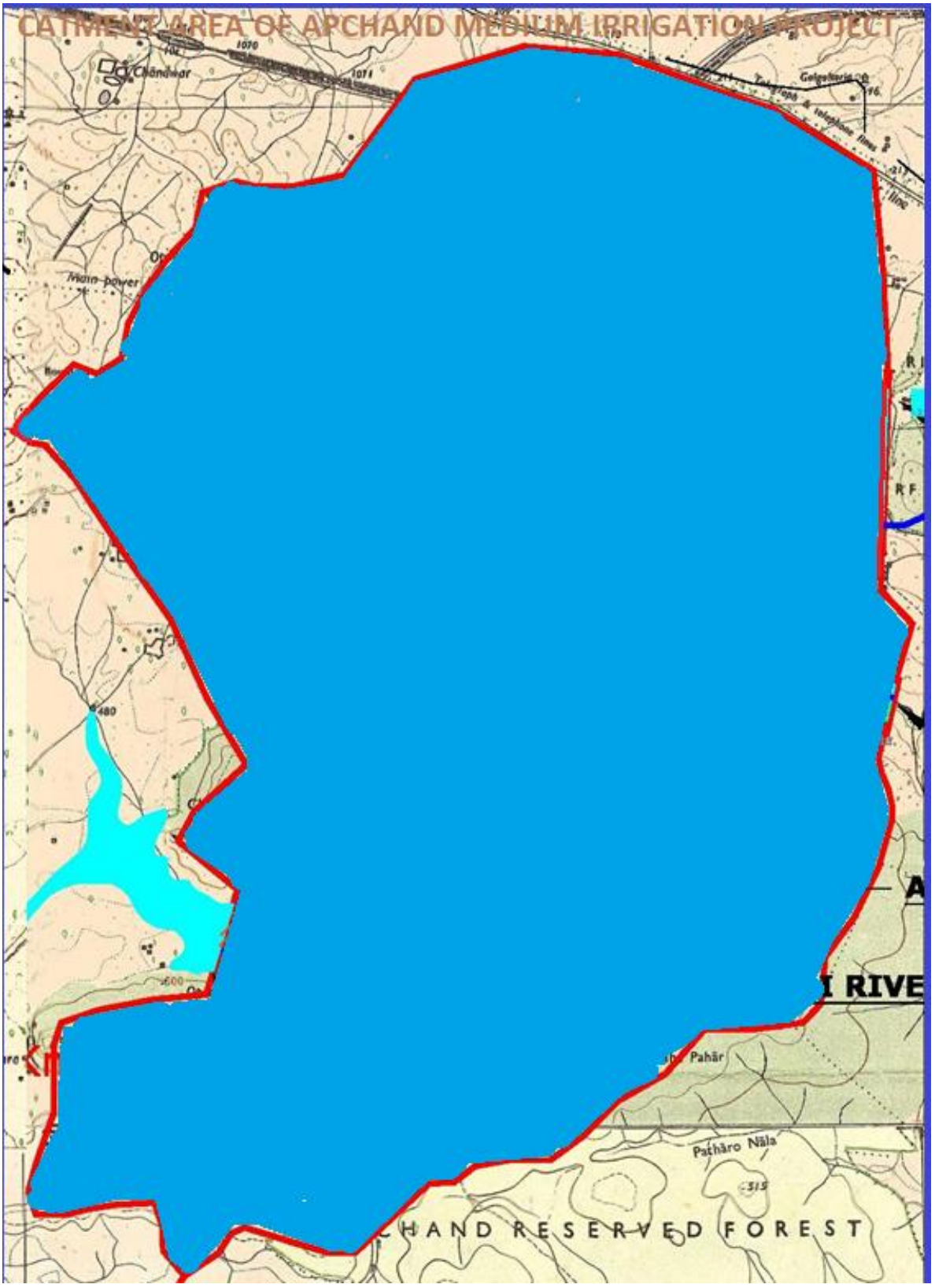

Figure 1.2: Mosaic Map Showing Location of Sub-watersheds

1.5 Topography

The project catchment area is hilly and nearby 7.75 % of catchment is covered by forest of deciduous dry type with Teak and Mixed type. And about 82.42% area plain agriculture area.

Total Catchment area of project is 66.755 Sq. Km and there are 1 proposed Medium Inrrigation scheme on this project. The drainage map of the catchment is shown in **Figure 1.3.**

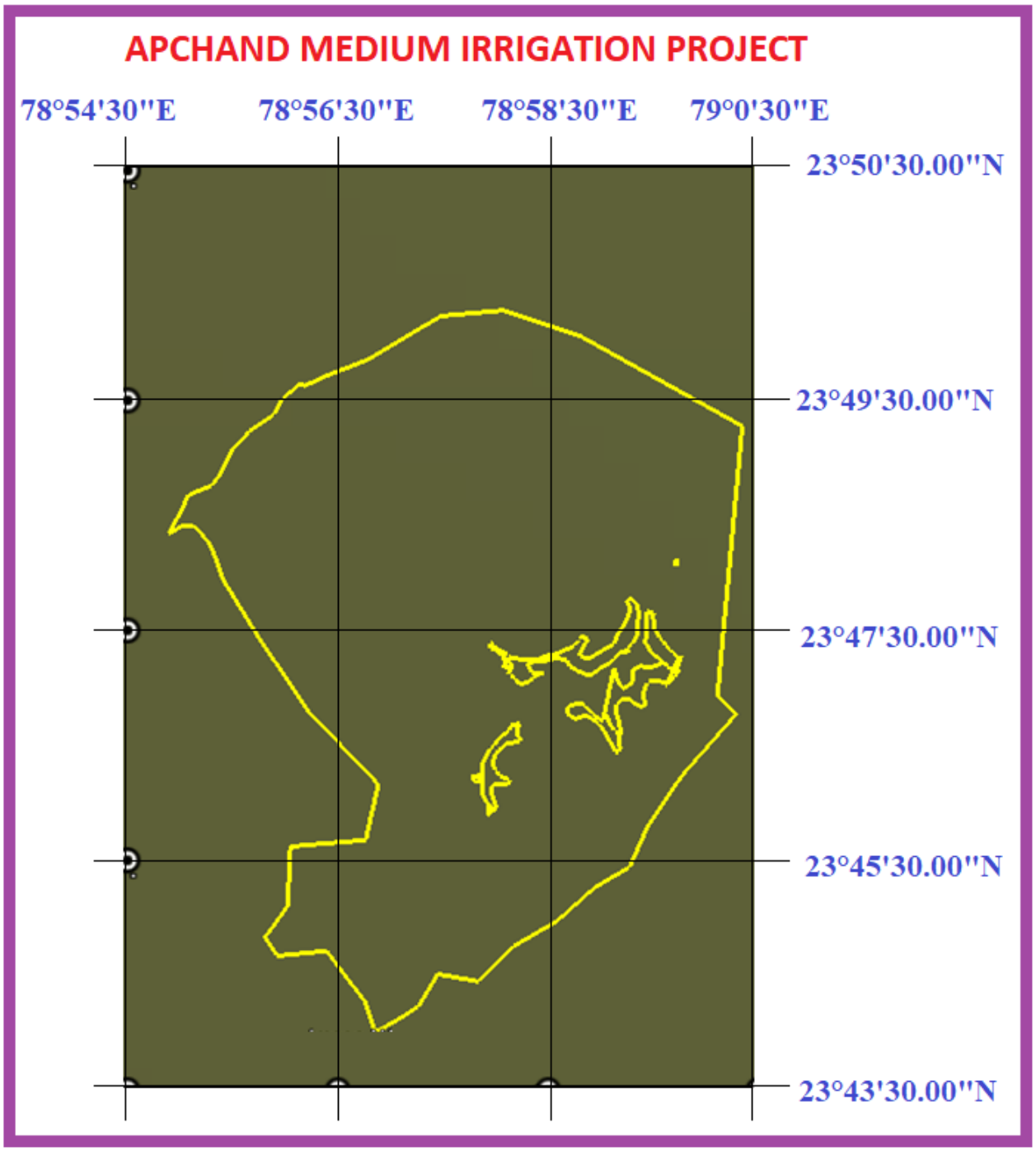

Figure 1.3: Drainage map of the catchment.

1.6 Soil

Soil Erosion and Forest Area Coverage:

Soil erosion in the Vindhyan plateau region is a not problem, as the catchment area is bounded dense forest area, which results has no loss of soil fertility and no such increased sediment load in the rivers. During ground survey the soil is pronominally loam clay and deep brown in color i.e. hard soil and moorum.

Therefore, it is not required to e proper maintenance of soil functions and its health. So this project not proposing additional measures for management interventions in the relevant watershed. The slope and the satellite maps are attached for the reference of slope and soil erosion.

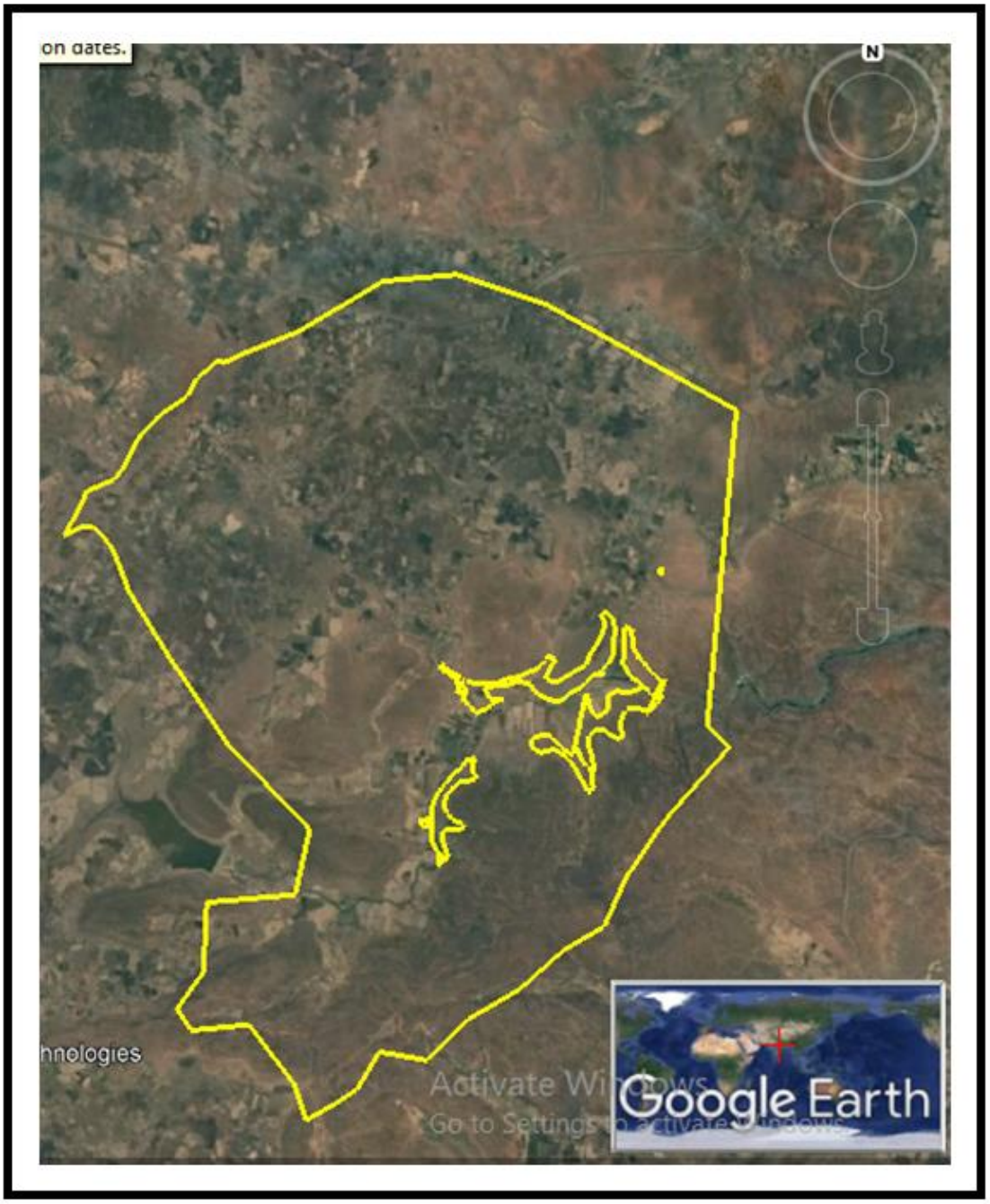

Figure – 1.4: Catchment Area Forest Cover Map

1.7 Land use

Land use-Land Cover Classification

Based on satellite data and topo-sheets, a land-use map has been prepared and verified in detail during ground surveys i.e. crosschecked with ground truths. The Land use/ Land-cover map of the catchment area is presented in **Figure 1.5** and its details are presented in **Table 1.3**.

Land use Categories and Erosion

The erosion acts differently in different land-use types. It is important to understand the nature of erosion in a land-use class to further plan for treatment.

Agricultural Land

Around 54.85 sq. km area of the catchment constituting 82.42 % of the total catchment comes under this category. Plain to Well-planned and developed terraces were seen at some places. In general, at places the sheet and rill type of soil erosion predominates with few gullies in early stage of its development. Very few or no measures are taken to conserve soil and tendency exists to interrupt the natural drainage due to faulty agricultural practices. Runoff often exceeds the safe velocity on long slope lengths. It is suggested to repair and better design the agricultural terraces, which follows the faulty agricultural practices.

Temporary and semi-permanent soil conservation structures like brushing dams, wiring woven and gabion check dams etc. shall be made for effective adaptive management.

Open/ Degraded Forest Land

Under open/Degraded forest category about 8.11 sq. km constituting 12.186% of the total catchment, is present. Forest crown density ranges from 0-40% or on average 20% crown density can be assumed present in the area. Soils have relatively good water holding capacity, humus, nutrient content and moderate to slight erosion rates on steeper slopes. Therefore, rill erosion predominates which in due course leads to scrub land formation with gullies. Afforestation is suggested so as increase the crown density by 20% in whole of the area to reduce erosion.

Dense Forest

Dense forest covers about 3.5 sq. km area constituting 5.259% of the catchment with the forest crown density above 40%. Soils are very good in water holding capacity, humus and nutrients with no erosion but due to steeper slopes, some area requires soil conservation measures.

River/ Water body

Around 0.050 Sq.km area constituting 0.075% of the catchment area is classified under water bodies. The category needs no treatment except that the unstable bank shall be provided stream bank stabilization through protection measures whenever required.

Scrub

Under shrub category about 0.040 sq. km area of catchment constituting 0.060 % of the total catchment is present.

Table 1.3: Land use classification for free draining catchment at Project Site

Land use/Land cover	**Area%**	**Area (ha)**
River/Water Bodies	0.075 %	5.0 Hact.
Agricultural Areas	82.42 %	5505.5 Hact.
Dense Forest	5.259 %	350.0 Hact.
Open/Degraded Forest	12.186 %	811.0 Hact.
Scrubs/Bushes/Grasses	0.060 %	4.0 Hact.
Total	**100.0%**	**6675.5 HACT.**

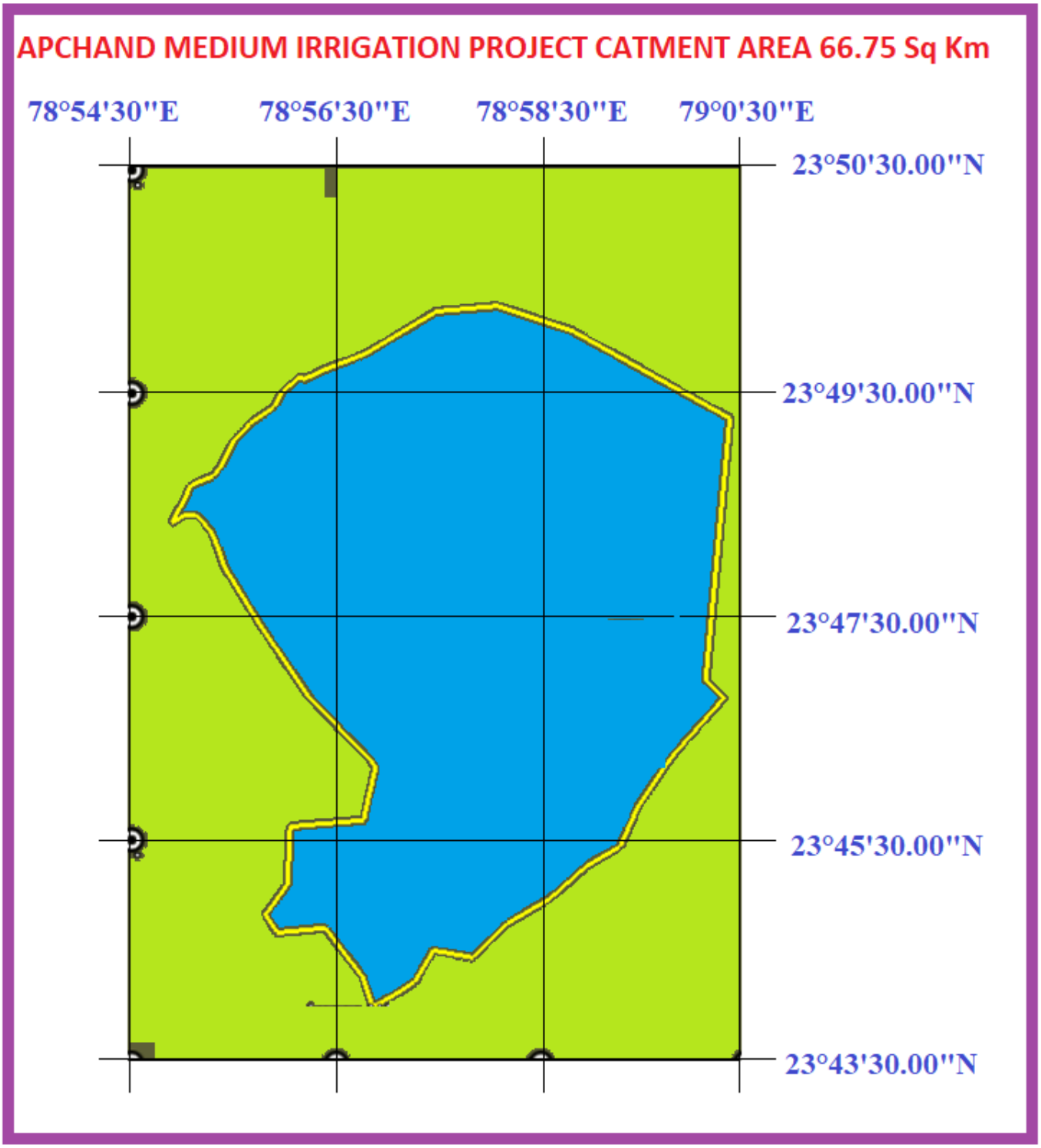

Figure 1.4: Land use Map of Catchment Area

Slope

The slope of a watershed plays a key role in controlling the soil and water retention thereby affecting the land-use capability. The percentage of the slope in a watershed determines the soil erosion susceptibility and forms the basis for classifying different of the watershed into suitable classes for formulating effective soil erosion conservation measures. Broadly, the following slope classes and ranges **(Table 1.4)** as per norms of All India Soil & Land Use Survey were adopted to classify the slopes for the present study.

Table 1.4: Slope Ranges showing the intensity of catchment area

Sr. No	Slope Range (Degrees)	Description
1	0-5	Very Gentle Slope
2	5-10	Gentle Slope
3	10-15	Moderate Slope
4	15-25	Moderately Steep Slope
5	25-35	Steep Slope

The Slope map of the free draining catchment is presented under **Table 1.5**.

Table 1.5: Area falling under different slope categories

Slope category (%)	Area (%)	Area (sq km)
0-10	39.5	26.368
10-20	22.85	15.254
20-30	16.85	11.248
30-40	20.8	13.885
Total	**100**	**66.755**

Figure 1.5: Slope Map of Catchment

1.8 Methodology Used for the Study

Superimposing topography, slope, soil and land use data/maps, a tentative estimation of erosion prone areas and landslides area in the catchment were made. The vulnerable and problematic areas were identified in different physiographic zones.

These data sets were used for preparation of the thematic maps, calculation of sediment yield index and Erosion Intensity Units.

Soil Loss Using Silt Yield Index (SYI) Method

- The Silt Yield Index Model (SYI), considering sedimentation as product of erosivity, erodibiity and

aerial extent was conceptualized in the All India Soil and Land Use Survey (AISLUS) as early as 1969 and has been in operational use since then to meet the requirements of prioritization of smaller hydrologic units within river valley project catchment areas.

- Methodology for the calculation of sediment yield index developed by All India Soil & Land Use Survey (Development of Agriculture, Govt. of India) was followed in this study.

Erosion Intensity and Delivery Ratio

- Determination of erosion intensity unit is primarily based upon the integrated information on soil characters, physiographic, slope, land-use/land-cover, litho logy and structure. This is achieved through super-imposition of different thematic map overlays. Based upon the field data collected during the field survey and published data, weightage value and delivery ration were assigned to each erosion intensity unit. The composite map for delineating different erosion intensity units was prepared through superimposition of the maps showing soil types, slope and land-use/land-cover. This thematic mapping of erosion intensity for entire catchment was done using the overlay and union techniques. Based on ground truth verification conducted during fieldwork and published data, weightage and delivery ratio was assigned to each erosion intensity units. The composite erosion intensity map was then superimposed on the drainage map with sub-watershed boundaries to evolve CEIU for individual sub-watershed.
- Each element of erosion intensity unit is assigned a weightage value. The cumulative weightage values of the erosion intensity units represent approximately the relative comparative erosion intensity within the watersheds. A basic factor of K=10 was used in determining the cumulative weightage values. The value of 10 indicated an equilibrium condition between erosion and deposition. Any value of K (10+X) is suggestive of erosion intensity in an ascending order whereas the value of K (10-X) is suggestive of deposition intensity in descending order.
- The delivery ratios were calculated for each composite erosion intensity unit. The delivery ration suggests the percentage of eroded material that finally finds entry into the reservoir or river/stream. Total area of different erosion intensity classes (composite erosion intensity unit) in each watershed was then calculated.
- The delivery ratio is generally governed by the type of material, soil erosion, relief length ratio, cover conditions, distance from the nearest stream, etc. However, in the present study the delivery rations to the erosion intensity units were assigned upon their distance from the nearest stream (being the most crucial factor responsible for delivery of the sediments) per the following scheme. The delivery ratio criteria adopted for the study is presented in **Table 1.6.**

Table 1.6: Delivery Ratio (DR) Criteria

Nearest Stream	Delivery Ratio (DR)
0-0.9 km	1.00
1.0-2.0 km	0.90
2.1-5.0 km	0.80
5.1-15.0 km	0.70
15.1-30.0 km	0.50

(ii) Sediment Yield Index & Prioritization of Sub-Watersheds

- The erosivity determinates are the climatic factors and soil and land attributes that have direct or reciprocal bearing on the units of the detached soil material. The relationship can be expressed as:

Soil erosivity = f (Climate, physiography, slope, soil parameters land use/land cover, soil management)

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

- Prioritization of smaller hydrological units within the vast catchments is based on the SYI of the smaller units. The boundary values of range of SYI values for different priority categories are arrived at by studying the frequency distribution of SYI values and locating the suitable breaking point. The watersheds/sub-watersheds are subsequently rated into various categories corresponding to their respective SYI values.

- The application of SYI model for prioritization of sub-watersheds in the catchment areas involves the evaluation of:
    - Climatic factors comprising total precipitation, its frequency and intensity
    - Geomorphic factors comprising land forms, physiography, slope and drainage characteristics
    - Surface cover factors governing the flow hydraulics
    - Management factors.
- The data on climatic factors can be obtained for various locations in the catchment area from the meteorological stations whereas the field investigations are required for estimating the other attributes.
- The various steps involved in the application of model are:
- Preparation of a framework of sub-watershed through systematic delineation
- Rapid reconnaissance surveys on 1:50,000 scale leading to the generation of a map indicating erosion-intensity mapping units.
- Assignment of weight age values to various mapping units based on relative silt-yield potential.
- Computing Silt Yield Index for individual watersheds/sub watersheds.
- Grading of watersheds/sub-watersheds into very high, high medium, low and very low priority categories.

- The area of each of the mapping units is computed and silt yield indices of individual sub-watersheds are calculated using the following equations:

Silt Yield Index

SYI = (Ai x Wi x Di) x 100/Aw; where I = 1 to n

Where

Ai = Area of ith (EIMU)

Wi = Weight age value of ith mapping unit

Di = Delivery ratio

n = No. of mapping units

Aw = Total area of sub-watershed

The SYI values for classification of various categories of erosion intensity rates were taken for the present study as:

	Priority Category	SYI Values
1.	Very High	>1300
2.	High	1200-1299
3.	Medium	1100-1199
4.	Low	1000-1099
5.	Very low	<1000

Accordingly, the sediment Yield Index has been calculated for sub-watersheds. The computation of SYI for each SWS is presented in **Table 1.7.**

Table 1.7: SYI and Priority Rating as per Erosion Intensity

Watershed code	Erosion intensity	Area (Ha)	Weightage	Area X Weightage	Delivery Ratio	Sediment Yeild	Sediment Yeild index	Priority
5D4	V.Severe	23.25	18	418.5	0.9	414.7335	15272.3486	Medium
5D4	Severe	48.95	16	783.2	0.9	776.1512		
5D4	Moderate	1466.15	14	20526.1	0.9	20341.365		
5D4	Slight	1961.95	12	23543.4	0.9	23331.509		
5D4	Negligible	3175.2	10	31752	0.8	31497.984		
	Total	**66755**	**-**	**-**	**-**	**76361.7432**		

1.9 Catchment Area Treatment Plan

There are mainly four categories of Land uses for which a proper treatment plan should be developed. First is the Agricultural Land, as this activity can never be eliminated, because the faulty practice results in heavy loss of fertile soil. Second, being open forestland for obvious conservation reasons. Third is scrub or degraded land, which contributes heavily to the silt load and possibilities exist to bring this area under pastures and other plantation to meet the local demand of fuel and fodder and thus decreasing the biotic pressure on the forests and leading to environment friendly approach of sustainable development. The fourth and most important category is Barren land because with practically no vegetal cover, the area produces huge amount of silt load. where in a few places soil conservation measures are required. For treatment of catchment area, the areas that require treatment have been delineated from the Composite Erosion Intensity Unit Map. The sum of weightages was reclassified as per the **Table 1.8** below to further subdivide the area as per the erosion intensity classes. The weightages for Land use,Slope & Soil were summed to get the Erosion Intensity Classes.Table 1.8: Erosion Intensity & Weightages

Erosion Intensity Class	Sum of weightages
Very severe (E5)	12 to 14
Severe (E4)	9 to 11
Moderate (E3)	6 to 8
Slight (E2)	4 to 5
Negligible (E1)	0 to 3

After exclusion of rocks and inaccessible terrain, only those areas which fall under very severe and severe erosion intensity category would be taken up for conservation treatment measures in very high priority category micro-watersheds, whereas in the rest of micro-watersheds belonging to other priority categories, the area falling under very severe erosion intensity class shall be taken for treatment with biological and engineering measures under the CAT Plan.

Considering the topographic factors, soil type, climate, land-use/land-cover in the catchment area following engineering and biological measures have been proposed to be undertaken with the aim to check the soil erosion, prevent/check siltation of reservoir and to maintain its storage capacity in the long run. The Aulliya Watershed Area Treatment Map is presented in **Figure 1.7** and the statistics are presented in **Table 1.9,**

Table – 1.9: Area of Low Sediment Index Watershed Wise

S. No.	Watershed	Very Severe	Severe	Moderate	Slight	Negligible	Water bodies	Total (in SqKm)
1	5D4	0.2325	0.4895	14.6615	19.6195	31.752	-------	66.755

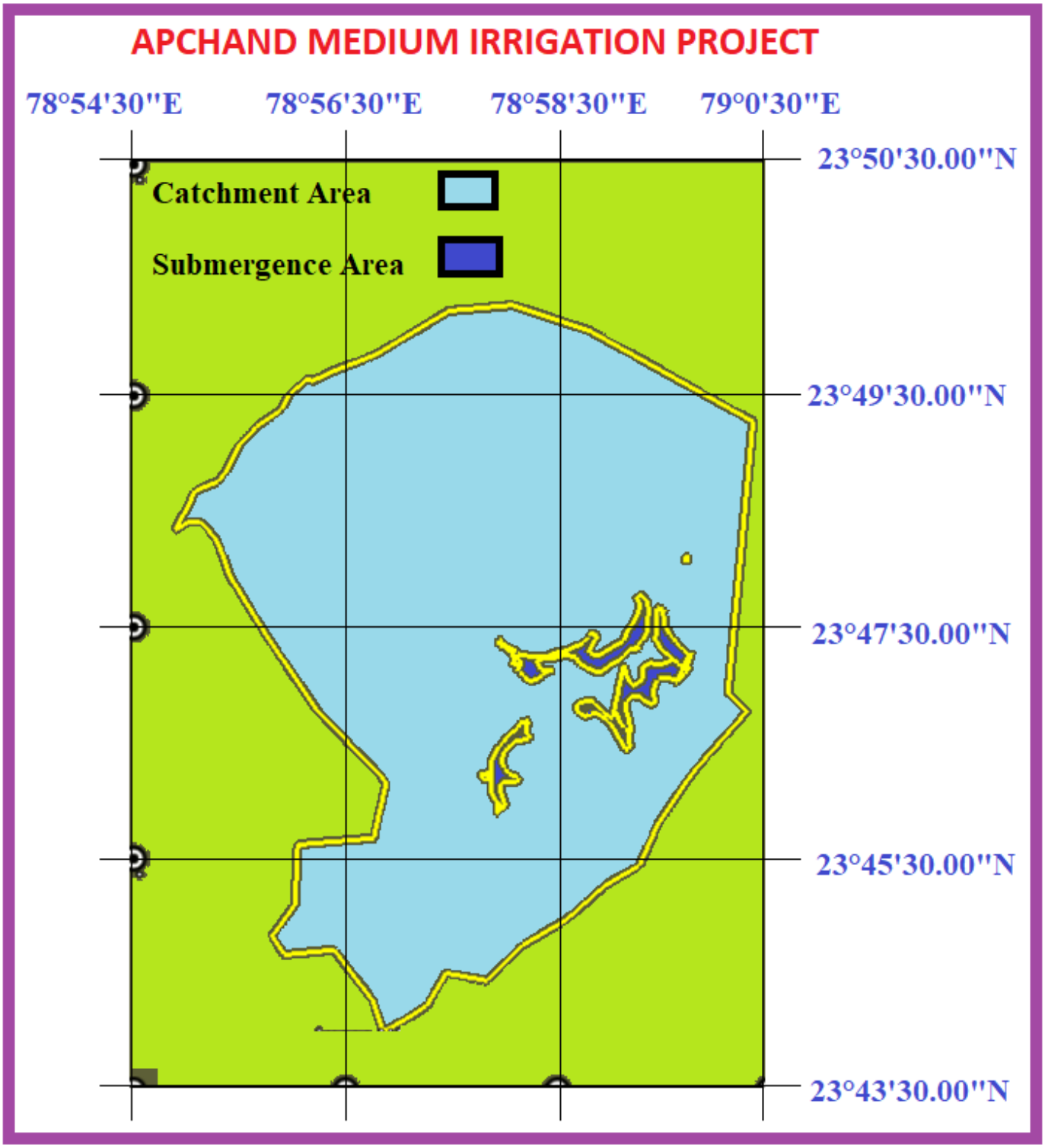

Figure – 1.7 (i) & (ii): Compartment wise Map for Apchand Medium Watershed Area Treatment

1.10 Treatment of Individual Sub-Watershed

There are mainly five categories of land uses for which a proper treatment plan should be developed. First is the agricultural land as this activity can never be eliminated. And, agriculture activities, if faulty, result in heavy loss of fertile soil. Second, is open forest land for conservation reasons Third is scrub or degraded land, which contributes heavily to silt load. Possibilities exist to bring this area under pastures and plantation to meet local demand of fuel and fodder and thus decreasing the biotic pressure on the forests leading to environment friendly approach of sustainable development. The fourth and most important category is barren land because with practically no vegetal cover the area produces huge amount of silt load. The fifth is dense forest land where a few places soil conservation measures are required.

In the present case, An area of 66755 ha falling under forest case would be taken up for conservation under the CAT plan within free draining catchment.

Considering the topographic factors, soil type, climate, land-use/land-cover in the catchment area following measures have been proposed to be undertaken with aim to check soil erosion, prevent/check siltation of reservoir and to maintain its storage capacity in the long run.

1.10.1 Activities to be

Undertaken Enrichment

Plantation

There are a few locations within forest in the catchment area where the crown density is poor and Plantation can be done to increase the patch density of crop.

Treatment of Pasture

The restoration and management of degraded pasture is a vital objective, both to provide sufficient habitat for spatial movement of the spillover species outside and within catchment area and to provide biological resources to the local populace. The pastures have their own unique significance in the geophysical, environmental and socio-economic set-up of the region. They are the prime and continual source of herbage for the wild herbivores which are prey base for carnivores, cattle, sheep and goats. These pastures are extensively grazed by the live stocks of the local people. The large scale and indiscriminate grazing of these pasture over a prolong time has left these pastures ominously degraded. The palatable grasses are no more than a few inches tall and the other related pasture species have also started showing signs of stress. Because of continuous and heavy pressure of grazing, barren patches have developed over vast areas and soil erosion is rampant in these pastures. There is an imperative need to address this abysmal and alarming situation immediately before these pastures are brought to such a condition, where, their rejuvenation becomes impossible. Owning to traditional rights of the grazers, it is difficult to restrict the number of animals grazing there. Thus, the only alternative left is to increase the

productivity of these pastures to cope with the grazing pressures. The situation warrants for a realistic survey and allied research in context of entire grazing issues and formulation of an action plan for corrective measures within the gambit of the state policy on the subject matter. Till such time the following recommendations are made for the management of pastures.

- Assessment of the carrying capacity of the pastures through surveys to ascertain allowable size of live stocks.
- Periodical field checking of the size of the herds mentioned in the permits to avoid misuse by some permit holders.
- Public awareness.
- Periodical closure of areas in pastures for the proliferation of seeds of desirable grass species.
- Implementation of rotational deferred grazing system to derive the advantage of early nutritive growth and rest period during the growing season.
- Interaction with the local people and so that a sort of social fencing could be achieved.

Nursery Support

In order the meet the huge requirement of saplings required under biological / bio-engineering measures and reservoir rim treatment new nursery has to be developed along with support to the existing nurseries which shall also augment the supply of saplings for the works proposed.

Table – 1.14: Basis for selection of catchment area treatment measures

Treatment measure	Basis for selection
Social forestry, fuel wood and fodder grassdevelopment	Near settlements to control tree felling
Contour Bunding	Control of soil erosion from agricultural fields.
Pasture Development	Open canopy, barren land, degraded surface
Afforestation	Open canopy, degraded surface, high soil erosion, gentle to moderate slope
Barbed wire fencing	In the vicinity of afforestation work to protect it from grazing etc.
Step drain	To check soil erosion in small streams, steps with concrete base are prepared in sloppy area where silt erosion in the stream and bank erosion is high due to turbidity of current.
Nursery	Centrally located points for better supervision of proposed afforestation, minimize cost of transportation of seedling and ensure better Survival.

Civil Structures

➢ Brush wood Check Dams and Retaining Walls

Brushes wood check dams are useful in arresting further erosion of depressions, channels, and gullies on the denuded landslides. In addition, retaining walls of stone masonry and RCC would be constructed to provide support at the base of threatened slopes.

➢ Slope Modification by Stepping or Terracing

The slope stability increases considerably by grading it. The construction of steps or terraces to reduce the slope gradient is one of the measures.

➢ Bench Terracing

The area under moderately steep slope i.e. between 10^0-15^0slopes would be subjected to bench terracing. The local people would be convinced to follow this type of terracing for comparatively better yield and with minimum threat to erosion. Moreover, in several habitations in the catchment such practices are already visible. While making bench terraces, care must be taken not to disturb the topsoil

by spreading earth from the lower terraces to higher terraces. The vertical intervals between terraces will not be more than 1.5m and cutting depth may be kept at 50 cm. The minimum average width of the terrace would be kept from 4 to 5 m to enable usage of prolong hinge. The shoulder bunds of 30 x 15 cm would also be provided. Staggered channels will drain off the excess water from the terraces.

➢ Gully Control-Check Dams

Gullies are mainly formed because physiographic, soil type, and heavy biotic interference in an area. The scouring of streams at their peak flows and sediment-laden run-off cause gullies. The gullies would be required to be treated with engineering/mechanical as well as vegetative methods. Check dams would be constructed in some of the areas to promote growth of vegetation that will consequently lead to the stabilization of slopes/area and prevention of further deepening of gullies and erosion. Diverse types of check dams would be required for different conditions comprising of different materials depending upon the site conditions and the easy availability of material (stones) at local level and transport accessibility. Generally, brush wood check dams are recommended to control the erosion in the first order basin/streams in upper reaches and dry random stone masonry check dam shall be provided in the lower reaches where discharge is higher. In such stream where discharge and velocity of flow are still higher gabion structure shall be provided. Lower down the sub-watershed, i.e., in the third order drainage silt retention dams in the form of gabion structure shall be provided.

- **Stream bank Protection**

Stream bank erosion is caused by variety of reasons such as destruction of vegetative cover, mass movement on unstable bank slopes, undermining of top portion of lower bank by turbulent flow and sliding of slopes when saturated with water. The Stream Bank Protection would include wire crate boulder spurs in two to three tiers depending upon the high flood level of the streams.

- **Contour Staggered Trenches**

Contour staggered trenches are mainly provided to trap the silt and runoff. This is also done to prepare a fertile base for plantation, in moderately steep to very, very steep slopes.

- **Landslide Control**

Rainfall pattern of the area and water seepage coupled with geological formation results in landslides. Water plays an important role in triggering of landslides and mass wasting processes along with other factors such as slope and nature of soil/land-cover/land-use. However, most of the landslides are caused by human negligence. Road construction, overgrazing of hill slopes, felling of trees for timber, fuel, and fodder and upslope extension of cultivation are some of main causes of landslides. Gabion structures shall be provided at the base of the land slide zones to control the toe erosion by water.

- **Provision for Forest Protection**

The need for rigorous watch and ward of the forest covered under the catchment area becomes more imperative in view of proposed new plantation under the CAT plan and due to increased human activity in the form of labour, who shall be engaged for forestry works. Thus, fire protection measures including construction and maintenance of fire lines, construction of check-posts, watch towers have to be undertaken. Besides these construction / repair of forest boundary pillars shall also be carried out. The forest staff shall have to be properly equipped with modern utility gadgets like walky-talky, GPS and fire- fighting equipment's.

1.11 Cost estimation for treatment in Forest area comes under Catchment Area

Total Catchment Area = 66.755 Sqkm
Total Forest area lie within C.A. = 11.610 Sqkm
Name of Forest Division:- South Sagar Dist. Sagar
Daily Wages Rate:- Rs. 342/- (Year 2021-22)

Cost Abstract (For 1Hact.)

(Estimate is prepared on basis of approved estimate of Apchand Medium Irrigation project CAT plan.)

Sl. No.	Description of Work	Unit	Qty.	Rate in Mandays per unit	Total Amount (Rs.)
1	Survey of Area with Cleaning in 3 M wide strip & Marking over tree lie within 3m strip and fixing of pegs on 200-200 Meter interval with making of frame (Khancha) & writing over them.	Hact.	1	0.45	153.90/-
2	Excursion in area & Preparation of Catchment area treatment plan	Hact.	1	0.25	85.50/-
4	Construction of Checkdam by Collection of loose Boulders spread over surface of forest area	1 Cum/ Hact.	1	1.95/cum	666.90/-
5	Making of Contour Trench / Contour Bund in Forest Area	15 RM/ Hact.	1	0.10/RM	513.00/-
6	Collection of Seeds / Purchase	3kgs./ Hact.	1	100/- per Kg.	300.00/-
7	In Second (II) Year, Sowing of Seeds in Check dam/Contour Trench/Contour Bund	Per Hact.	1	1.00	342.00/-
10	Other Miscellaneous Exp.		1 Hact.	Lumpsum	70.00/-
			Total Amount		**2131.30/-**

Total Expenditure for 1 Hactare = Rs 2131.30/-
Therefore amount required for 66755 Hactare = Rs.1.42,27,493.00/-

Say 142.27 Lakhs

(Bhim Singh Mohaniya)
Executive Engineer
Water Resources Division No1 Sagar