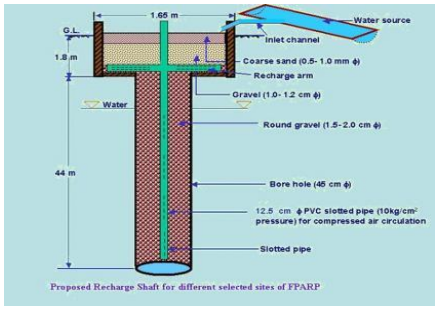
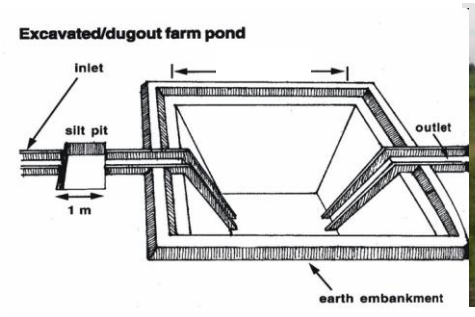
Plan on Artificial Recharge to Groundwater and Water Conservation in Erode East Firka, Erode Taluk, Erode District, Tamil Nadu





By

Central Ground Water Board
South Eastern Coastal Region
RajajiBhawan, Besant Nagar
Chennai

Content

AT GLANCE	
Name of Firka	Erode East
Taluk	Erode
District	Erode
State	Tamil Nadu
Total area in Sq. Km	68.991
Total Area Suitable for Recharge in Sq.Km	68.991
Lat. & Lon.	11°16'22" to 11°24'4.5" & 77°40'26" to 77°46' 39".
Rainfall	927 mm
Monsoon	718 mm
Non- Mon soon	208 mm
Geology	Crystalline metamorphic gneiss complex comprising Hornblende gneiss
WATER LEVEL	
Pre – Monsoon (May -2015)	1.65 to 20.07 m bgl.
Post - Monsoon (Jan_2016)	1.00 to 14.90 m bgl.
GROUND WATER RESOURCES ESTIMATION	
Replenish able ground water resources	15.05 MCM
Net ground water available	13.55 MCM
Ground water draft for irrigation	6.18 MCM
Groundwater draft for domestic & industrial water supply	10.17 MCM
Total ground water draft	16.35 MCM
Stage of ground water development (%)	121 %
Uncommitted surface runoff available for the Firka	7.43 MCM
Total volume of weathered zone	8.28 MCM
Total volume available for recharge	12.42 MCM
ARTIFICIAL RECHARGE /CONSERVATION MEASURES	
Structures Proposed (tentative) Masonry Check dam Nalla Bund Revival, repair of pond, tanks with recharge shaft Only shafts in Bigger tanks Farm Pond	 03 14 04 03 100 Unit
Improving Water Efficiency/ Saving (Micro irrigation system for 100 ha)	0.70 MCM
Expected recharge	1.00 MCM
Excepted total groundwater recharge/ saving	1.70 MCM
Tentative total cost of the project	3.64
Expected raise in water level by recharging/saving.	1.62 m

Plan on Artificial Recharge to Groundwater and Water Conservation in Erode East firka, ErodeTaluk, Erode district, Tamil Nadu

1. Introduction

India is the largest user of groundwater in the world. Food grain security of the country is largely dependent on water resources and groundwater resources play major role in irrigation sector. Imprints of Over-Exploitation on groundwater resources are being observed as steep deepening of water levels, drying of shallow groundwater abstraction structures, ingress of salinity in fresh aquifers etc. which signal towards taking necessity of emergent action for artificial recharge and rainwater harvesting by utilizing surplus runoff and maintaining groundwater resources at sustainable stage.

In Tamil Nadu dependency on groundwater has increased many folds during the recent years and the groundwater extraction for irrigation, domestic and industries have resulted in lowering of water levels, long-term water level declining trend and even drying up of wells. In order to regulate the groundwater development, Central Ground Water Board in association with State Ground Water Departments has computed Dynamic Groundwater Resources and categorized blocks as Over Exploited, Critical, Semi Critical and Safe.

Out of 1129 firkas (assessment units) in Tamil Nadu the groundwater situation in 374 firkas overexploited, 48 firkas critical, 235firkassemi-critical, 437 firkas safe and 35 firkas are saline. Various measures such as rainwater harvesting, artificial recharge and water use efficiency are successfully practiced by some NGOs, Central and State govts., which need replication at larger scale in close coordination with State govt. agencies and stakeholders so that capacity building of state implementing agencies and awareness of stakeholders towards artificial recharge and rainwater harvesting can be made.

2. Objectives of the scheme

Objectives of the proposed scheme are

- To upscale recharge activities, supplement additional groundwater resources by harvesting surplus runoff, sustainability of groundwater resources at shallow depths
- Recovery of over-exploited groundwater areas by implementing artificial recharge measures in groundwater stress areas.
- Conservation, development and sustainable management of natural resources including their use.

3. Study area details

3.1 Location

The total area of Erode East firka is 68.99sq.km and Erode East firka lies between North latitudes 11°16’22 “to 11°24’ 5” and east longitudes 77°40’26”to 77°46’ 39”. Location map of Erode East firka is given in Figure 1.

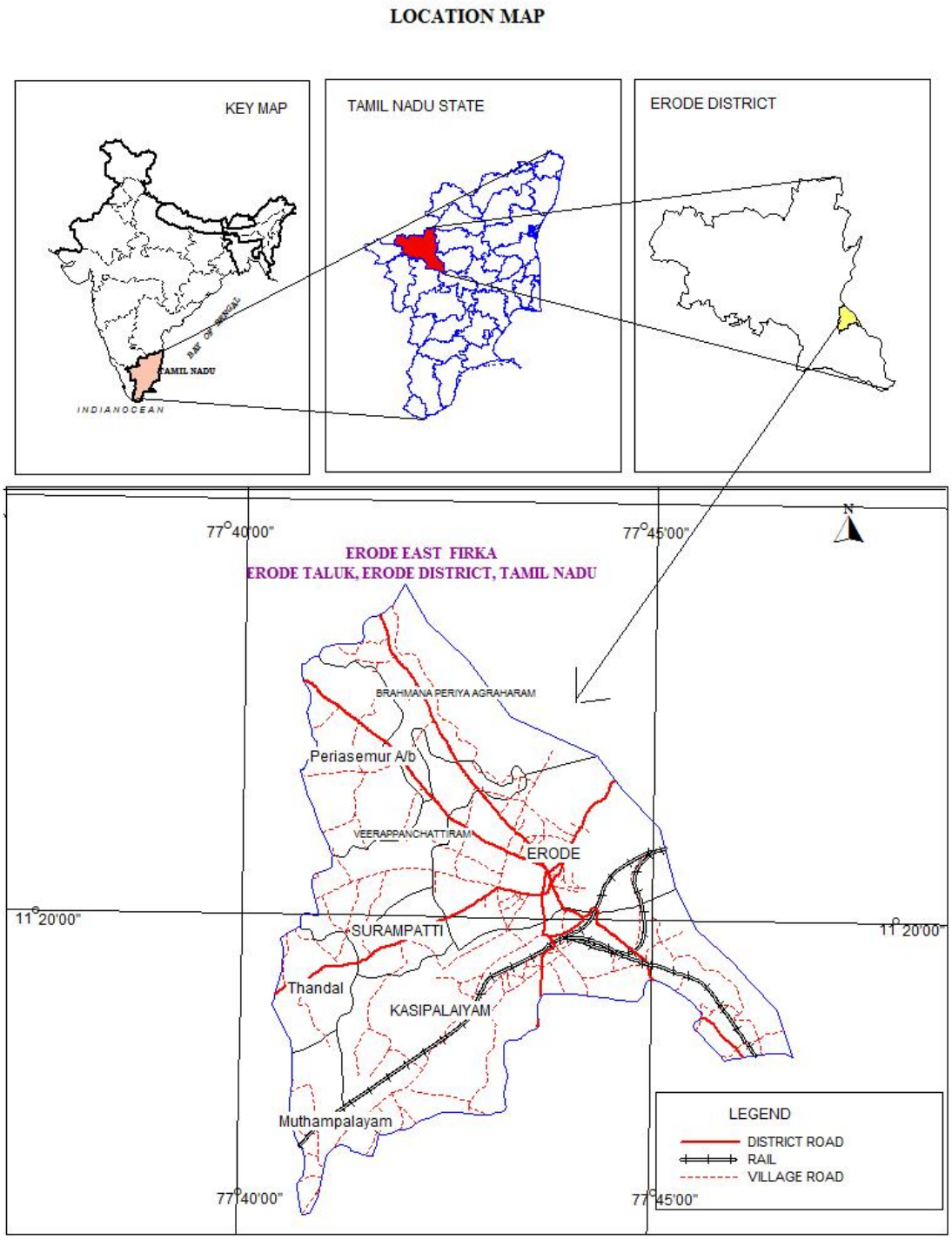


Figure 1. Location map of Erode East firka

3.2 Geomorphological Set up

Geomorphologically, the area consists of pediment and inselberg. Majority of the area is covered by pediment dissected /un-dissected formation. (*Source: IRS, Anna university, Chennai Tamil Nadu). Geomorphological map prepared using IRS- 1D data on 1: 50,000 scale and units are as per NNRMS standard*s. The various geomorphological units with its % of coverage area are given in table 1. and shown in figure 2.

Table 1. Various geomorphological units with its % of coverage area in Erode East firka

LANDFORMS	% of Area
PEDIMENT DISSECTED/UNDISSECTED	50.81
MODERATE	18.65
PEDIMENT-INSELBERG COMPLEX	2.82
SHALLOW	27.72

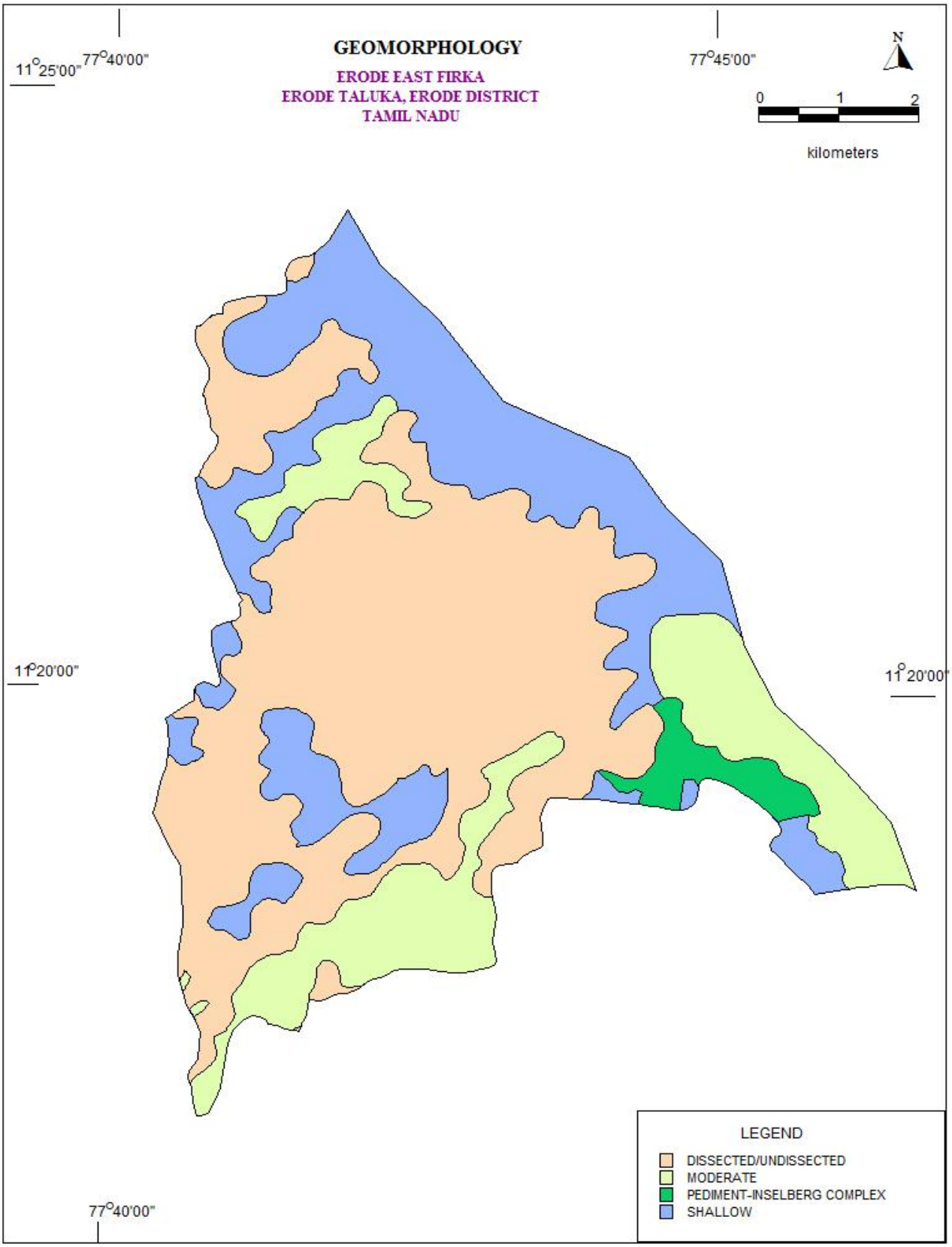


Figure 2. Geomorphology of Erode East Firka

3.3 Land use and soil

The land use pattern of the Erode East Firka is given in figure 3. Predominantly the most of the area is characterised by the town and cities and flowed by the wet crop, plantation and dry crop (i.,e agricultural field)and accounts for 40 % of the total area of the firka (Source: IRS, Anna university, Chennai Tamil Nadu).

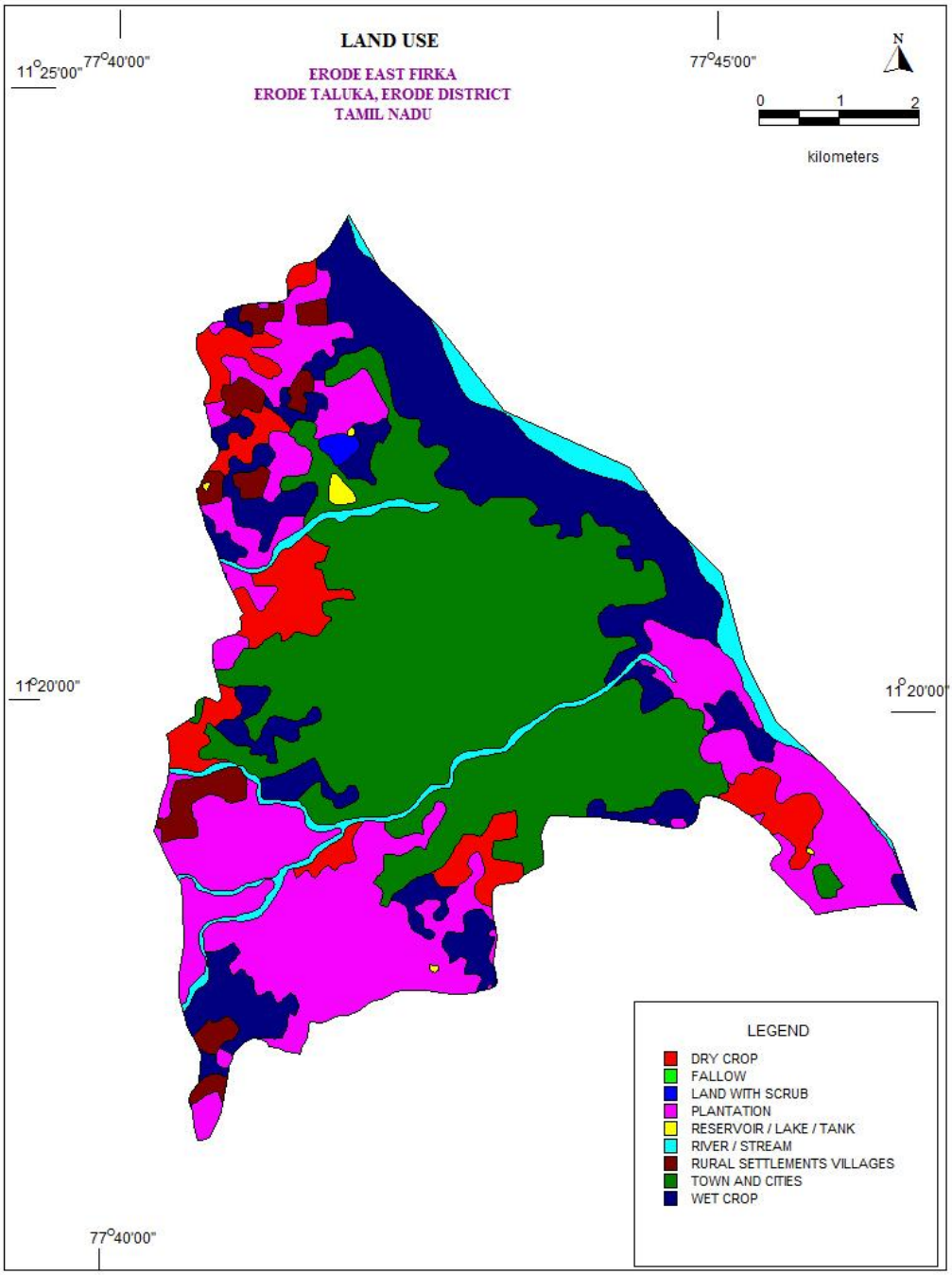


Figure 3.Landuse map of Erode East Firka

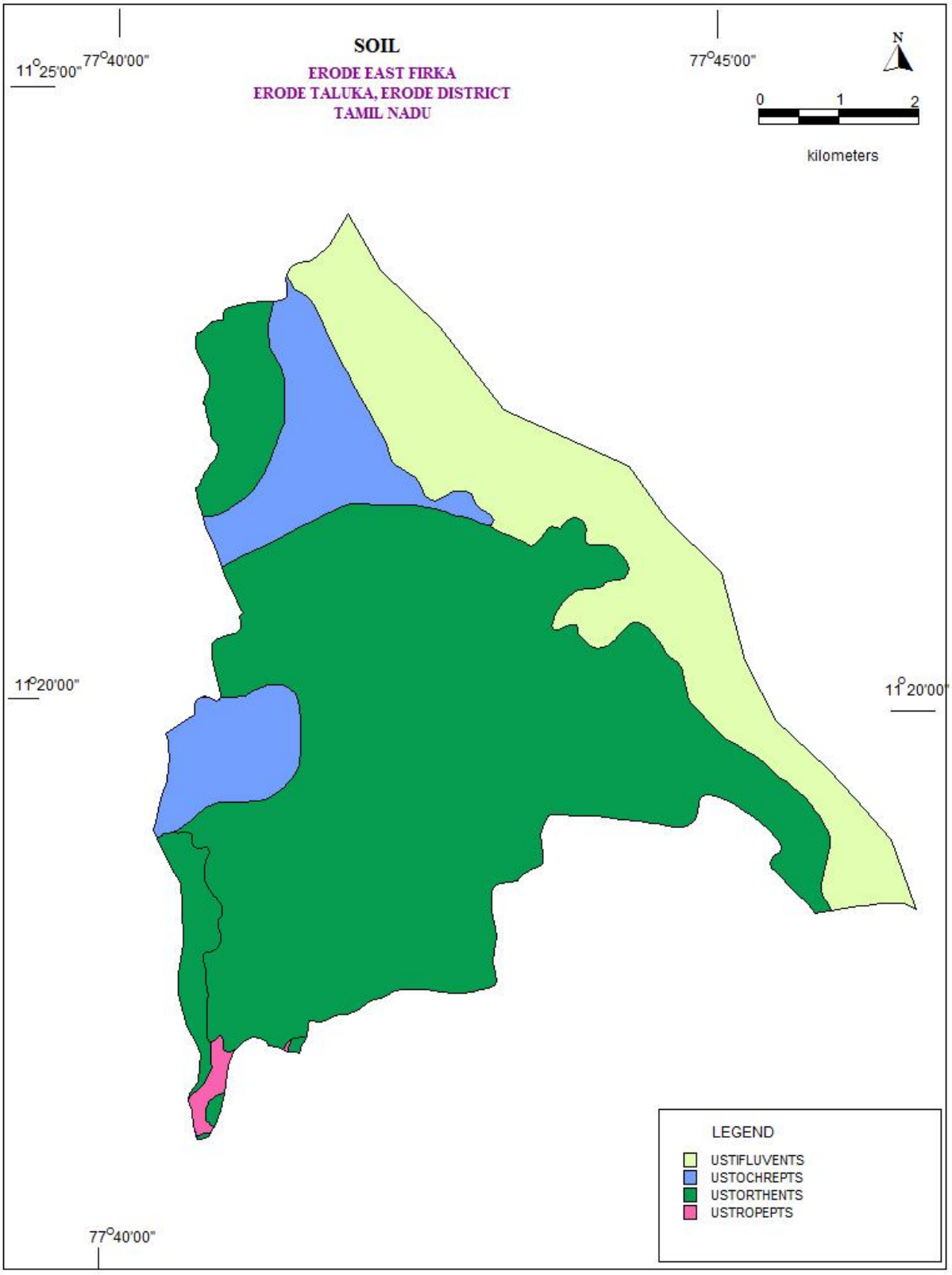


Figure 4. Soil map of Erode East Firka

3.4 Drainage

The entire Firka area falls in the Cauvery river basin. Minor streams are flowing and only seasonal floods inundate the basins. Basin sub soil water is used to irrigate the lands. Tanks and surface water bodies are spread over the entire firka. Canals flows through the firka, for irrigation. The drainage pattern is the dendritic and sub- dendritic. The drainage map of Erode East firka is given in Fig 5.

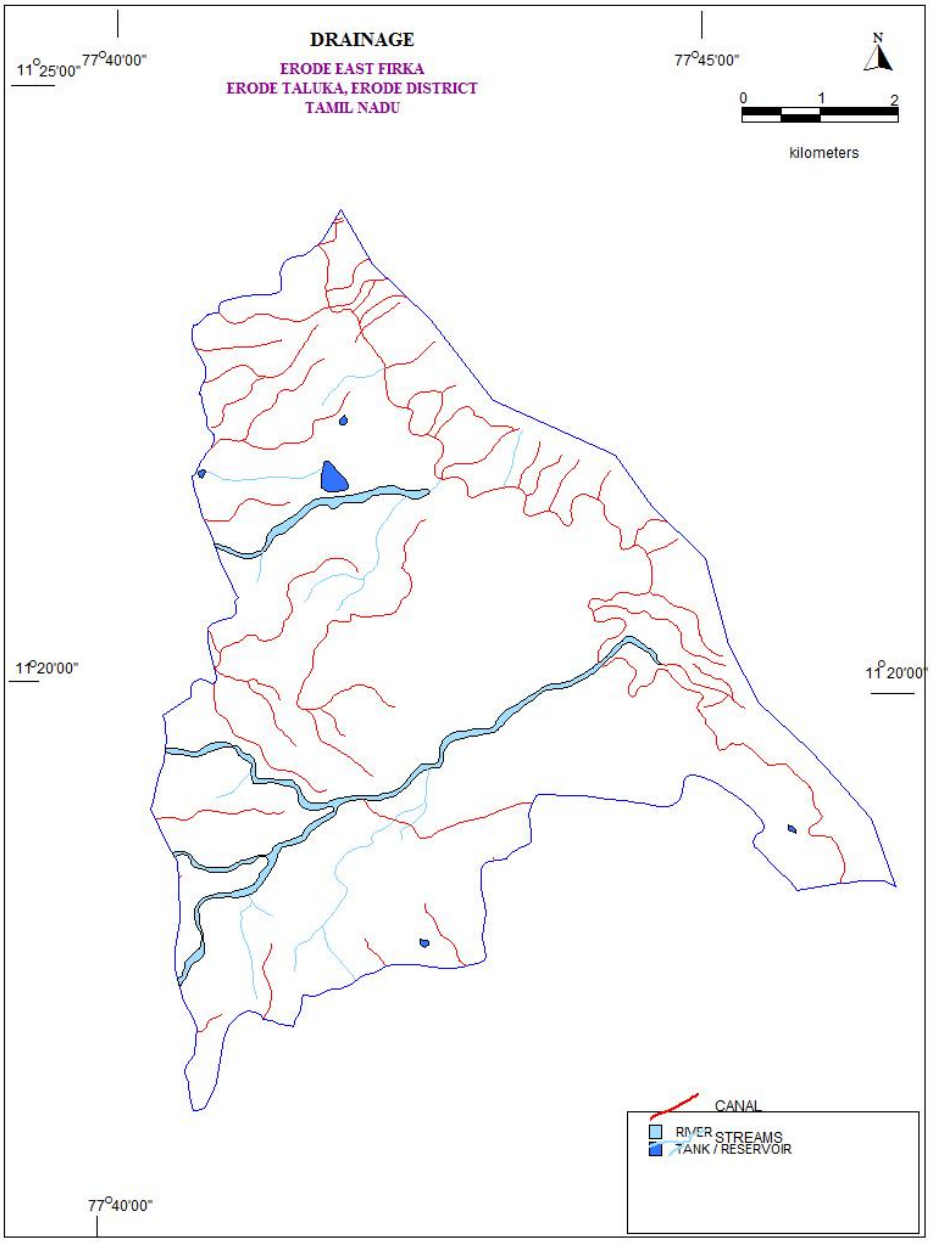


Figure 5.Drainage map of Erode East firka

3.5 Rainfall

Erode East area falls under tropical climate with temperature in the summer months of March to May. The average temperature varies from 19 to 35° C. The humidity is also high in the order of 70%. The wind speed is high during the months of July and August. The wind speed ranges from 7.4 to 12.6 km/hr, which increases from 100 to 120 km/hr during cyclone period. Erode East firkas receives rainfall from southwest monsoon (June – September), northeast monsoon (October – December) and non-monsoon periods (January – May). The area receives the major rainfall from northeast monsoon. Rainfall is generally heavy during low-pressure depressions and cyclones during the northeast monsoon period. The normal annual rainfall is 927 mm.

Taluk	Name of Firkas	Area in sq.km	Monsoon rainfall (Jun to Dec) In m	Non monsoon rainfall (Jan – May) In m	Total Rainfall In m
Erode	Erode East	68.991	0.718	0.208	0.927

3.6 Hydrogeology

The entire firka is underlain by the crystalline metamorphic gneiss complex consisting Hornblede –Biotite gneiss, Epidote-Hornblede gneiss and Magnesite Quartzites.Ground water is occurring in phreatic conditions in weathered and fractured gneiss rock formation. The weathering is highly erratic and the depth of abstraction structures is controlled by the intensity of weathering and fracturing. Large diameter dug well is more common ground water abstraction structures in the area. The diameter of the dug well is in the range of 3 to 10 m and depth of dug wells range from 6 to 18 m bgl. The dug wells yield up to 1 lps in summer months and few wells remains dry. The yield is adequate for irrigation for one or two crops in monsoon period.

The depth of wells varies from 6.64 to 17 m bgl. The present water levels in tn the firka is in the range of 1.7 to 14.90 m bgl during pre- monsoon (May 2015) and from 1.00 to 20.07 m bgl during post monsoon (January 2016). The hydrogeological map of Erode East firka is given in Figure 6.Decadal mean water level ofpre-monsoon and post monsoon are given in fig 7a & b. The decadal maps reveal that, mean water level during pre-monsoon in majority area is < 6 m bgl likewise during post monsoon majority part is under < 5m ground water level.

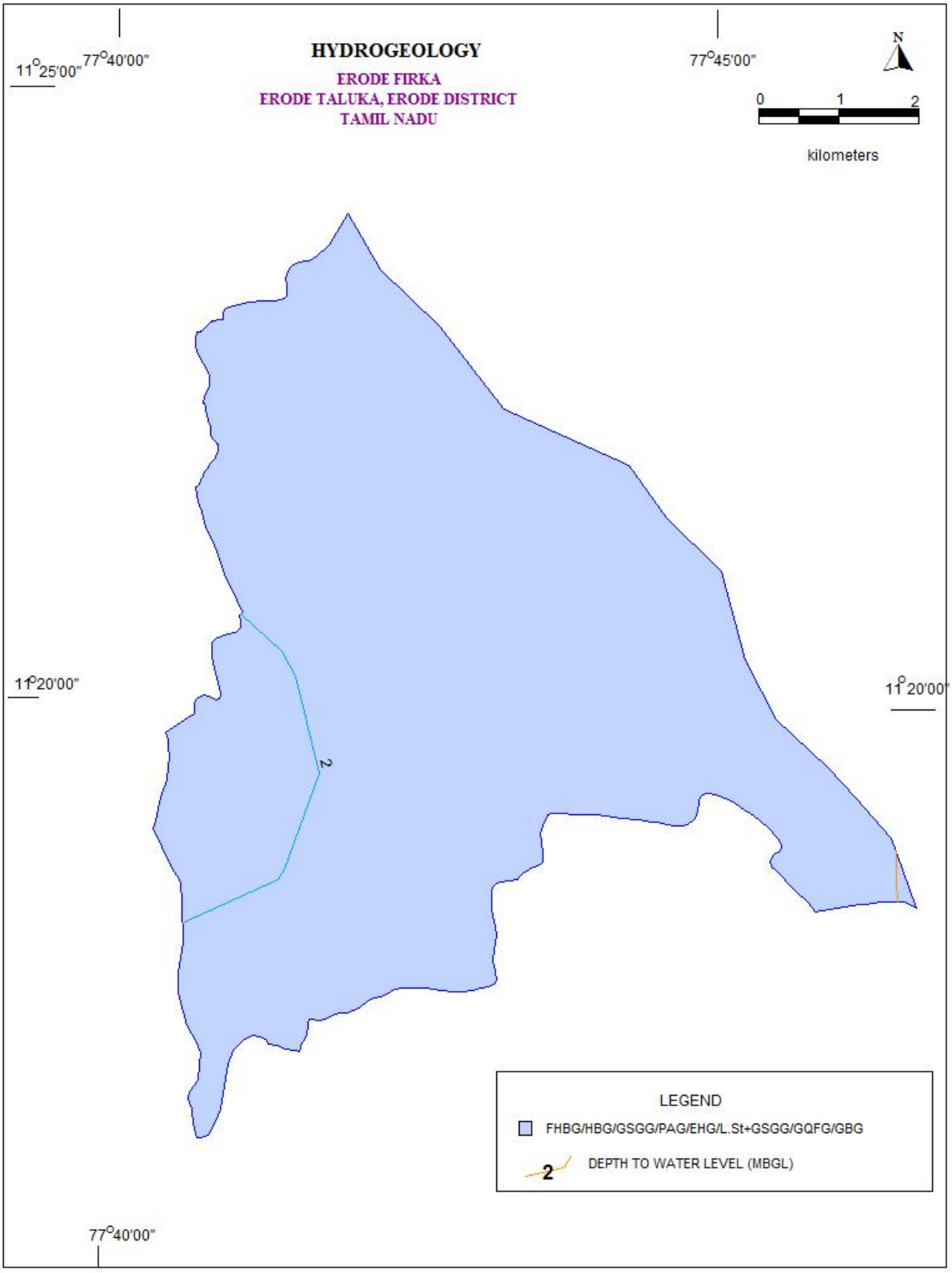


Figure 6 - Hydrogeological Map of Erode East firka

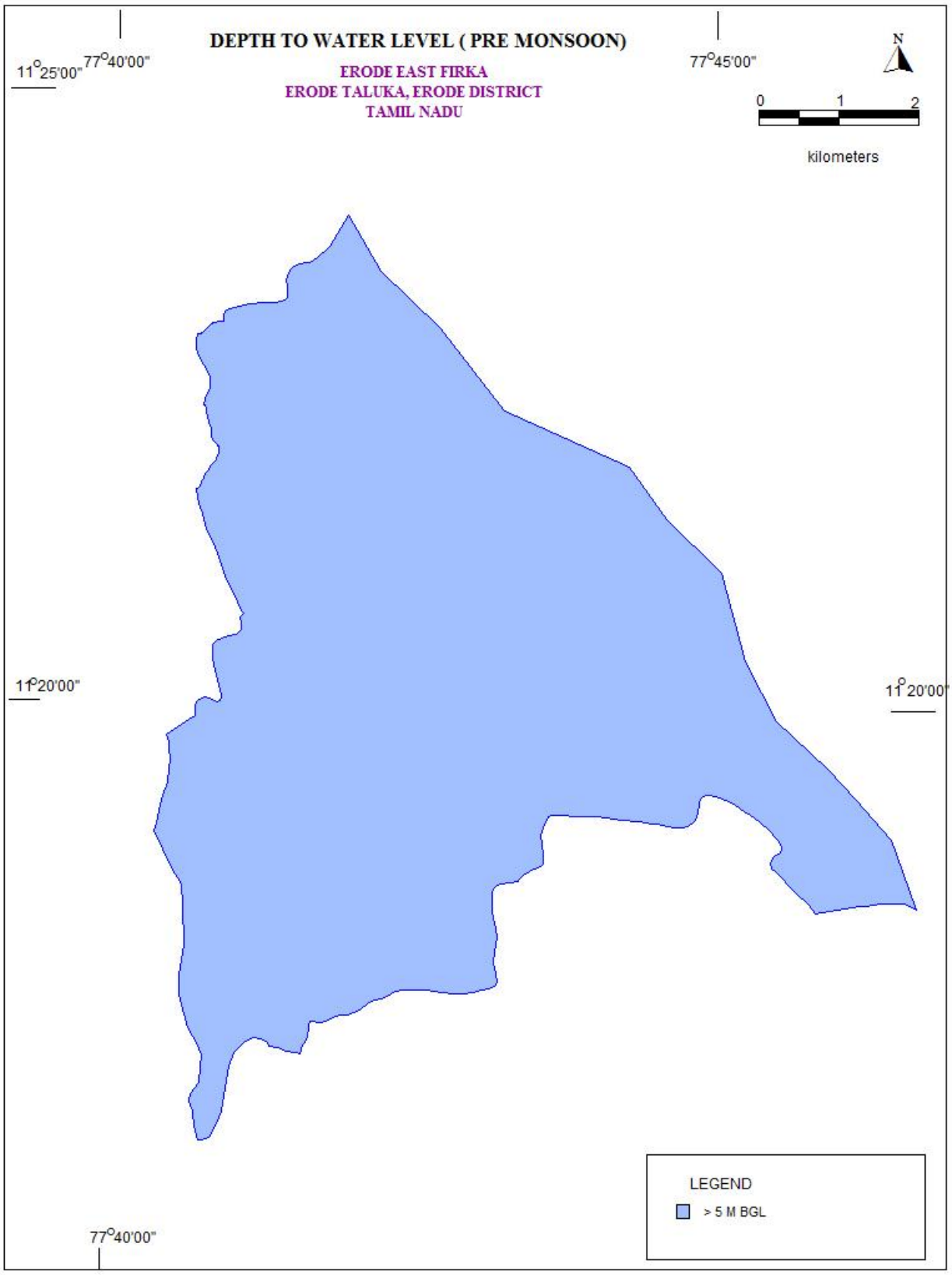


Figure 7a. Pre -monsoon (decadal)water level in Erode East firka

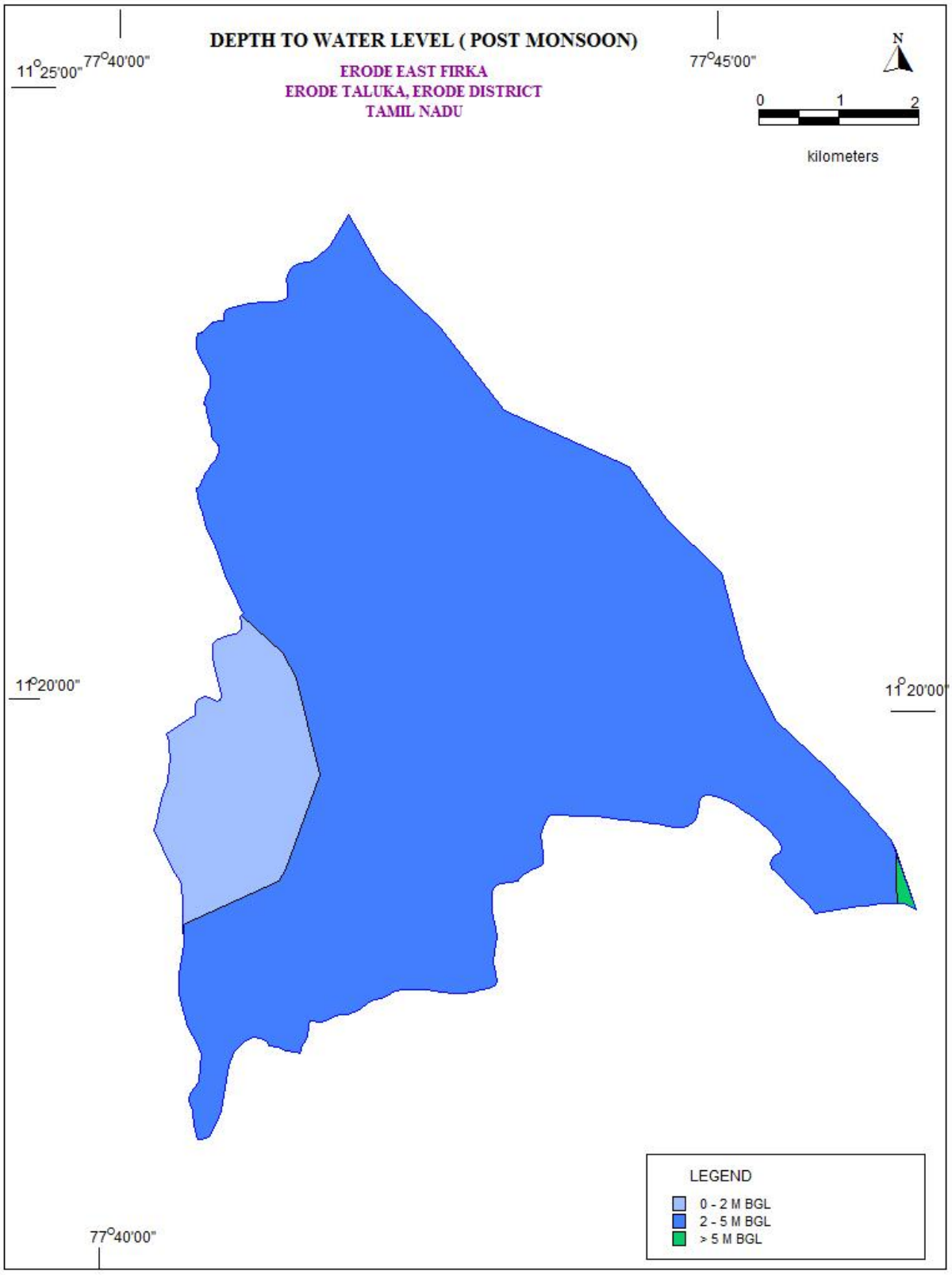


Figure 7b. Post-monsoon (decadal) water level in Erode East firka

3.7 Dynamic Ground water Resources

The ground water resources have been computed jointly by Central Ground Water Board and State Ground Water Resources Data Centre (PWD, WRO, Govt. of Tamil Nadu) as on 31st March 2011. The computation has been done using GEC1997 methodology. The salient features of the computations are furnished in table 2.

Table 2. Dynamic Ground water resources estimation of Erode East firka

Firka	GW WORTHY AREA	REPLENISHABLE GROUND WATER RESOURCES	NET GROUND WATER AVAILABLE	GROUND WATER DRAFT FOR IRRIGATION	GROUNDWATER DRAFT FOR DOMESTIC & INDUSTRIAL WATER SUPPLY	TOTAL GROUND WATER DRAFT	STAGE OF GROUND WATER DEVELOPMENT (%)	CATEGORY
	(Sq.Km)	(In MCM)					%	
Erode East	68.991	15.05	13.55	6.18	10.17	16.35	121	OVER EXPLOITED

4. Spatial Data Integration

The potential area for groundwater recharge is highly influenced by Geology, Geomorphology, Land use /land cover, Drainage, Surface Water Body, Weathered Thickness and first fractured Depth in the area. In order to ascertain the suitable area for groundwater recharge in firka, spatial data integration of have been attempted using index overlay model in GIS environ. In this model,above seven layers have been integrated byassigning weightage for the theme having scale of 1-100 and sub-classes of the theme between 1 to 10 scales.The resultant map has been reclassified into four classes(High-low integrated values) indicating the suitable area for artificial recharge and given in fig-7 and described below.

ZONE	% OF AREA COVERAGE	SIGNIFICANCE*
Very high	43	Suitable for all major recharge structures like Percolation pond and stop dam, check dam etc.,
High	44	Suitable for all major recharge structures like stop dam, check dam etc.,
Moderate	11	Suitable for all major recharge structures like earthen check dam, Boulder check dam and Nala bund etc.,
Poor	2	Hilly/Forest /Catchment area

*However, the field verification is required to confirm above potential area for groundwater recharge.

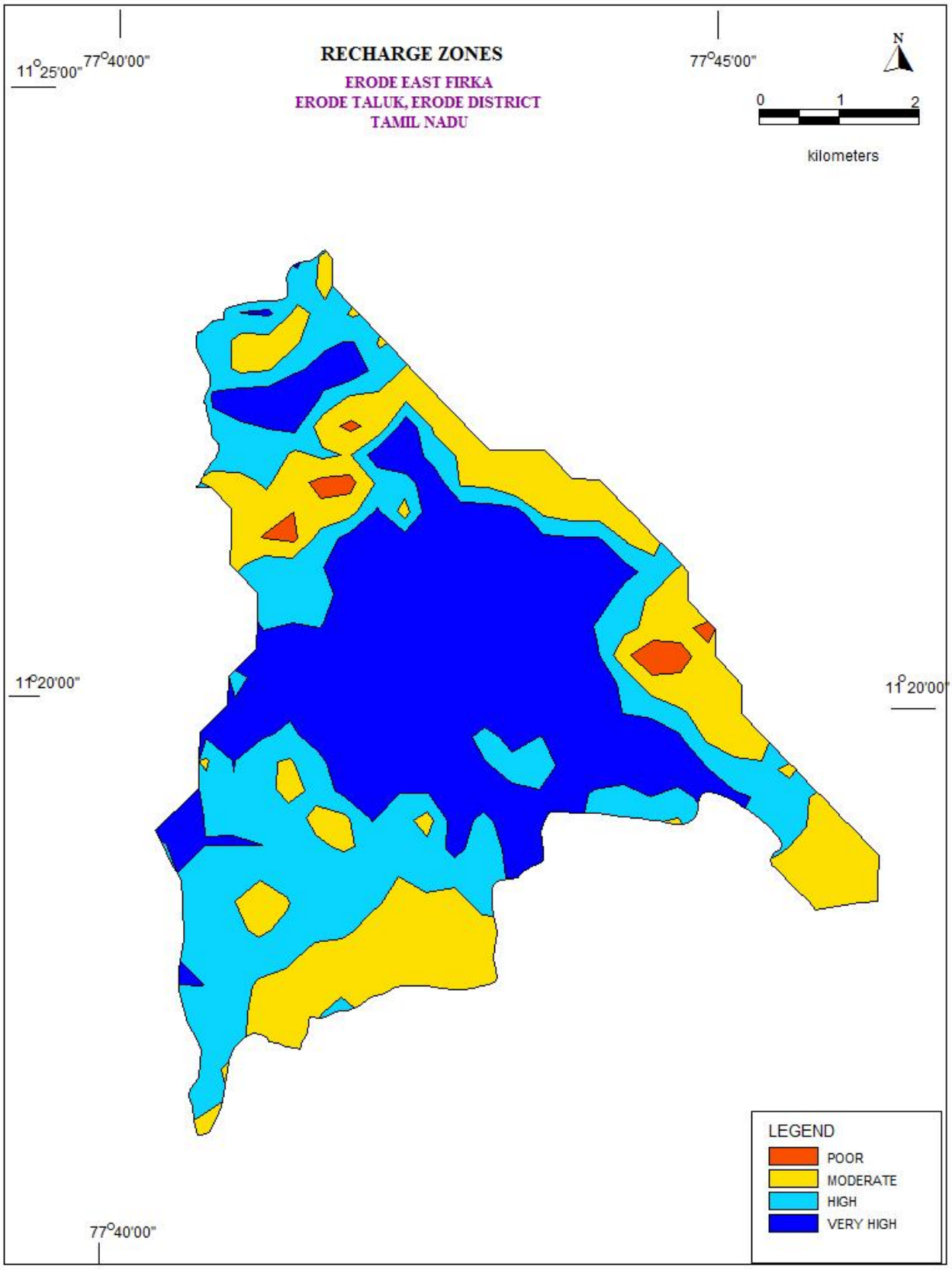


Figure 7 Showing the recharge worthy area Erode East firka

5. Planning for groundwater recharge /conservation

5.1 Justification of the artificial recharge & conservation measures

- The Erode East firkas is with high stage of groundwater development i.e, 121 % and with sufficient amount of uncommitted surface runoff/flow of 7.43 MCM.
- The total weathered zone available beneath the ground in the firka is 8.29 MCM. Further there is scope of 12.42 MCM of volume available for recharge considering seasonal water fluctuation.
- However, most of the ground water developments for domestic purposes are met through bore wells only. Hence, there is sufficient scope of recharge.
- Model generated in the Erode East areas reveals that 92 % of areas are suitable for recharge.
- In Erode East firka more than 70 % area is characterised by the town and cities, there is sufficient scope for the water conservation measures i.e roof top rain water harvesting.

5.2 Availability of surplus surface water for artificial recharge or conservation

The uncommitted surface flow for Erode East firka is estimated as per the norms followed by State Ground & Surface Water Resources data centre, PWD, Taramani, Chennai (Aug 2015). The available of surplus surface water for Erode East firka is 7.43 MCM.

5.3 Proposed interventions including tentative location of artificial recharge /conservation measures

On basis of above description the following three type of approach have been made to propose artificial recharge or conservation structures.

a. Artificial recharge
b. Water conservation measure
c. Water Efficiency

5.3.1 Artificial recharge

The details of artificial recharge structure proposed along with justification are given below.

5.3.1.1 Check dam/Nala bund

Erode East firka area is covered by the seasonal nallahs/drains which carry heavy discharge during monsoon period. As per the integrated model prediction around 80 % of the firkas areas are suitable for these structures. It is proposed to construct 3 Check dam and 14 Nala bunds. The tentative location of these 17 ARs are given below and shown in **Plate 1**. The size and location of these structures are tentative and detailed field survey is essential to ascertain the exact size and location.

Tentative location of proposed 3 Check dam in Erode East firka

S. NO.	LONGITUDE	LATITUDE	TYPE OF ARS
1	77.704399000	11.349896000	Check Dam
2	77.712468000	11.319215000	Check Dam
3	77.698630000	11.300049000	Check Dam

Tentative location of proposed 14 Nalla bund in Erode East firka

SL.NO	LONGITUDE(DD)	LATITUDE (DD)	TYPE OF ARS
1	77.699530000	11.362832000	Nala Bund
2	77.707753000	11.358179000	Nala Bund
3	77.686360000	11.361663000	Nala Bund
4	77.701632000	11.376455000	Nala Bund
5	77.724116000	11.365714000	Nala Bund
6	77.696682000	11.347475000	Nala Bund
7	77.684562000	11.318191000	Nala Bund
8	77.701172000	11.345633000	Nala Bund
9	77.710608000	11.314401000	Nala Bund
10	77.686836000	11.298135000	Nala Bund
11	77.704643000	11.311626000	Nala Bund
12	77.694236000	11.296151000	Nala Bund
13	77.699685000	11.294900000	Nala Bund

5.3.1.2. Revival, repair of water bodies

The existing ponds and tanks in loose their storage capacity as well as the natural ground water recharge through these water bodies has also become negligible due to siltation and encroachment by farmers for agriculture purposes. There are several such villages where ponds/ tanks are in dilapidated condition. These existing village tanks which are normally silted and damaged can be modified to serve as recharge structure in case these are suitably located to serve as percolation tanks. Through desilting, coupled with providing proper waste weir, the village tanks can be converted into recharge structure. Several such tanks are available in the area which can be modified for enhancing ground water recharge. Studies, however, are needed to ascertain whether the village tanks are suitably located to serve as recharge structures. The locations of about 4 existing ponds/tanks have been identified with latitude and longitude given below and marked on Plate 1. Three only shafts are proposed inside the only larger tank.

Tentative location of proposed de-siltation of pond/tanks with recharge shaft in Erode East firka.

Sl.NO	LONGITUDE	LATITUDE	STRUCTURE	ACTION
1	77.712445000	11.297018000	TANK / RESERVOIR	DESILTTAION AND RECHARGE SHAFT
2	77.764321000	11.314105000	TANK / RESERVOIR	DESILTTAION AND RECHARGE SHAFT
3	77.697811000	11.361273000	TANK / RESERVOIR	DESILTTAION AND RECHARGE SHAFT
4	77.699552000	11.361493000	TANK / RESERVOIR	DESILTTAION AND RECHARGE SHAFT*
5	77.697385000	11.363563000	TANK / RESERVOIR	DESILTTAION AND RECHARGE SHAFT*
6	77.679558000	11.362509000	TANK / RESERVOIR	DESILTTAION AND RECHARGE SHAFT*
7	77.699795000	11.370301000	TANK / RESERVOIR	DESILTTAION AND RECHARGE SHAFT

* only shafts in larger tank

5.3.2 Water conservation measure

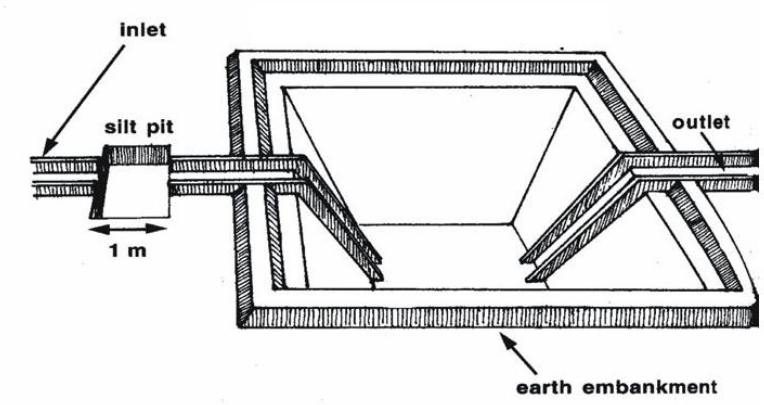
5.3.2.1 Farm Pond

A farm pond is a large dug out in the earth, usually square or rectangular in shape, which harvests rainwater and stores it for future use. It has an inlet to regulate inflow and an outlet to discharge excess water. The pond is surrounded by a small bund, which prevents erosion on the banks of the pond. The size and depth depend on the amount of land available, the type of soil, the farmer's water requirements, the cost of excavation, and the possible uses of the excavated earth. Water from the farm pond is conveyed to the fields manually, by pumping, or by both methods.

Advantages of Farm Ponds

- They provide water to start growing crops, without waiting for rain to fall.
- They provide irrigation water during dry spells between rainfalls. This increases the yield, the number of crops in one year, and the diversity of crops that can be grown.
- Bunds can be used to raise vegetables and fruit trees,thus supplying the farm household with an additional source of income and of nutritious food.
- Farmers are able to apply adequate farm inputs and perform farming operations at the appropriate time, thus increasing their productivity and their confidence in farming.
- They check soil erosion and minimize siltation of waterways and reservoirs.
- They supplies water for domestic purposes and livestock
- They promote fish rearing.
- They recharge the ground water.
- They improve drainage.
- The excavated earth has a very high value and can be used to enrich soil in the fields, levelling land, and constructing farm roads

As per the Landuse classification of the firka, majority of the area is covered by the agricultural field. Hence it is proposed to construct 100 farm ponds as per the specification of AED, Govt. of Tamil Nadu (30 x 30 x 1.5 m).



5.3.2.2. Micro Irrigation System (Sprinkler/ drip/ HDPE pipes)

Micro irrigation is defined as the frequent application of small quantities of water directly above and below the soil surface; usually as discrete drops, continuous drops or tiny streams through emitters placed along a water delivery line

In flood/furrow irrigation method more than 50% of applied water is wasted through seepage to deeper level, localized inundation causes loss through evaporation and it leaches out the nutrients from the plant. While through drip & sprinkler irrigation wastage of irrigational water could be minimized. The studies on different crops, has revealed that irrigation water is saved drastically. The conveyance losses (mainly seepage & evaporation) can be saved up to 25 to 40% through utilization of HDPE pipes. Initially the scheme is proposed to be implemented in worst affected areas showing deepest water levels and significant declining trends.

It is proposed to take up micro irrigation system in 100 ha. The cost estimation for this component has been taken from SOR of Agricultural Engineering Department (AED), Govt. of Tamil Nadu. Tentative locations of proposed micro irrigation are shown in Plate 1.

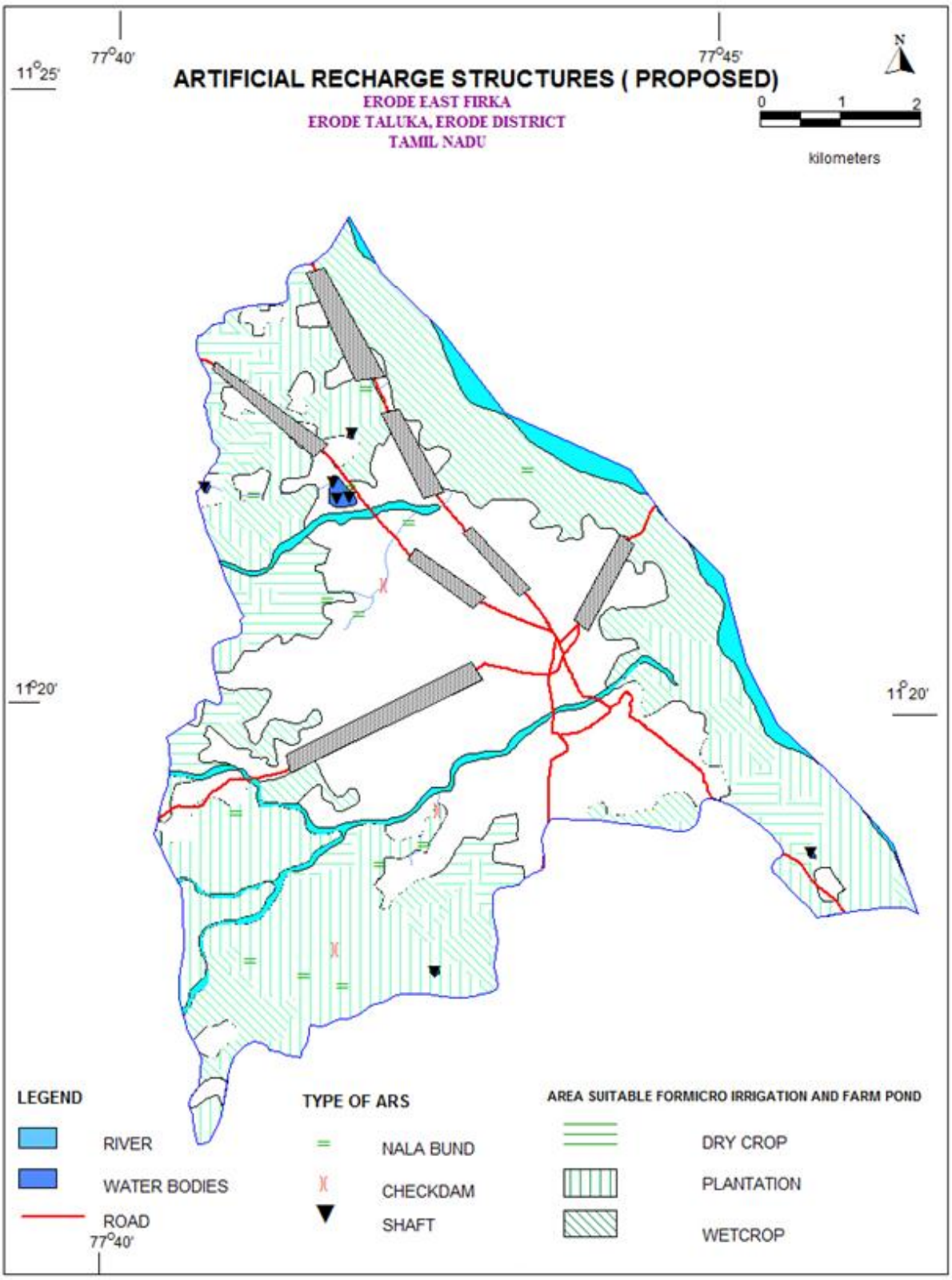


Plate 1. Location map showing the proposed AR Structures in Erode East firka

6. Tentative Cost Estimation

The tentative number of feasible structures, its cost and expected annual groundwater recharge/water saving is given in the table 7. The unit rates are as followed by the PWD, Govt. of Tamilnadu (Sources: Scheduled rates, Govt. of Tamilnadu 2015).

Table 7. Showing the Cost Estimation of proposed Artificial Recharge Structures

Feasible Artificial Recharge & Water Conservation structures/ activities	Tentative Design	quantity (in nos. or area in sq. m)	Total volume (cu.m)	Tentative unit cost (in Rs lakh)	Total tentative cost (in Rs lakh)	Expected Annual GW recharge/ Saving (cu.m))
Recharge Structures/ Activities						
Masonry Check dams (5 Fillings)	Crest- 10 -15 m; Height- 1.0 m to 1 .5 m	3	3400 (80%)	9.0	27	40800
Nala bund/Gab ion (4 fillings)	Width: 5 to 15 m)	14	3000	2.0	28	33600
Revival, repair of water bodies (3 fillings)	(~150 m x150 m x1.5m)	4	33750 (80%)	25.0	100	324000
Recharge shaft within the pond /tanks	Shaft = 1.5 m dia x 2m depth with filter media in lower 1 m . Bore dia =10", Casing = 6" Depth = 30 m)	7		2.0	14	
Farm Pond (in ha)(5 filling)	(30 m x 30m x 1.5 m)	100 unit	1200(85%)	1	100	600000
				Sub total	**269**	998400
Water Conservation Measure						
Sprinkler/ drip/ HDPE pipes	For 1 ha with 5 m interval HDPE pipe	100 ha		0.6 /ha	60	700000
				Total	**329**	1698400
Impact assessment and O & M						
Piezometers Up to 50 m bgl – 3 nos. @ 0.6 lakh (Impact assessment to be carried out by the implementing agencies)					**1.8**	
				Total cost of the Project	**330.80**	
O & M - 5 % of total cost of the scheme					**16.54**	
Impact assessment to be carried out by the implementing agencies @ 5% of Total cost					**16.54**	
				TOTAL	**363.88**	

Note:

- The type, number and cost of structure may vary according to site, after the ground truth verification.
- CD, PC- the storage of Check-dams and percolation ponds is also proposed for irrigating the surrounding areas for enhancing the groundwater recharge as well as effective utilization of the artificial recharge structures.

7. Implication modalities

The implementation of the scheme will be done by the line department of the state selected by the respective State authority. Further, it is to add that more than 50 % MGNREGA works related to water conservation/sustainable management,accordingly a convergence guideline has been madebetween National Rural Employment Guarantee Act (NREGA) (Ministry of Rural Development) & Programmes of Water Resources (MoWR , RD & GR). The district Erode is one among the list of districts identified for Convergence between NREGS and schemes of MoWR. The details of permissible works under convergence are envisaged in the Joint Convergence Guideline.

a.) Time schedule

Steps	1st Quarter	2th Quarter	3rd Quarter	4th Quarter	5th Quarter	6th Quarter	7th Quarter	8th Quarter
❖ Identification of line department /implementing agency and preparation of DPR								
❖ Approval of scheme and release of sanction of funds								
❖ Implementation of ARS								

Phase = one quarter or 3 months or equivalent to financial quarter

b.) Operation and maintenance

In all projects Impact assessment has to be carried out to ensure that projects is economically viable, socially equitable and environmentally sustainable by inter-related socio-economic, cultural and human-health impacts, both beneficial and adverse. Accordingly it is proposed a have impact assessment at rate of 5 % of the total cost of the project for 5 years from the completion of artificial recharge structures.