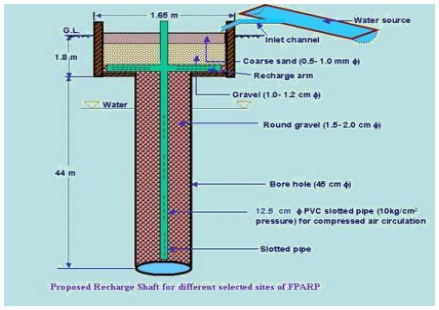
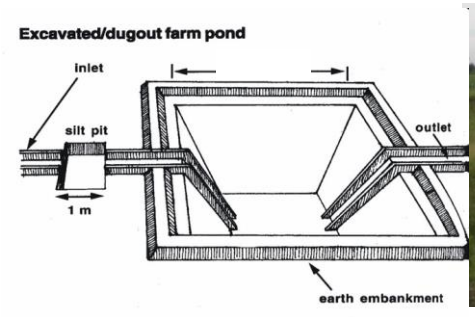
Plan on Artificial Recharge to Groundwater and Water Conservation in Namagiripettai Firka, Rasipuram Taluk, Namakkal District, Tamil Nadu





By

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

Content

AT GLANCE	
Name of Firka	Namagiripettai
Taluk	Rasipuram
District	Namakkal
State	Tamil Nadu
Total area	157.56
Total suitable area	150.00
Lat. & Lon.	11°32’02.76“ to 11° 24’20.14” & 78° 12’32.04”to 78°20’18.96”.
Rainfall	0.829 m
Monsoon	0.642 m
Non- Mon soon	0.187m
Geology	Charnockite and Gneiss
WATER LEVEL	
Pre - Monsoon	7.00-10.00 m bgl.
Post - Monsoon	5.00-10.00 m bgl.
GROUND WATER RESOURCES ESTIMATION	
Replenish able ground water resources	20.4990MCM
Net ground water available	18.4491 MCM
Ground water draft for irrigation	35.1115 MCM
Groundwater draft for domestic & industrial water supply	00.8962 MCM
Total ground water draft	36.0077MCM
Stage of ground water development (%)	195 %
Uncommitted surface runoff available for the Firka	15.173 MCM
Total volume of weathered zone	1260.5 MCM
Total aquifer volume available for recharge	1418 MCM
ARTIFICIAL RECHARGE /CONSERVATION MEASURES	
Structures Proposed (tentative) Masonry Check dam Nalla Bund Revival, repair of pond, tanks with recharge shaft	 7 10 10
Improving Water Efficiency / saving Micro irrigation system for 50 ha	0.35 MCM
Excepted groundwater recharge	0.9742 MCM
Total expected groundwater recharge/ saving	1.3242 MCM
Tentative total cost of the project	Rs. 3.37 Cr
Expected rise in water level by recharging /saving	0.17 m

Plan on Artificial Recharge to Groundwater and Water Conservation in Namagiripettai Firka, Rasipuram Taluk, Namakkal 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 firkasoverexploited, 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 Namagiripettai firka is 157.56 sq.km and Namagiripettai firka lies between North latitudes 11° 24’20.14” to 11°32’02.76“ and east longitudes78° 12’32.04”to 78°20’18.96”. Location map of Namagiripettai firka is given in Figure 1.

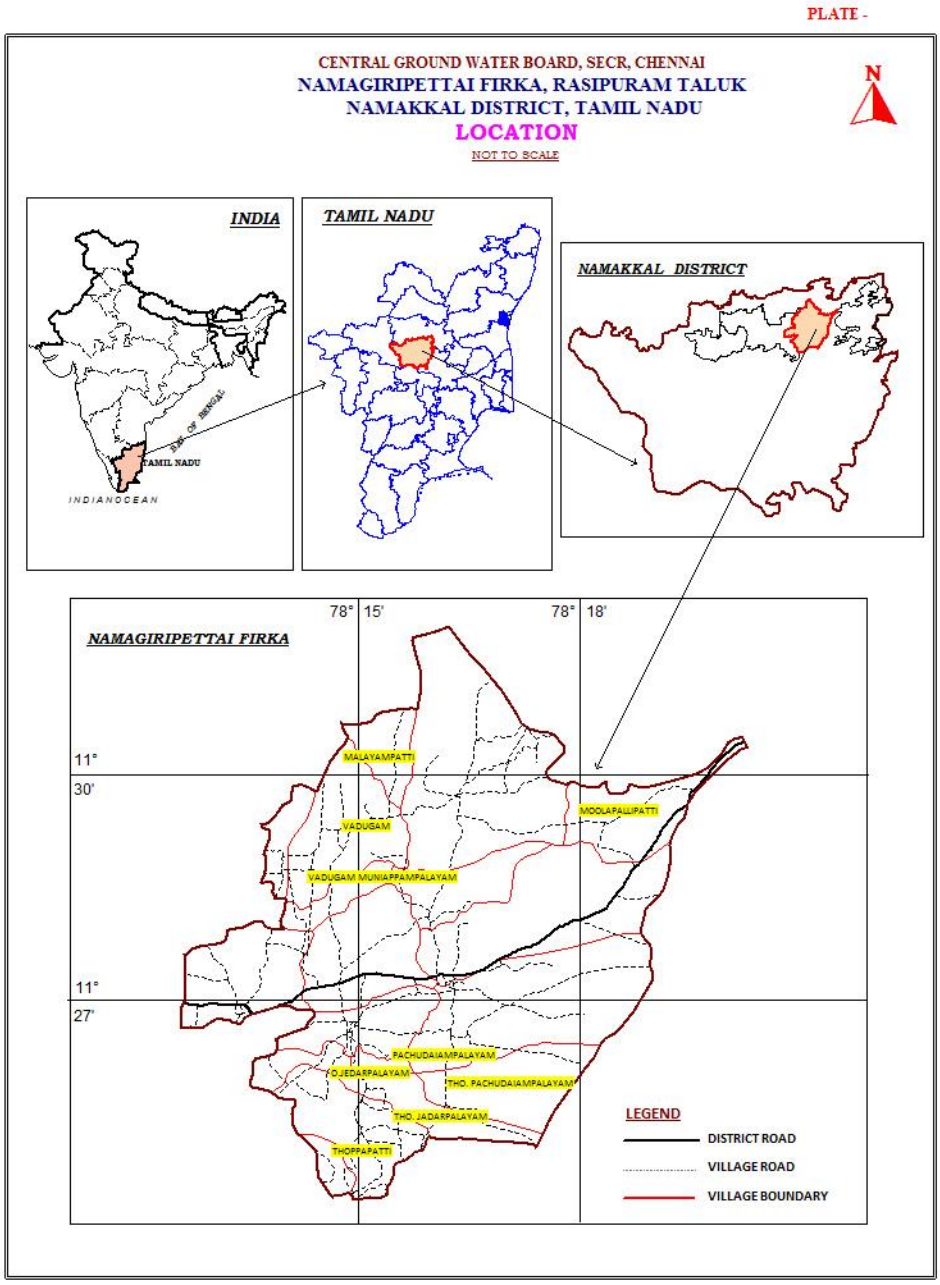


Figure 1. Location map of Namagiripettai firka

Geomorphological Set up

Geomorphologically, the area consists of hills and plain landforms. In plain landforms, Pediplain weathered moderate and shallow are occupied major part of the firka. These landforms are influencing the ground water recharge. Hill landform like residual hills, denudation hill and structural hills are act as runoff zone. (*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 Namagiripettai firka

LAND FORM	**AREA (Sq.km)**	**% AREA**
SHALLOW	78	79
DISSECTED/UNDISSECTED	6	6
DENUDATIONAL HILLS / RESIDUAL HILLS	8	8
BAJADA	0	0
MODERATE	7	7

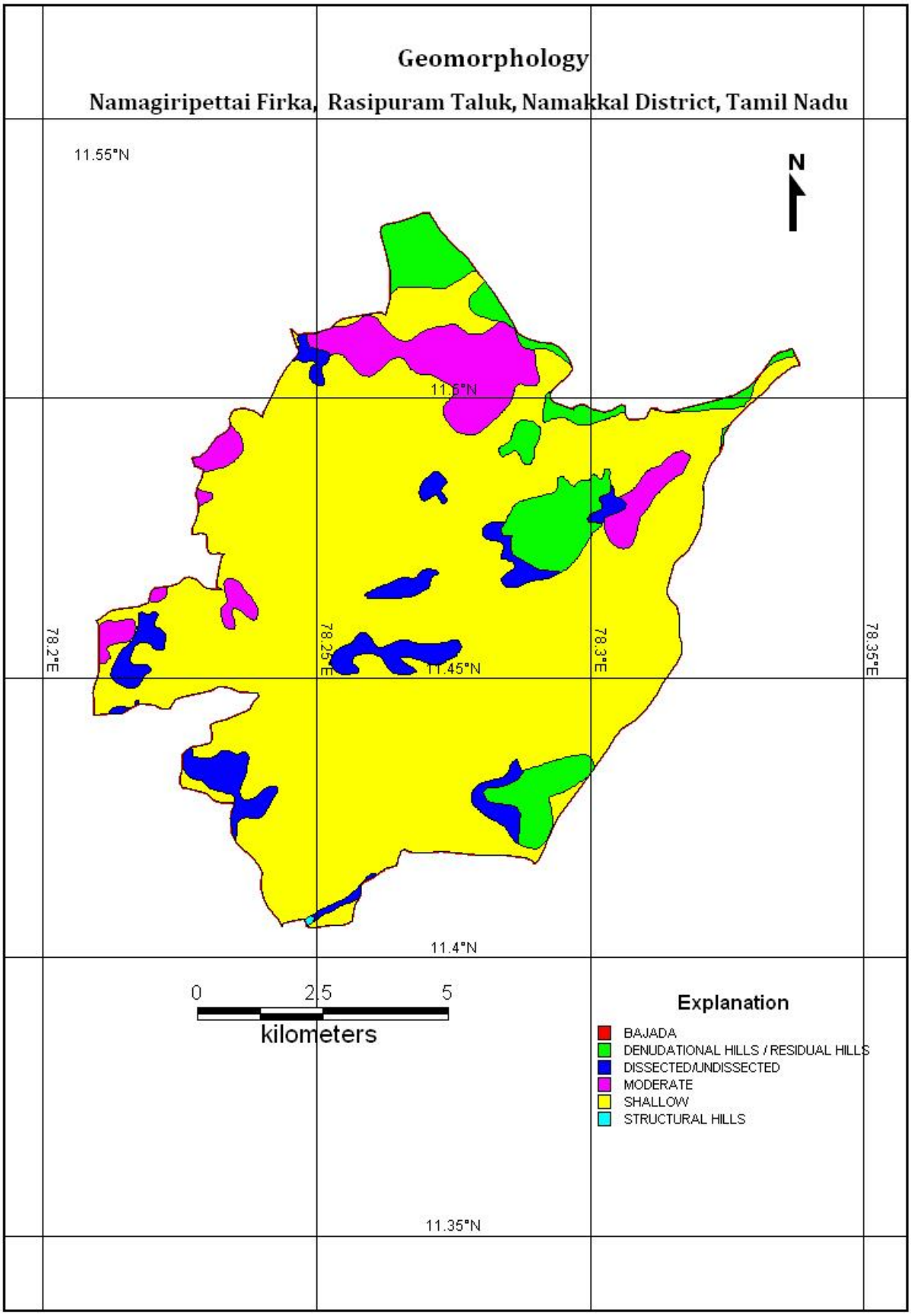


Figure 2. Geomorphology of Namagiripettai Firka

3.3 Land use and soil

The land use pattern of the Namagiripettai Firka is given in figure 3. Predominantly the most of the area is characterised by the wet crop, plantation and dry crop (i.,e agricultural field)and accounts for 70 % of the total area of the firka(Source: IRS, Anna university, Chennai Tamil Nadu). This area is highly suitable for water conservation and recharge. The entire Firkas is occupied by rock outcrops with loamy soil.

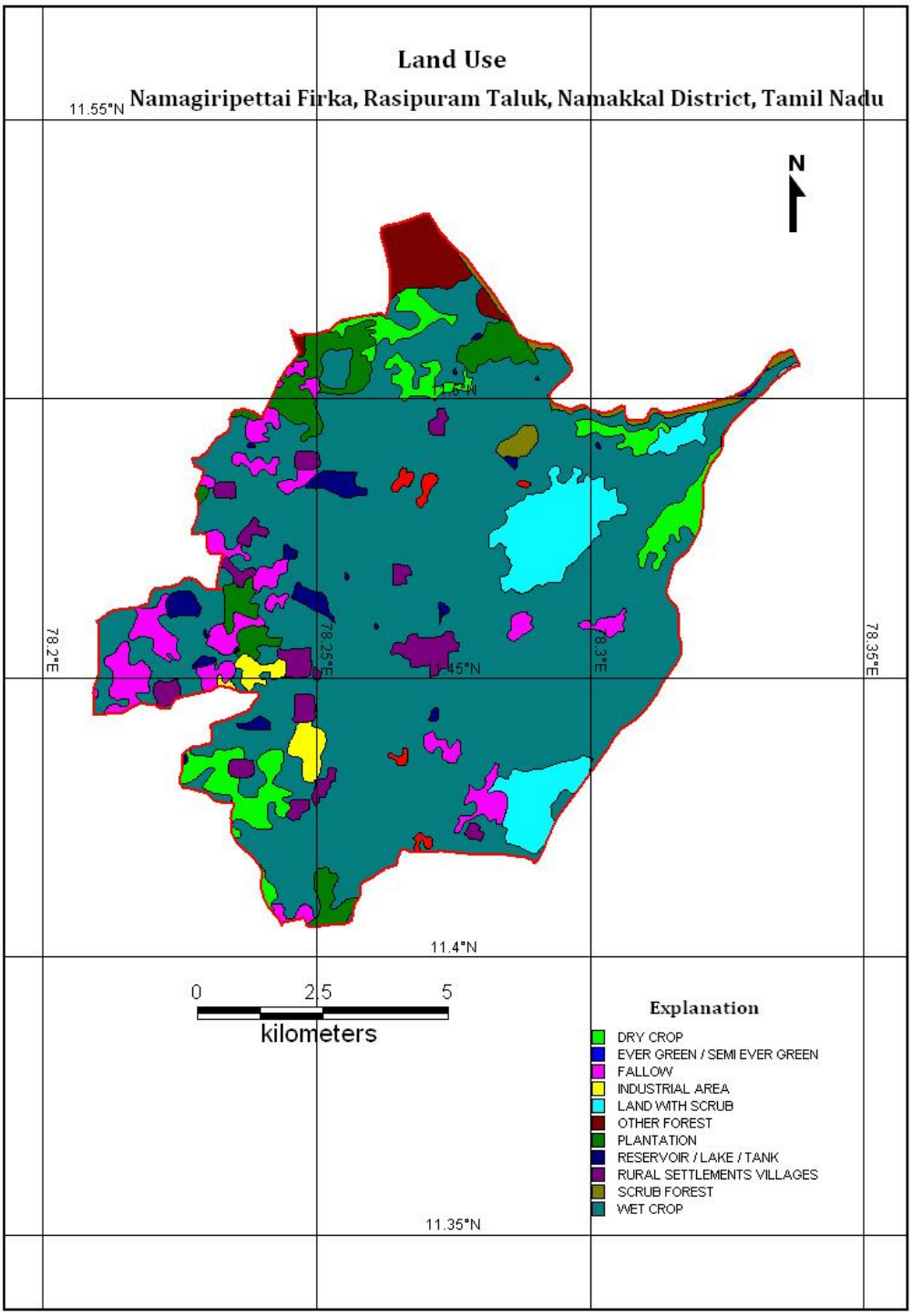


Figure 3.Landuse map of Namagiripettai Firka

3.4 Drainage

The entire Firka area is within the Thirumanimuthar river sub basin of cavuary basin and number of small streams originate from the hills located in the Namagiripettai firka. Only seasonal floods inundate lower parts of the basins. Basin sub soil water is used to irrigate the lands. Tanks and surface water bodies are spread over the entire firka. The drainage pattern is the dendritic and sub- dendritic. The drainage map of Namagiripettai firka is given in Fig 4.

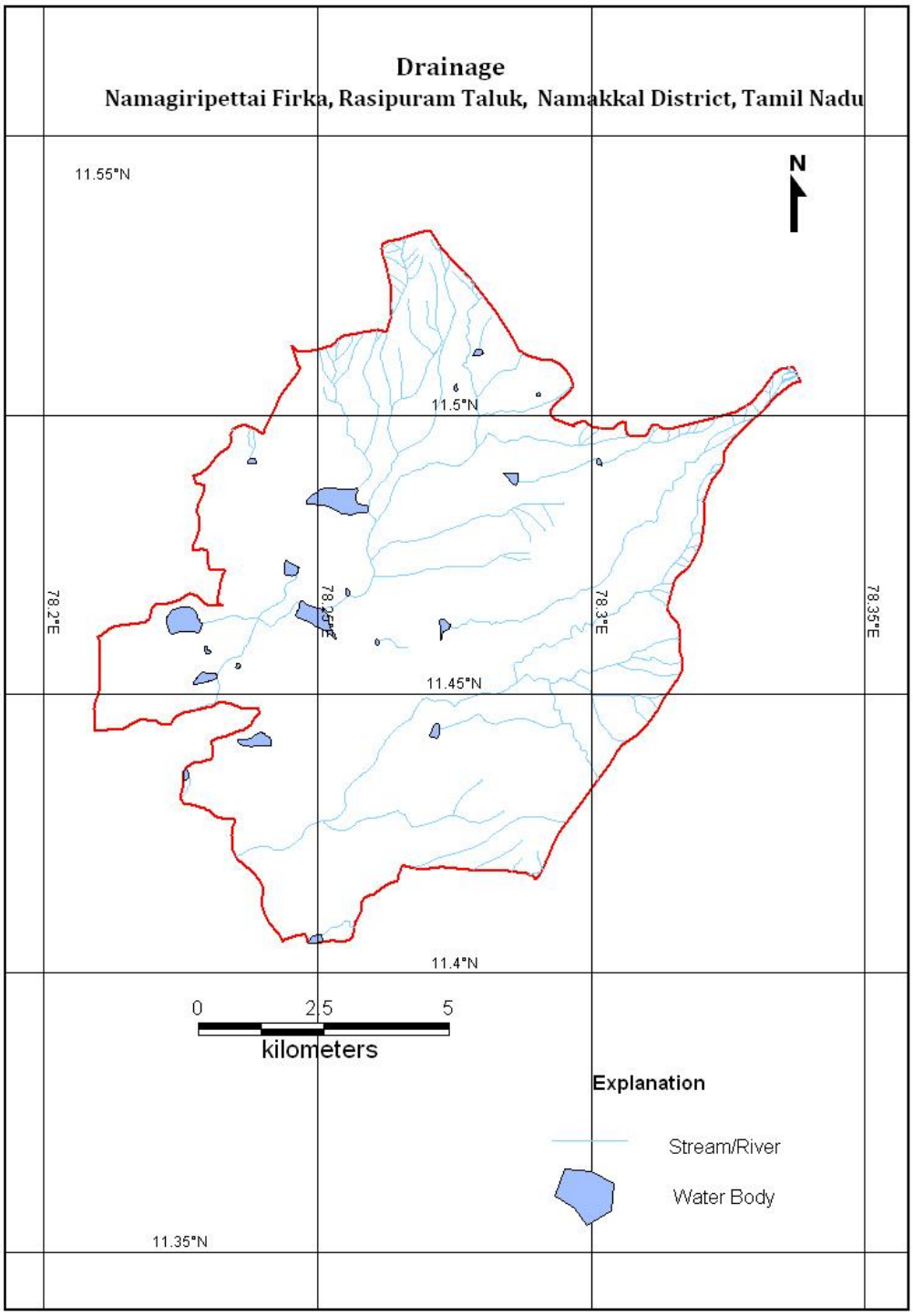


Figure 4.Drainage map of Namagiripettai Firka

3.5 Rainfall

Namagiripettai area falls under tropical climate with temperature in the summer months of March to May. The average temperature varies from 26 to 41° C. The humidity is also high in the order of 80%. 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. Namagiripettai 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 829 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
Rasipuram	Namagiripettai	157.56	0.642	0.187	0.829

3.6 Hydrogeology

The entire firka is underlain by gneiss and Charnockites. Ground water is occurring in pheratic 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 7 to 10 m and depth of dug wells range from 1.00 to 14.40 mbgl. The premonsoon (May 2014) water level of Namagiripettai is 10.82 mbgl and postmonsoon (January 2015) water level is 10.76 mbgl. 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 7.00 to 45.00 m bgl. Water levels in observation wells tapping shallow aquifers varied from 1.00 to 14.40m bgl during pre- monsoon and it varies from 0.85 to 15.03m bgl during post monsoon. The hydrogeological map of Namagiripettai firka is given in Figure 5.Decadal mean water level of pre-monsoon and post monsoon are given in fig 6 a & b. The decadal maps reveal that, mean water level during pre-monsoon in majority area is 5 to 10 m bgl like wise during post monsoon majority part is under 2 to 5m ground water level.

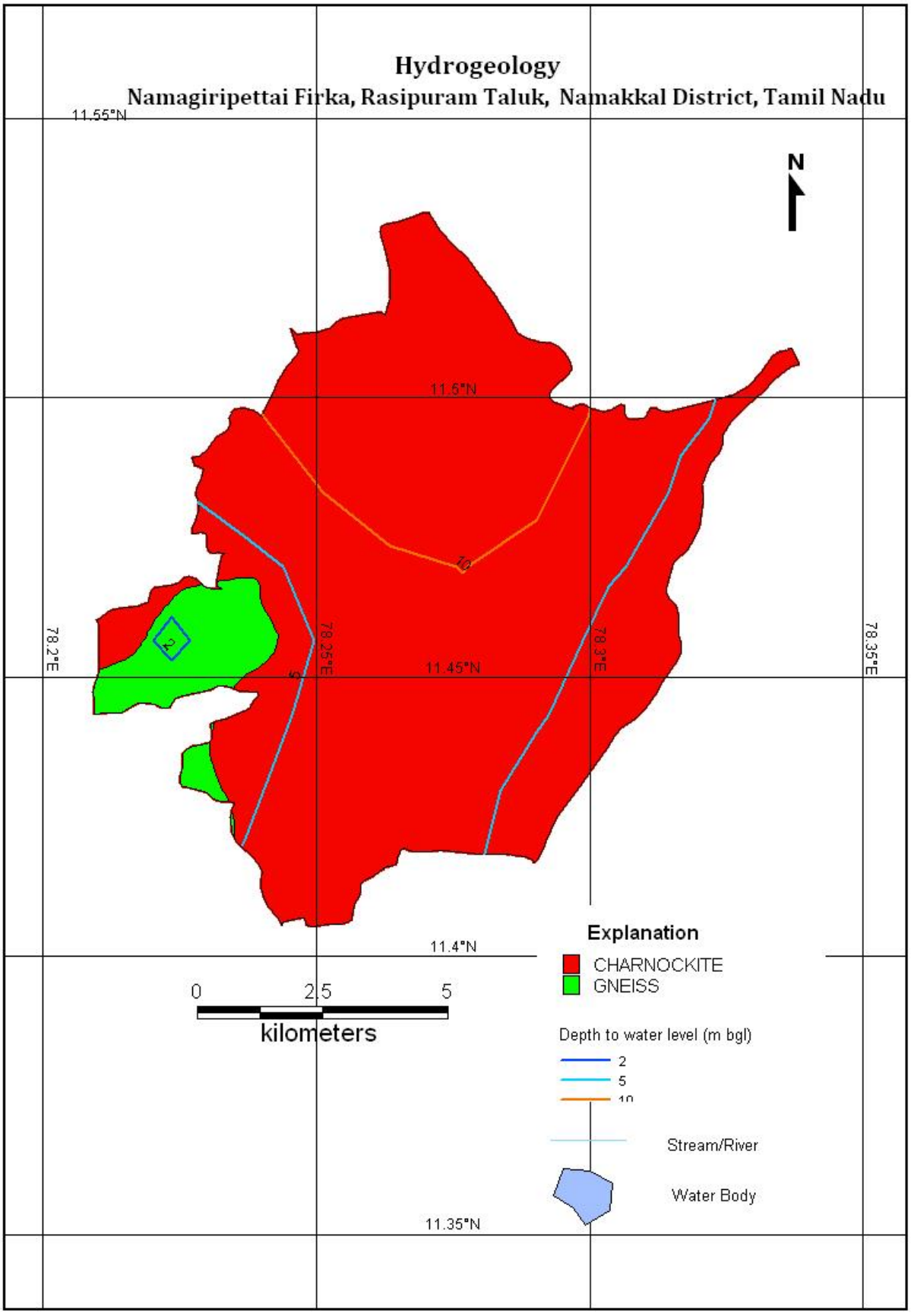


Figure 5 Hydrogeological Map of Namagiripettai Firka

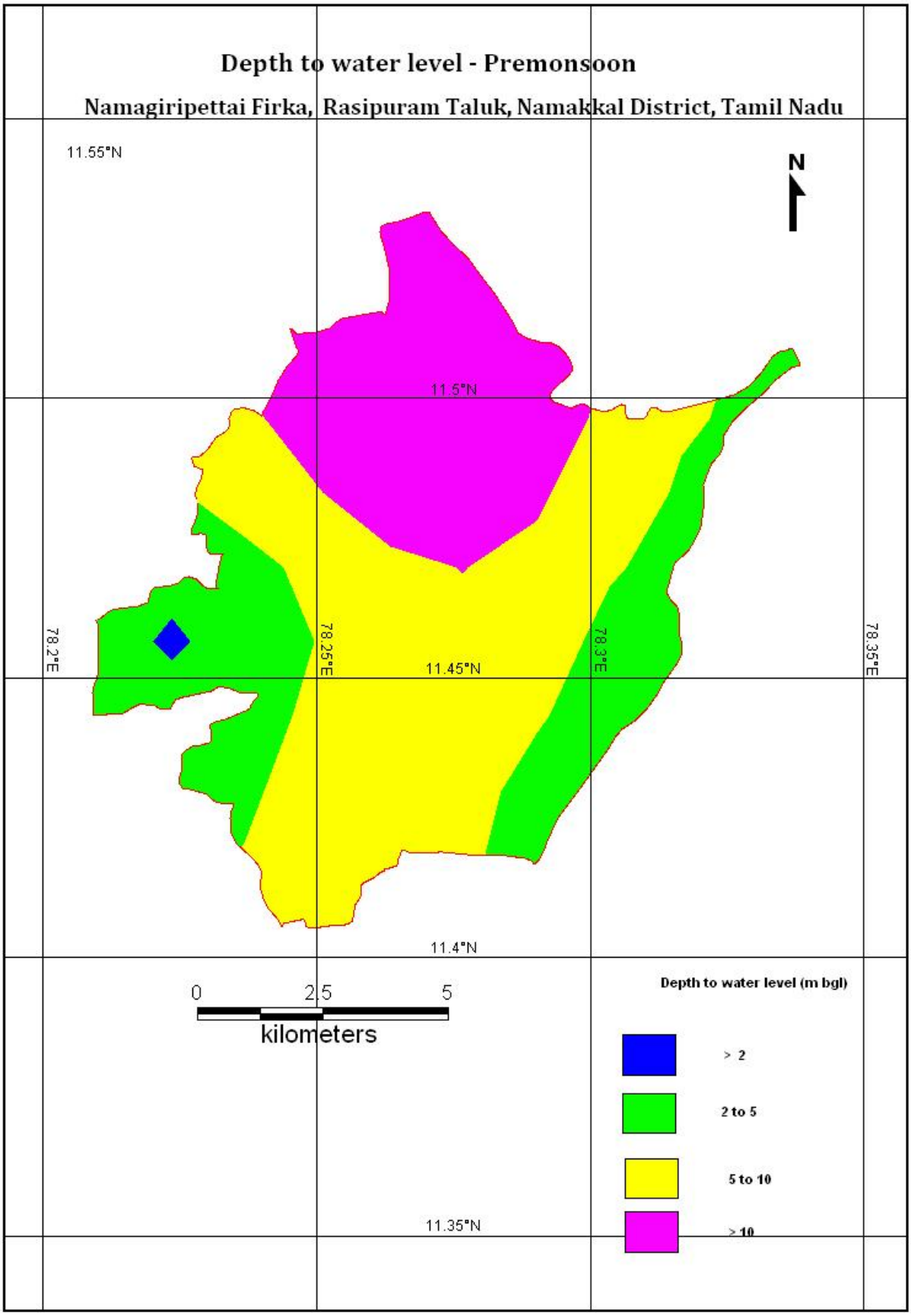


Figure 6a.Pre -monsoon water level in Namakripettai firka(Decadal)

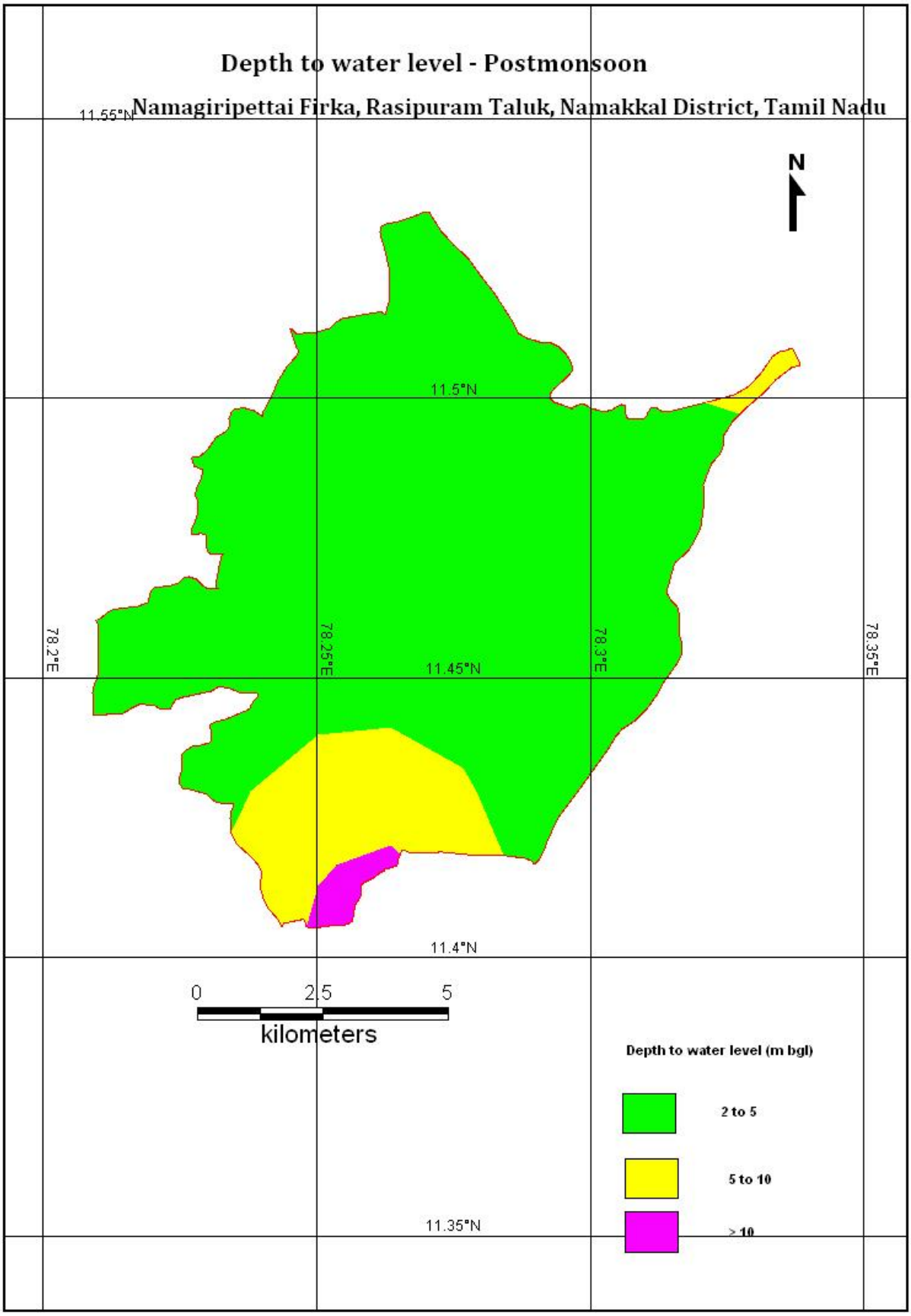


Figure 6 b. Post-monsoon water level in Namagiripettai firka(Decadal)

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 Namagiripettai 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)					%	
Namagiripettai	157.56	20.4990	18.4491	35.1115	00.8962	36.0077	195	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 by assigning 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	1	Suitable for all major recharge structures like Percolation pond and nalla bund, check dam etc.,
High	52	Suitable for all major recharge structures like nallabund, check dam etc.,
Moderate	41	Suitable for all major recharge structures like earthen check dam, Boulder check dam and Nala bund etc.,
Poor	5	Hilly/Forest /Catchment area

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

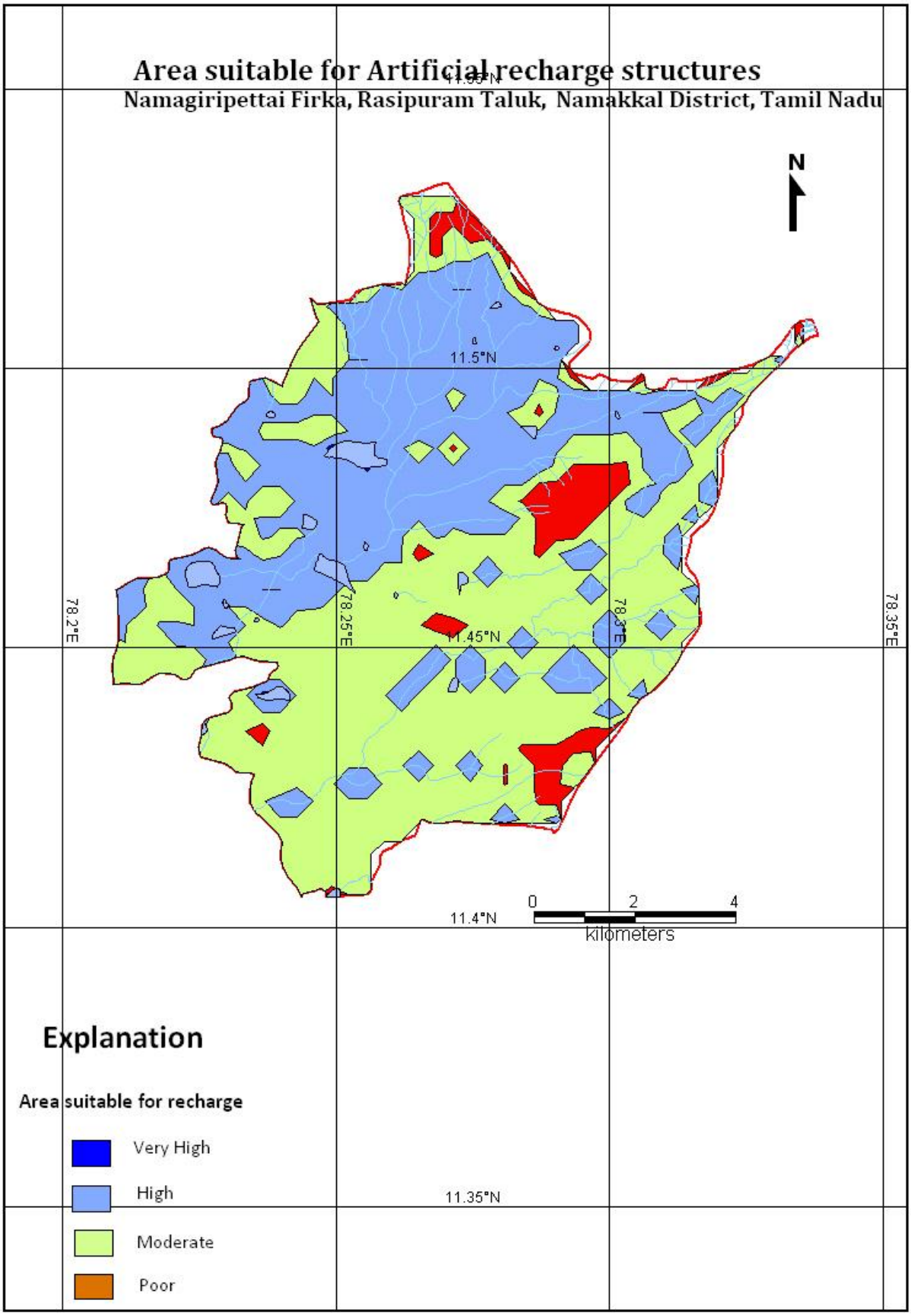


Figure 7showing the recharge worthy area Namagiripettai firka

5. Planning for groundwater recharge /conservation

5.1 Justification of the artificial recharge & conservation measures

- The Nanagiripettai Firka is with high stage of groundwater development i.e, 195 % and with sufficient amount of uncommitted surface runoff/flow of 15.173 MCM.
- The total weathered zone available beneath the ground in the firka is 8m. Out of these total volume available for recharge considering 8 m depth from 3 m) is 1260.5 MCM.
- The Namagiripettai Firka consists of 10 surface water bodies / which are well connected by the drainage. Revival and Recharge of these ponds will enhance the sustainability of the ground water abstraction structures.
- The water levels in the pre and post season are within range of 2 to 10 m
- However, most of the ground water developments for agricultural purposes are met through dug-cum bore well and bore wells only. Hence, there is sufficient scope of recharge.
- Model generated in the Namagiripettai areas reveals that more than 95 % of areas are suitable for recharge.
- In Namagiripettai firka more than 70 % area is characterised by the agricultural activities, there is sufficient scope for the water conservation measures for enhance the crop production and better ground water development.

5.2 Availability of surplus surface water for artificial recharge or conservation

The uncommitted surface flow for Namagiripettai 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 Namagiripettai Firka is 15.173 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

Namagiripettai firka area is covered by the seasonal nallahs/drains which carry heavy discharge during monsoon period along with heavy silt load and this is debauched into the water bodies within a short duration. It is proposed that such seasonal nala rivers will be identified and the rain water will be harnessed through construction of series of check dams, nala bund and gabion structures so as to harness this water thereby increasing the resident period of the water in these

channels and to increase the soil moisture content. As per the integrated model prediction around 50 % of the firkas areas are suitable for these structures. It is proposed to construct 7 Check dam and 10 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 details field survey is essential to ascertain the exact size and location.

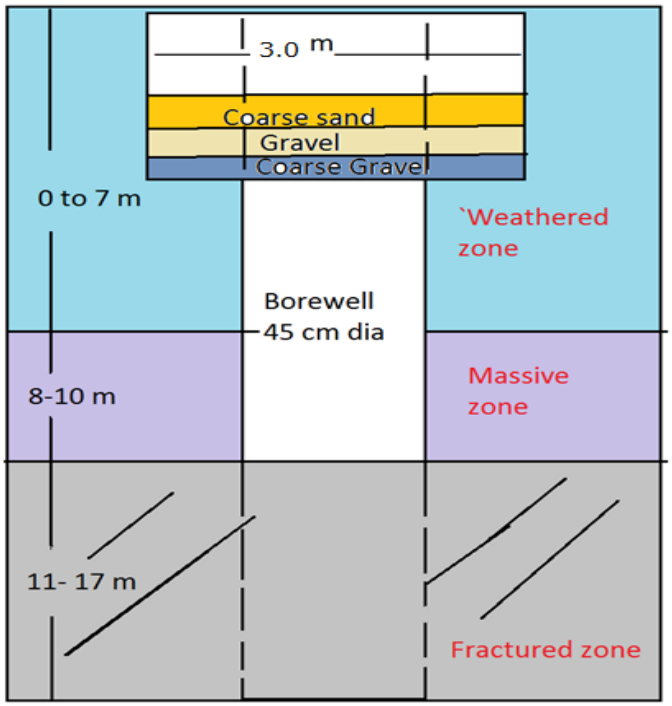
Tentative location of proposed 7 Check dam in Namagiripettai firka

S.No	Longitude	Latitude	Structure
1	78.2723	11.5145	Check Dam
2	78.2739	11.5218	Check Dam
3	78.2905	11.5016	Check Dam
4	78.3084	11.4544	Check Dam
5	78.2836	11.4818	Check Dam
6	78.2649	11.4289	Check Dam
7	78.2663	11.5252	Check Dam

Tentative location of proposed ------ Nalla bund in Namagiripettai firka

S.No	Longitude	Latitude	Structure
1	78.267	11.5165	Nalla Band
2	78.2718	11.5184	Nalla Band
3	78.2596	11.5102	Nalla Band
4	78.256	11.5091	Nalla Band
5	78.2656	11.507	Nalla Band
6	78.2863	11.5088	Nalla Band
7	78.2753	11.4297	Nalla Band
8	78.2758	11.4279	Nalla Band
9	78.2813	11.42	Nalla Band
10	78.2814	11.4735	Nalla Band

5.3.1.2. Recharge Shaft



5.3.1.3. 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 10 existing ponds/tanks having an area of less than 150 sq.m have been identified with latitude and longitude given below and marked on Plate 1.The above 10tanks/ponds could be taken up for the renovation with recharge shaft (recharge shaft as per design described above) on priority. Thus total 3.0 lakh cu. m of rainwater could be harvested by revival of ponds/tanks alone.

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

S.No	Longitude	Latitude	Structure
1	78.2496	11.4059	Desiltation with recharge shaft
2	78.2258	11.4349	Desiltation with recharge shaft
3	78.2291	11.4527	Desiltation with recharge shaft
4	78.2299	11.4583	Desiltation with recharge shaft
5	78.2453	11.4722	Desiltation with recharge shaft
6	78.2732	11.4626	Desiltation with recharge shaft
7	78.2714	11.4432	Desiltation with recharge shaft
8	78.2379	11.4916	Desiltation with recharge shaft
9	78.2858	11.4887	Desiltation with recharge shaft
10	78.2793	11.5113	Desiltation with recharge shaft

Water conservation measure

5.3.2.1 Farm Pond

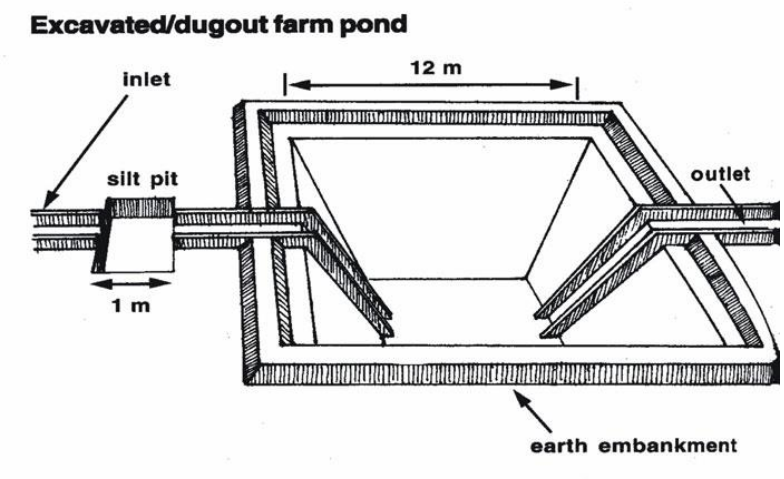
A farm pond is a large dug out in the earth, usually square or rectangular in shape, which harvests rainwater and stores it for future use. It has an inlet to regulate inflow and an outlet to discharge excess water. The pond is surrounded by a small bund, which prevents erosion on the banks of the pond. 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 50 farm ponds as per the specification of AED, Govt. of

Tamil Nadu (30 x 30 x 1.5 m). These 50 farm ponds can hold/ harvest about 135000 cum of rainfall runoff in Single Filling. Considering 4 filling this can accommodate 5.4 MCM of runoff rainfall.



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 50 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.

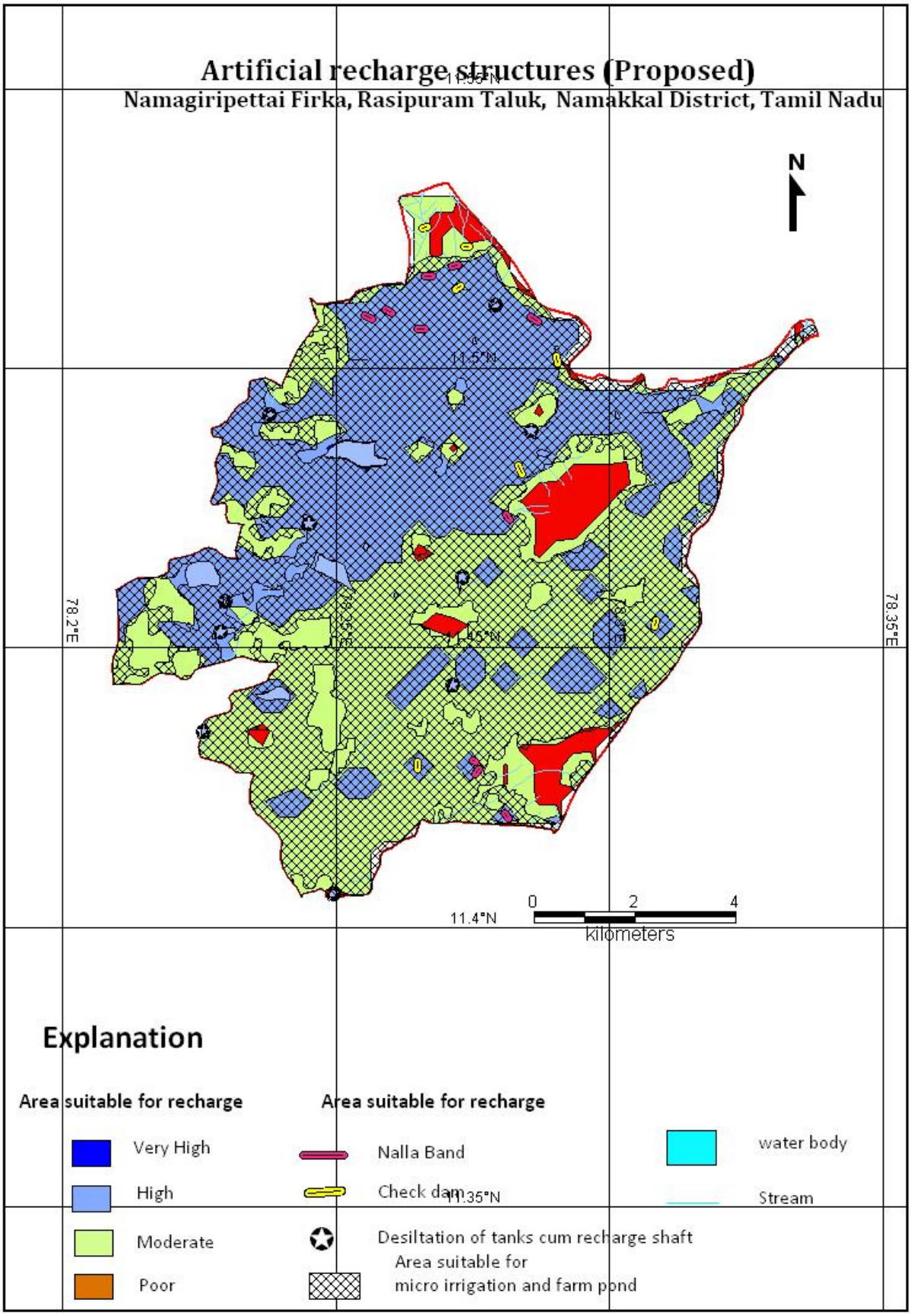


Figure.8. Location map showing the proposed AR Structures in Namagiripettai firka

6. Tentative Cost Estimation

The tentative cost for different activities is given in table below. The unit rates are as followed by the PWD, Govt. of Tamil Nadu (Sources the total estimated cost of the project is Rs 5.39 crores. It is expected that 60 % of total annually recharge is about 35.06 ham (0.35 MCM) of available monsoon runoff can be recharged to ground water. A tentative number of feasible structures and cost is given in the table 7.

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 (cu.m)
Recharge Structures/ Activities						
Masonry Check dams (4 Fillings)	Crest- 20 -15 m; Height- to 1 m	7	119000	9	63	95200
Nala bunds/ Gabion (4 Fillings)	Width: 10 to 15 m	10	3000	2.0	20	24000
Revival, repair of water bodies (3 fillings)	(~100mx100mx1m)	10	750000	12	120	600000
Recharge shaft with the pond /tanks	(3 m dia. with bore well up to 20 m)	10		2	20	
Water Conservation Activities						
Farm Pond (in ha) (4 filling)	(30 m x 30m x 1.5 m)	50	300000	1	50	255000
Sprinkler/ drip/ HDPE pipes for 300 ha select area	For 1 ha with 5 m interval HDPE pipe	50	500000	0.6	30	350000
				Sub total	**303**	**1324200**
Impact assessment and O & M						
Piezometers Up to 50 m bgl – 6nos. @ 0.6 lakh (Impact assessment to be carried out by the implementing agencies)					**3.6**	
Total cost of the project					**306.6**	
O & M - 5 % of total cost of the scheme					**15.33**	
Impact assessment to be carried out by the implementing agencies @ 5% of total cost					**15.33**	
				TOTAL	**337.26**	

Note: The type, number and cost of structure may vary according to site, after the ground truth verification

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 made between National Rural Employment Guarantee Act (NREGA) (Ministry of Rural Development) & Programmes of Water Resources (MoWR , RD & GR). The district Namakkal 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.

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