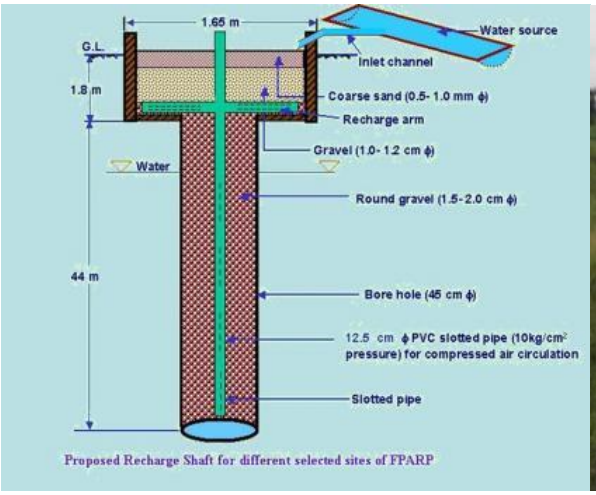
Plan on Artificial Recharge to Groundwater and Water Conservation

Rasipuram Firka, Rasipuram Taluk, Namakkal District, Tamil Nadu



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

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AT GLANCE	
Name of Firka	Rasipuram
Taluk	Rasipuram
District	Namakkal
State	Tamil Nadu
Total area	31.56
Total suitable area	28.72
Lat. & Lon.	11°23'10"to 11° 31'25" & 78° 02' 59"to 78°14'49".
Rainfall	0.864 m
Monsoon	0.684 m
Non- Mon soon	0.180 m
Geology	Granitic gneiss and Charnockite
WATER LEVEL	
Pre – Monsoon	2 to 20 m bgl.
Post - Monsoon	2 to 10 m bgl.
GROUND WATER RESOURCES ESTIMATION	
Replenish able ground water resources	5.06 MCM
Net ground water available	4.55 MCM
Ground water draft for irrigation	7.56 MCM
Groundwater draft for domestic & industrial water supply	0.205 MCM
Total ground water draft	7.77 MCM
Stage of ground water development (%)	171 %
Uncommitted surface runoff available for the Firka	3.243 MCM
Total volume of weathered zone	252.51 MCM
Total aquifer volume available for recharge	220.96MCM
ARTIFICIAL RECHARGE /CONSERVATION MEASURES	
Structures Proposed (tentative) Masonry Check dam Nalla Bund Revival, repair of pond, tanks with recharge shaft	 7 6 13
Improving Water Efficiency Micro irrigation system for 100 ha	0.35 MCM
Excepted groundwater recharge	1.1446 MCM
Total expected groundwater recharge/ saving	1.4946 MCM
Tentative total cost of the project	3.71 cr
Expected rise in water level by recharging /saving	1.02

Plan on Artificial Recharge to Groundwater and Water Conservation in Rasipuram Firka, Rasipuram Taluk, Salem 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 Rasipuram firka is 31.56 sq.km and its lies between North latitudes 11°23’10“ to 11° 31’25”and east longitudes 78° 02’ 59” to 78°14’49”. Location map of Rasipuram rfirka is given in Figure 1.

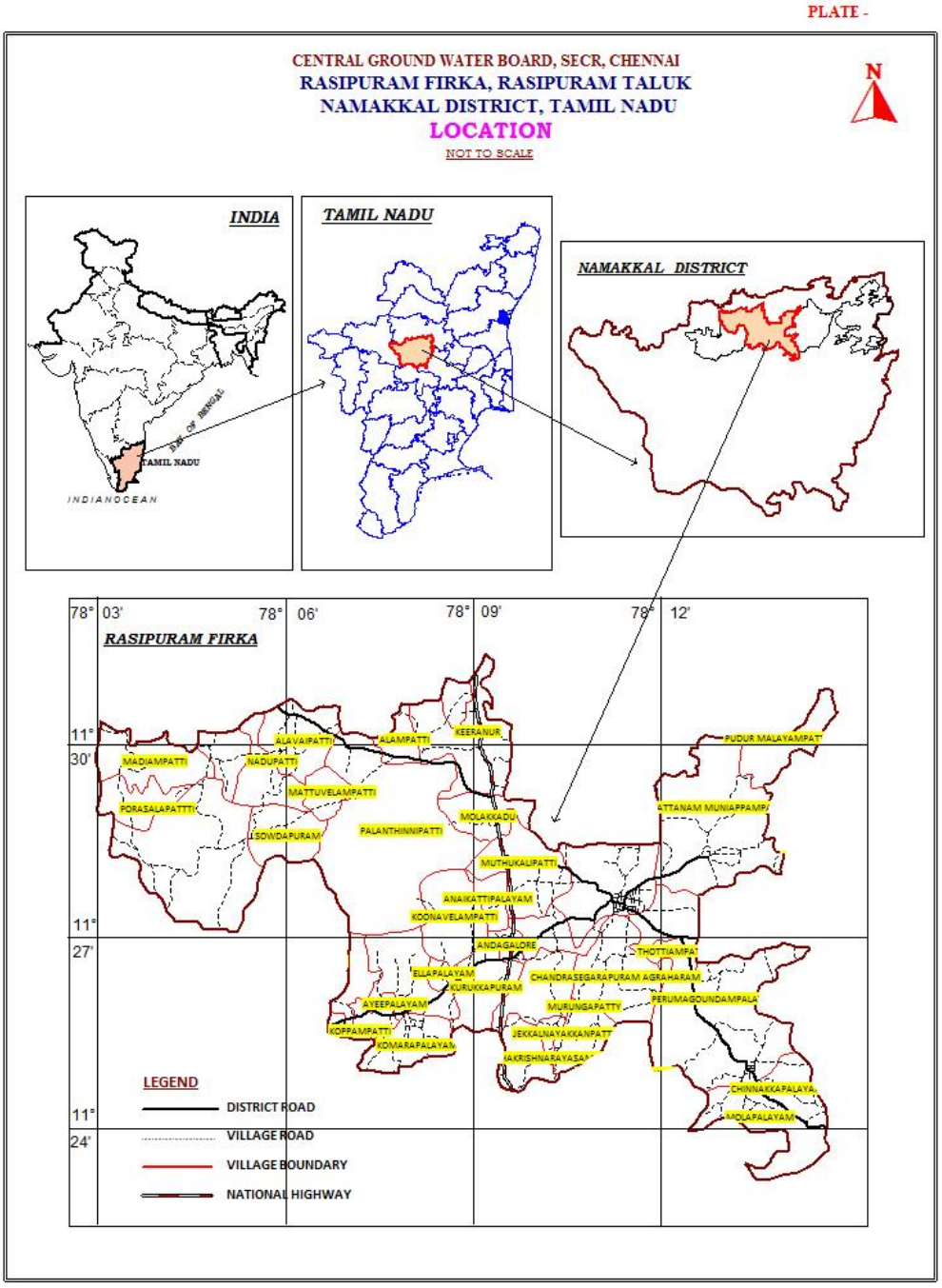


Figure 1. Location map of Rasipuram firka

3.2 Geomorphological Set up

Geomorphologically, the area consists of hills and plain landforms. In plain landforms, Pediplain weathered shallow and moderate 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 rasipuram firka

LAND FORM	**AREA (Sq.km)**	**% AREA**
BURRIED PEDIMENT SHALLOW	99	66
PEDIMENT DISSECTED/UNDISSECTED	8	5
DENUDATIONAL HILLS / RESIDUAL HILLS	19	13
MODERATE	21	14
INSELBERG	1	0
STRUCTURAL HILLS	2	1

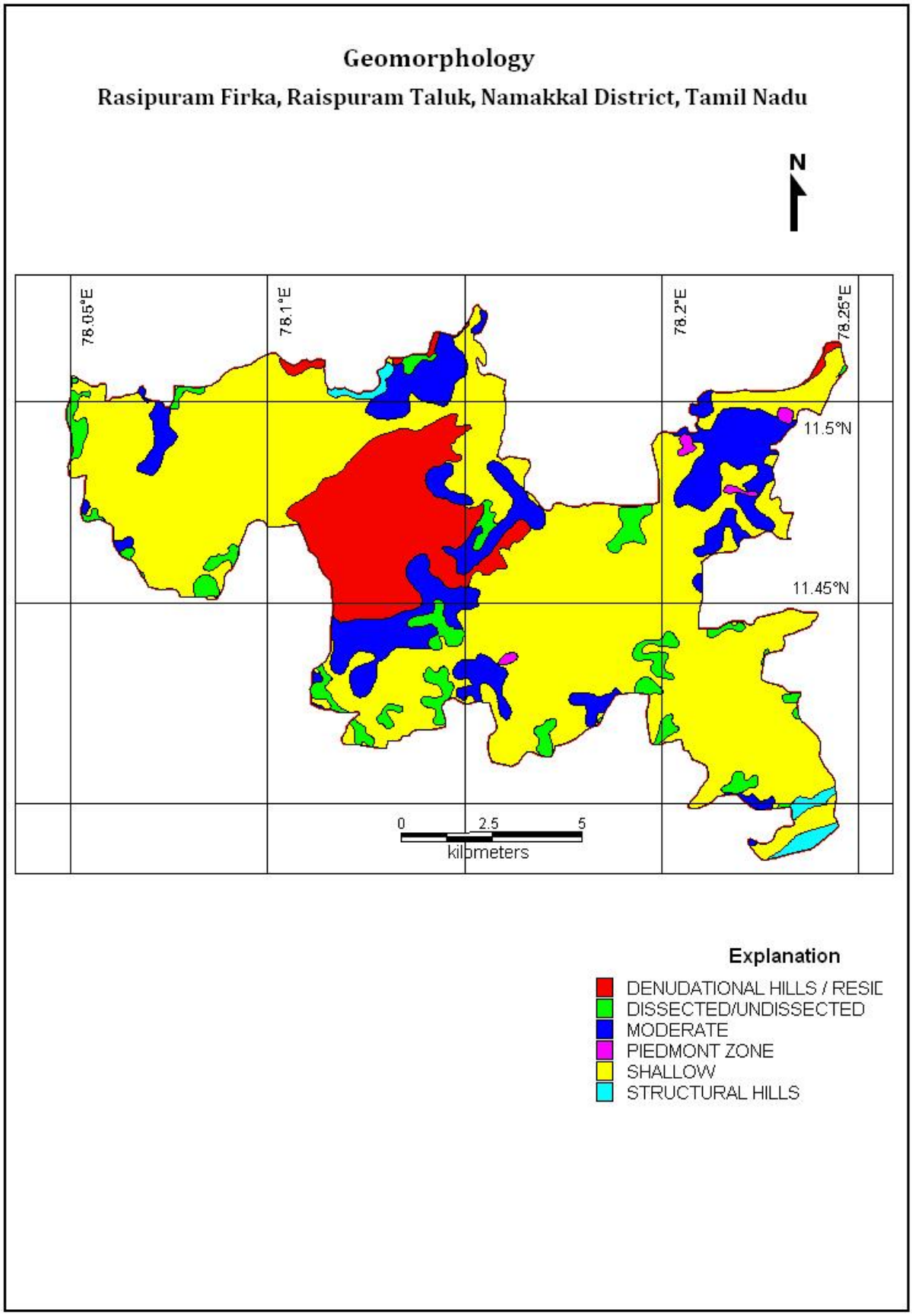


Figure 2. Geomorphology of Rasipuram firka

3.3 Land use and soil

The land use pattern of the Rasipuram 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 66 % 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 firka is occupied by Entisols and Alfisols soils predominantly. The land use and soil are shown in figure 3 & 4.

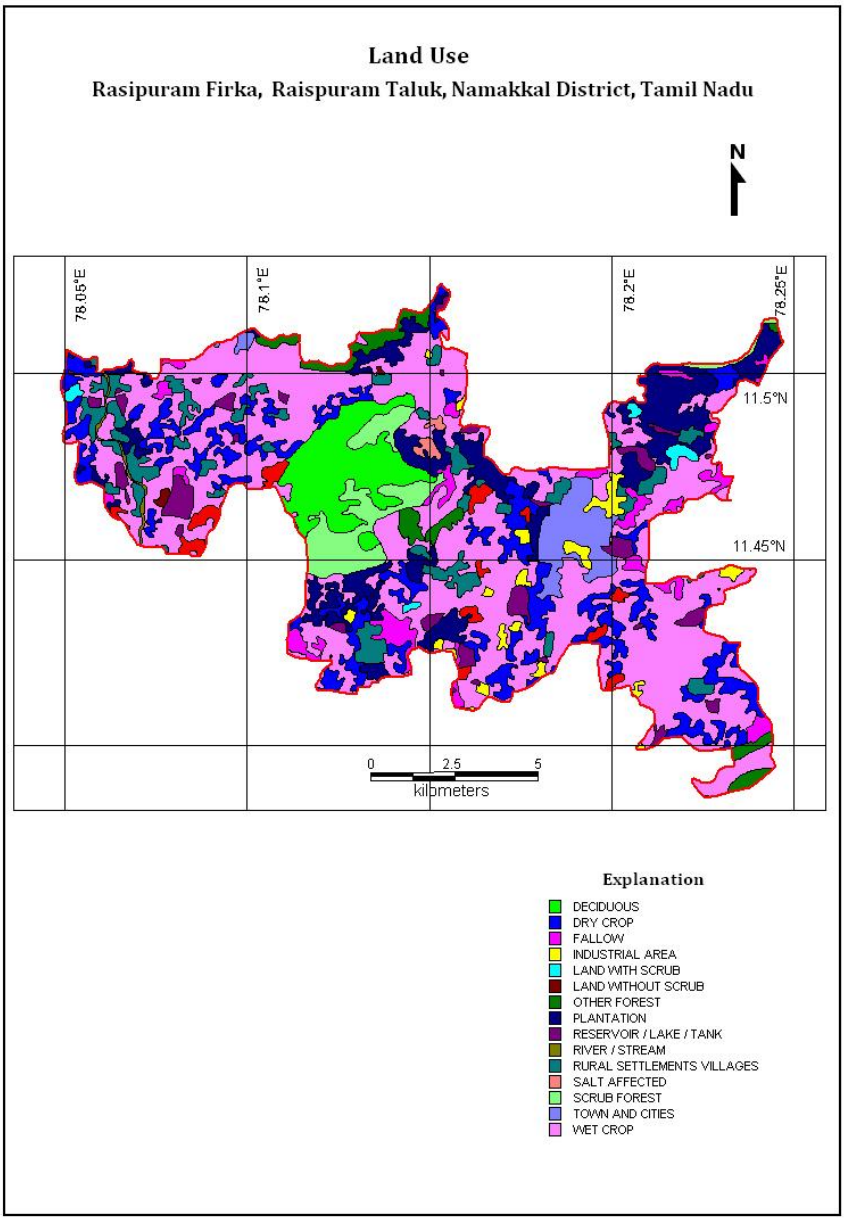


Figure 3.Landuse map of Rasipuram Firka

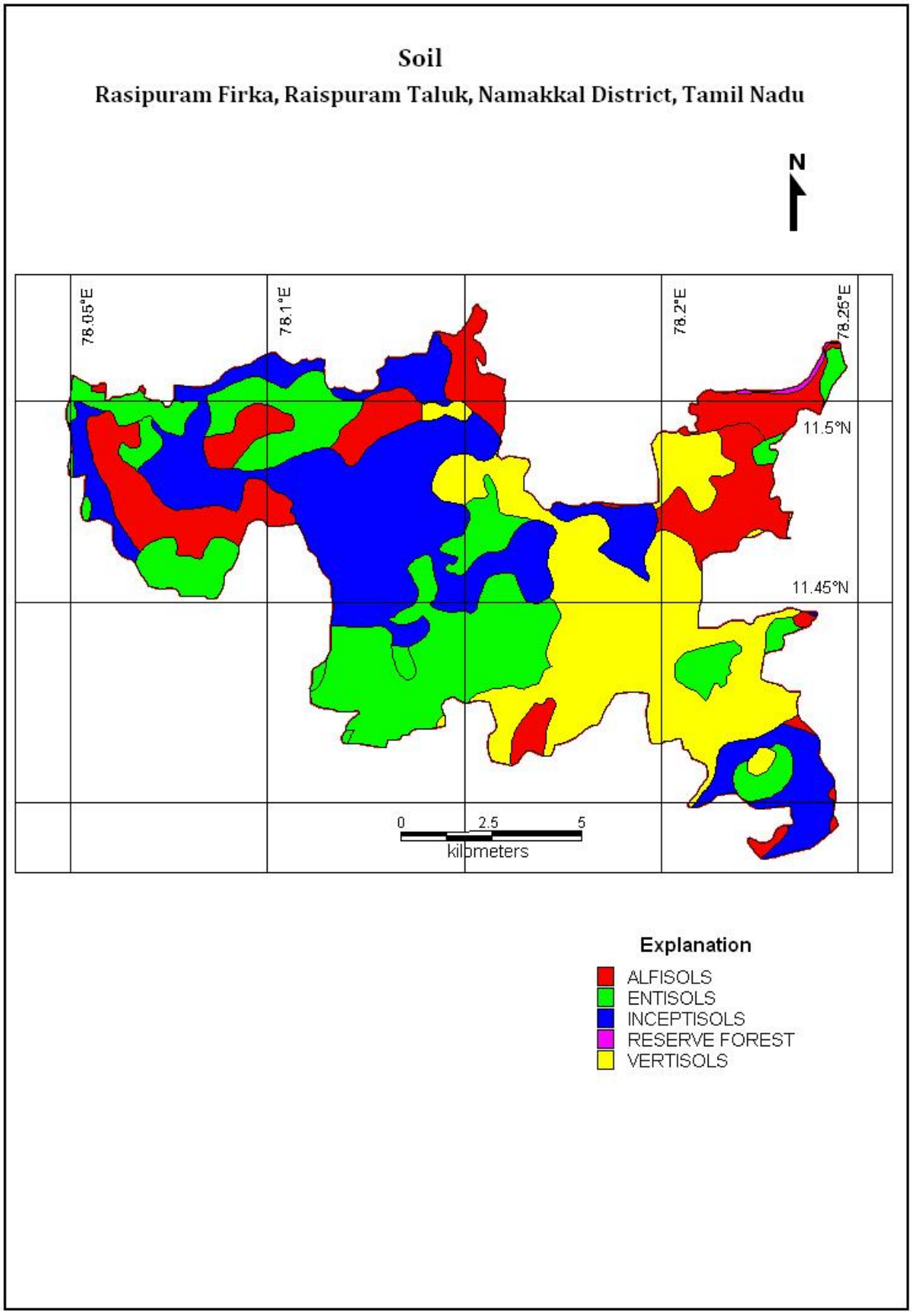
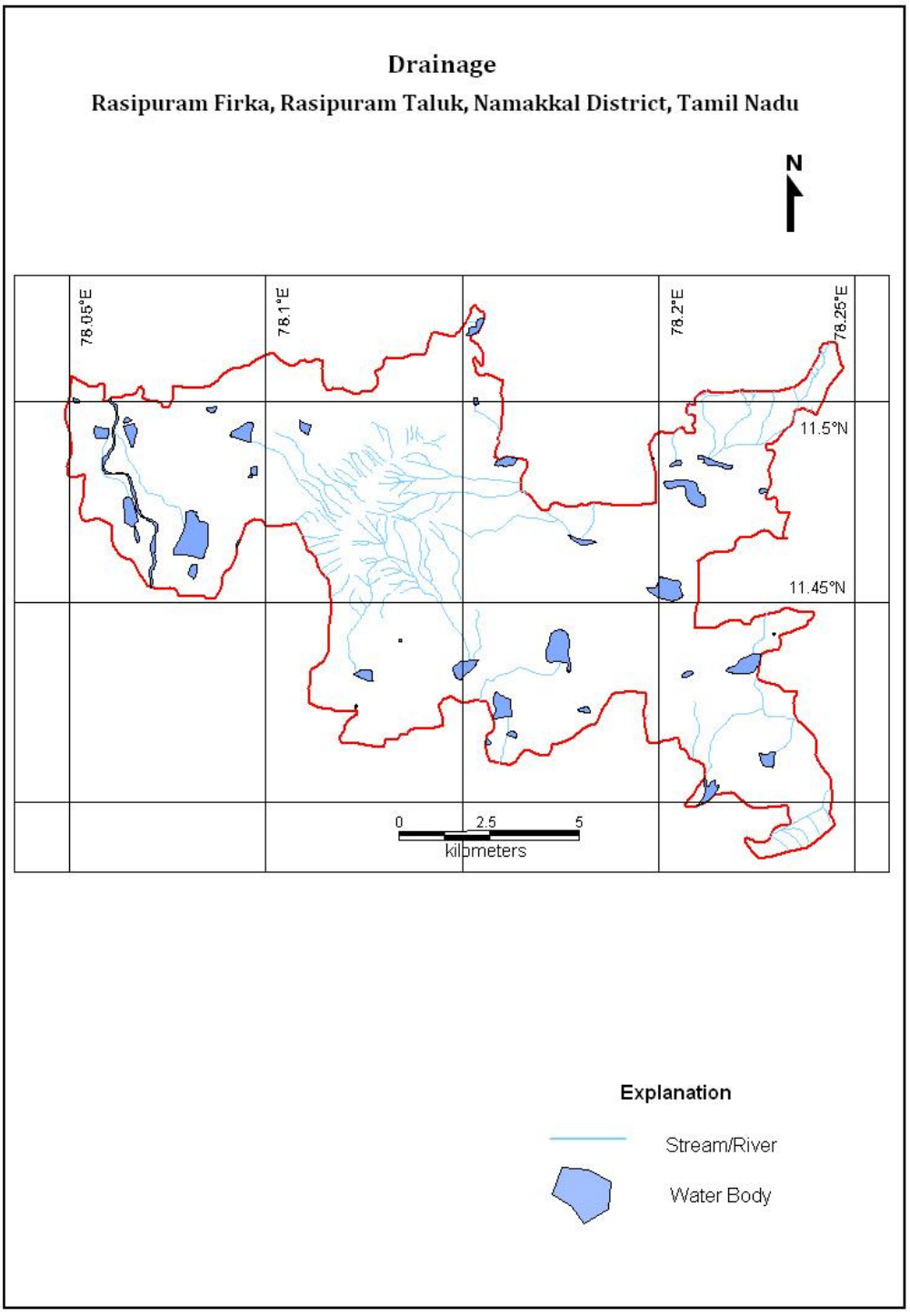


Figure 4.Soil map of Rasipuram firka.

3.4 Drainage

The entire Firka area is within the Thirumanimuthar river basin and number of small streams originates from the hills located in the Rasipuram 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 dendrite and sub-dendritic. The drainage map of Rasipuram firka is given in Fig 5.

Figure 5.Drainage map of Rasipuram Firka



3.5 Rainfall

The Rasipuram firka receives the rain under the influence of both southwest and northeast monsoons. The northeast monsoon chiefly contributes to the rainfall in the area. The Area on the whole enjoys a dry climate. Weather is pleasant during the period from November to January. The driest months are from January to April, the average relative humidity in afternoons being about 40%. Even during the rainy months the average humidity is appreciably below the saturation level. Winds are generally light. From November to April winds blow mainly from north-easterly direction, from May to September south-westerly predominates. The hot weather begins early in March, the highest temperature being reached in April and May. Weather cools down progressively from about the middle of June and by December, the mean daily maximum temperature drops to 30.2°C, while the mean daily minimum drops to 19.2°C in January.

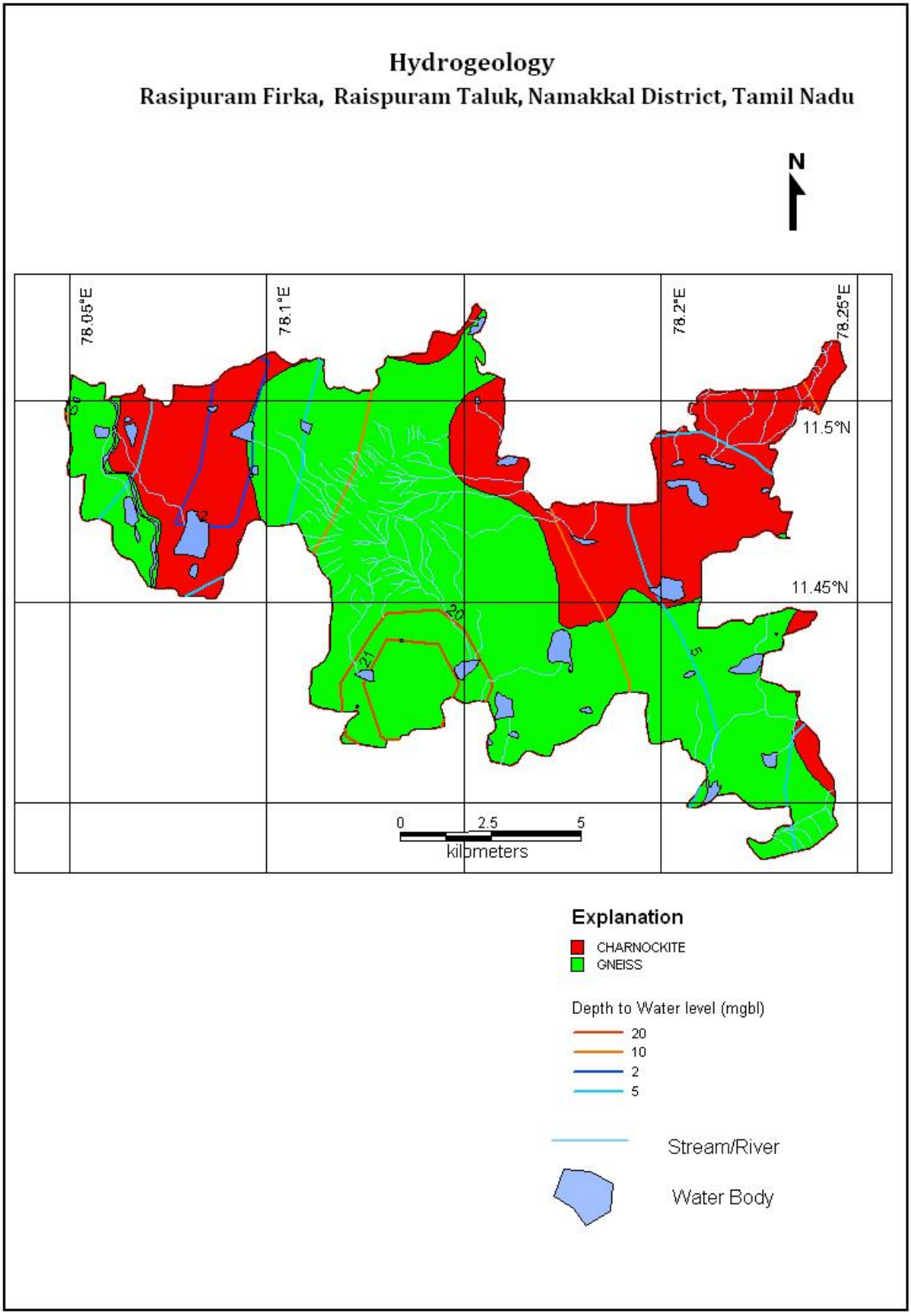
Taluk	Name of Firkas	Area in sq.km	Monsoon rainfall (Jun to Dec) In m	Non monsoon rainfall (Jan – May) In m	Total Rainfall In m
Rasipuram	Rasipuram	31.56	0.684	0.180	0.864

3.6 Hydrogeology

The entire firka is underlain by the crystalline metamorphic gneiss complex consisting gneiss and Charnockite. Ground water is occurring in pheratic conditions in weathered and fractured 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 15 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. Hydrogeology of Rasipuram firka is shown in Figure 5.

The depth of wells varies from 7.5 to 15 m bgl. Water levels in observation wells tapping shallow aquifers varied from 5 to 20m bgl during pre- monsoon and it varies from 2 to 10m bgl during post monsoon. The hydrogeological map of Rasipuram 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 <10 m bgl likewise during post monsoon majority part is under <10m ground water level.

Figure.5 Hydrogeological Map of Rasipuram Firka



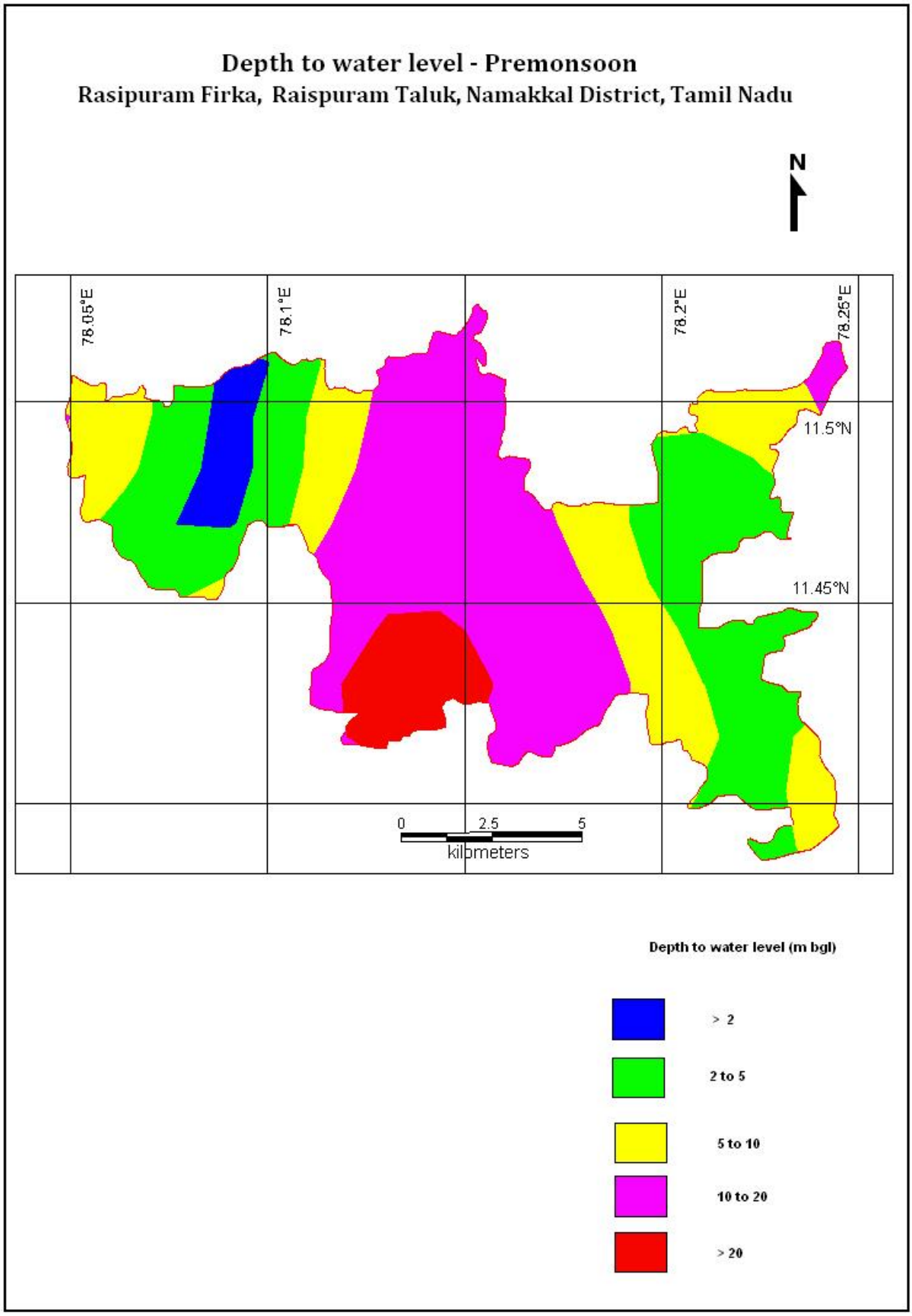


Figure 6a.Pre -monsoon water level in Rasipuram firka(Decadal)

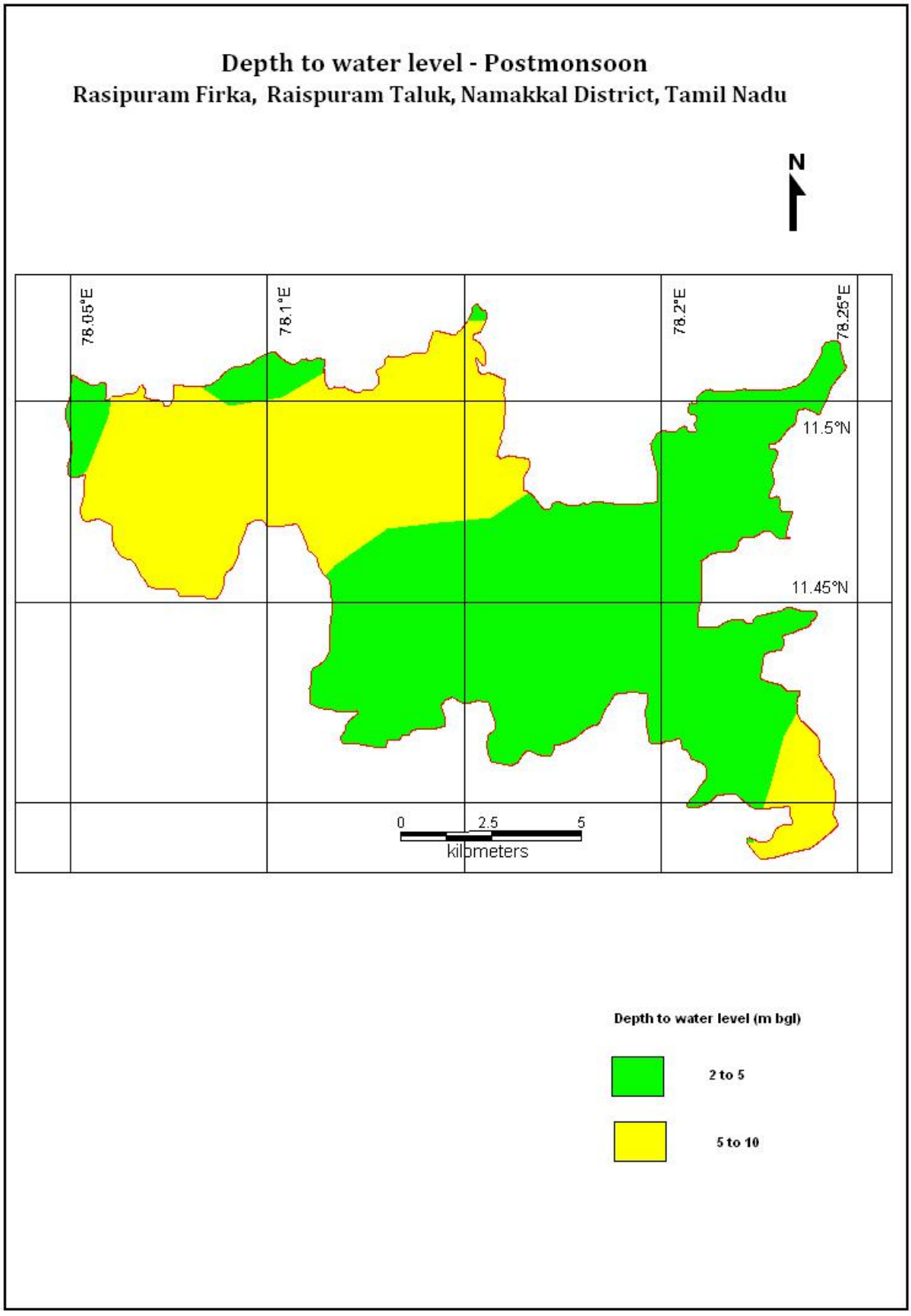


Figure 6 b. Post-monsoon water level in Rasipram firka(Decadal)

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 Rasipuram firka

Firka	GW WORTHY AREA	REPLENISH ABLE 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)					%	
Attur	31.56	5.06	4.55	7.56	0.205	7.77	171	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 even 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 nallabund, check dam etc.,
High	22	Suitable for all major recharge structures like nallabund, check dam etc.,
Moderate	68	Suitable for all major recharge structures like earthen check dam, Boulder check dam and Nala bund etc.,
Poor	9	Hilly/Forest /Catchment area

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

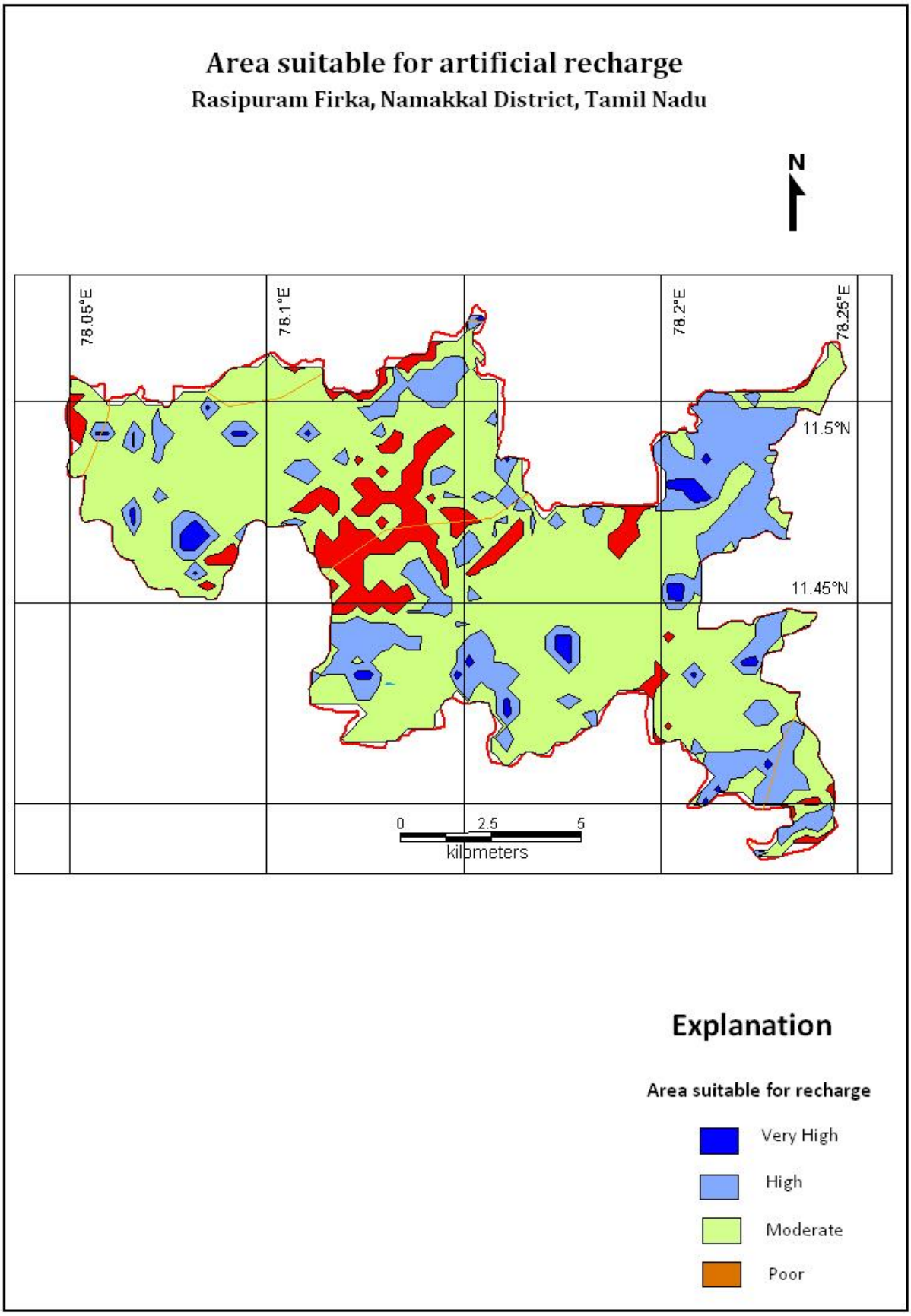


Figure 7.showing the recharge worthy area Rasipuram firka

5. Planning for groundwater recharge /conservation

5.1 Justification of the artificial recharge & conservation measures

- The Rasipuram Firka is with high stage of groundwater development i.e, 171 % and with sufficient amount of uncommitted surface runoff/flow of 3.243 MCM.
- The total weathered zone available beneath the ground in the firka is 8 m. Out of these total volume available for recharge is 220.95 MCM.
- The water bodies /lakes, 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 20 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 Rasipuram areas reveals that more than 91 % of areas are suitable for recharge.
- In Rasipuram firka more than 66 % 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 Rasipuram 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 Rasipuram Firka is 3.243MCM.

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

Rasipuram 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 30 % of the firkas areas are suitable for these structures. It is proposed to construct 7 Check dams and 6 Nala The tentative location of these 13 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.

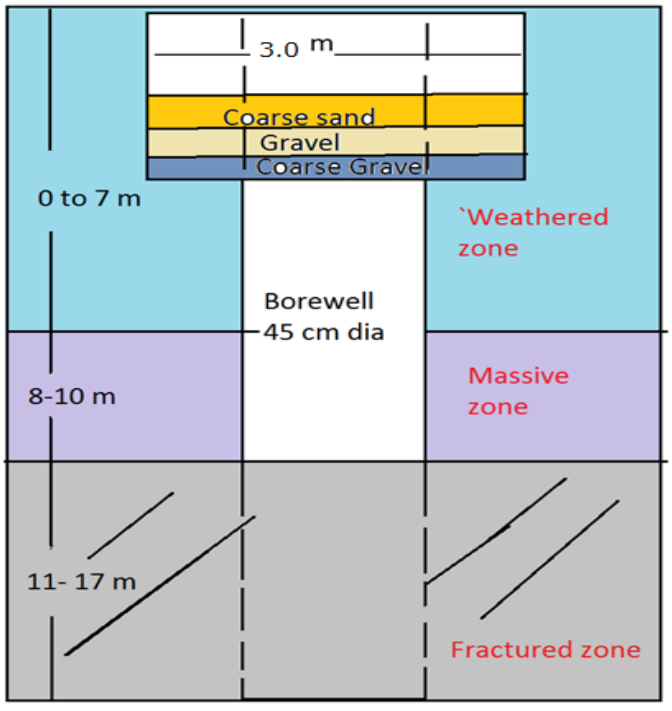
Tentative location of proposed seven Check dam in Rasipuram firka

S.No	Longitude	Latitude	Structure
1	78.1476	11.4449	Check Dam
2	78.1211	11.4415	Check Dam
3	78.1531	11.4807	Check Dam
4	78.1568	11.4763	Check Dam
5	78.1097	11.4852	Check Dam
6	78.2181	11.4932	Check Dam
7	78.222	11.4896	Check Dam

Tentative location of proposed six Nalla bund in Rasipuram firka

S.No	Longitude	Latitude	Structure
1	78.1493	11.4578	Nalla Band
2	78.1565	11.4676	Nalla Band
3	78.0696	11.4784	Nalla Band
4	78.1587	11.431	Nalla Band
5	78.2292	11.4984	Nalla Band
6	78.2145	11.5009	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 13 existing ponds/tanks having an area of less than 200 sq.m have been identified with latitude and longitude given below and marked on Plate 1.The above 13 tanks/ponds could be taken up for the renovation with recharge shaft (recharge shaft as per design described above) on priority. Thus total 390000 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 Rasipuram Firka

S.No	Longitude	Latitude	Structure
1	78.1566	11.415	Desiltation with recharge shaft
2	78.1631	11.4168	Desiltation with recharge shaft
3	78.1808	11.4231	Desiltation with recharge shaft
4	78.2071	11.4321	Desiltation with recharge shaft
5	78.2263	11.4775	Desiltation with recharge shaft
6	78.2039	11.4845	Desiltation with recharge shaft
7	78.1531	11.5004	Desiltation with recharge shaft
8	78.1102	11.493	Desiltation with recharge shaft
9	78.0965	11.483	Desiltation with recharge shaft
10	78.0857	11.498	Desiltation with recharge shaft
11	78.0515	11.5004	Desiltation with recharge shaft
12	78.0647	11.4955	Desiltation with recharge shaft
13	78.0668	11.4665	Desiltation with recharge shaft

Water conservation measure

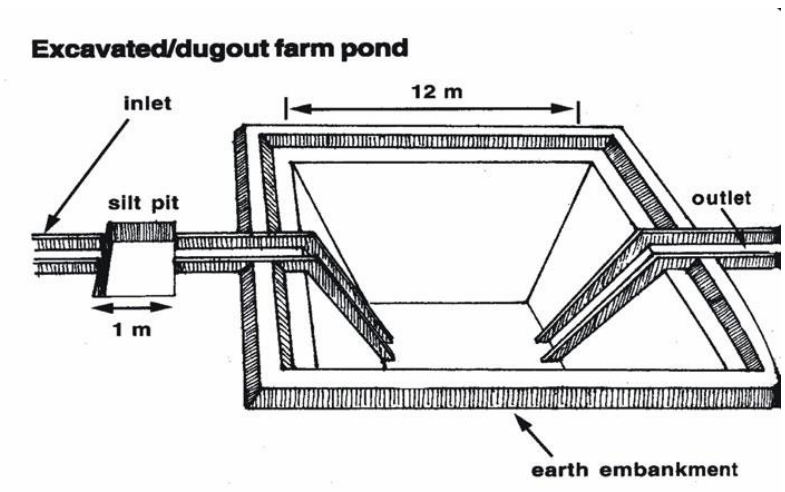
5.3.2.1 Farm Pond

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 101250 cum of rainfall runoff in Single Filling. Considering 4 filling this can accommodate 0.135 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.

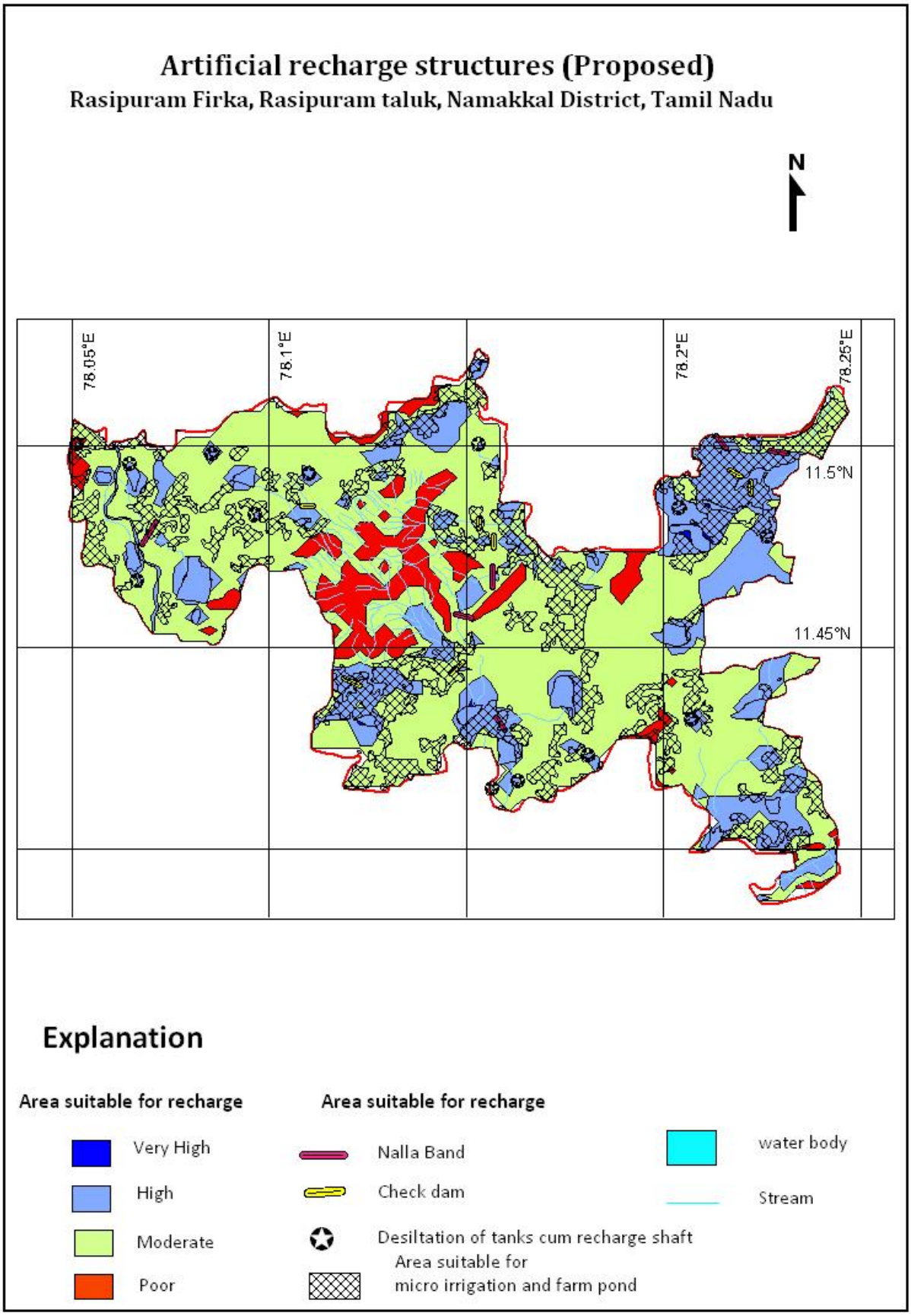


Figure.8. Location map showing the proposed AR Structures in Rasipuram firka

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 6.18 crores. It is expected that 60 % of total annually recharge is about 40.32 ham (0.40 MCM) of available monsoon runoff can be recharged to ground water. It is also expected to reduce ground water withdrawal by through best irrigational and on-farm practices. 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	6	18000	2	12	14400
Revival, repair of water bodies (3 fillings)	(~100mx100mx1m)	13		12	156	
Recharge shaft with the pond /tanks	(3 m dia. with bore well up to 20 m)	13	975000	2	26	780000
Water Conservation Activities						
Farm Pond (in ha) (4 filling)	(30 m x 30m x 1.5 m) 900 sq.m or 0.1 ha	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	**337**	**1494600**
Impact assessment and O & M						
Piezometers Up to 50 m bgl – 1 nos. @ 0.6 lakh					**0.6**	
Total cost of the project					**337.6**	
O & M - 5 % of total cost of the scheme					**16.88**	
Impact assessment to be carried out by the implementing agencies @ 5% of total cost					**16.88**	
				TOTAL	**371.36**	

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 Villupuram 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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