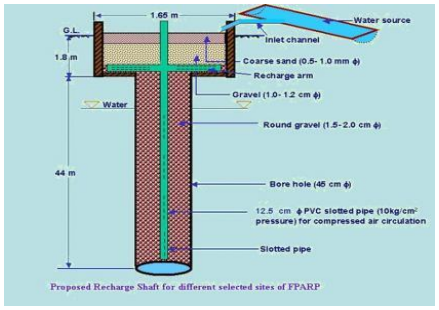
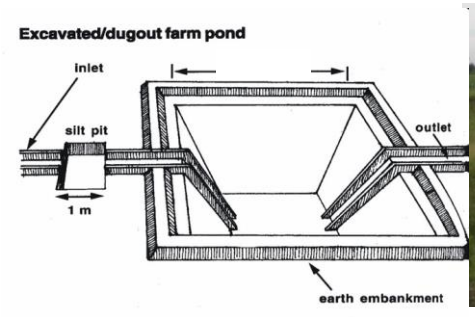
Plan on Artificial Recharge to Groundwater and Water Conservation in Kattukottai Firka, Attur Taluk, Salem District, Tamil Nadu





By

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

Content

T GLANCE	
Name of Firka	Kattukottai
Taluk	Attur
District	Salem
State	Tamil Nadu
Total area	126.8
Total Area suitable for recharge	107.78
Lat. & Lon.	11°29’ 43 “to 11° 39’05” & 78° 38’ 38”to 78°45’ 50”.
Rainfall	0.822 m
Monsoon	0.701 m
Non- Mon soon	0.121mm
Geology	Gneiss, Charnockite and Mylonite
WATER LEVEL	
Pre - Monsoon	1.0 to 15.9 m bgl.
Post - Monsoon	2.0 to 10.4 m bgl.
GROUND WATER RESOURCES ESTIMATION	
Replenish able ground water resources	36.61 MCM
Net ground water available	32.95 MCM
Ground water draft for irrigation	43.3 MCM
Groundwater draft for domestic & industrial water supply	1.24 MCM
Total ground water draft	44.55 MCM
Stage of ground water development (%)	135 %
Uncommitted surface runoff available for the Firka	13.35 MCM
Total volume of weathered zone	1269.3MCM
Total Aquifer volume available for recharge (considering 7 m depth from 3 m bgl)	888.51MCM
ARTIFICIAL RECHARGE /CONSERVATION MEASURES	
Structures Proposed (tentative) Masonry Check dam Nalla Bund Revival, repair of pond, tanks with recharge shaft .	 8 30 1
Improving Water Efficiency /saving (Micro irrigation system for 100 ha)	0.7 MCM
Excepted ground water recharge	0.75 MCM
Excepted total ground water recharge/saving	1.45 MCM
Tentative total cost of the project	Rs.3.39 Cr
Expected raise in water level by recharging /saving	0.46 m

Plan on Artificial Recharge to Groundwater and Water Conservation in Kattukottai Firka, Attur 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 firkas overexploited, 48 firkas critical, 235 firkas semi-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 Kattukottai firka is 126.8 sq.km and Kattukottai firka lies between North latitudes 11°29’ 43 “to 11° 39’05” and east longitudes 78° 38’ 38”to 78°45’ 50”. Location map of Kattukottai firka is given in Figure 1.

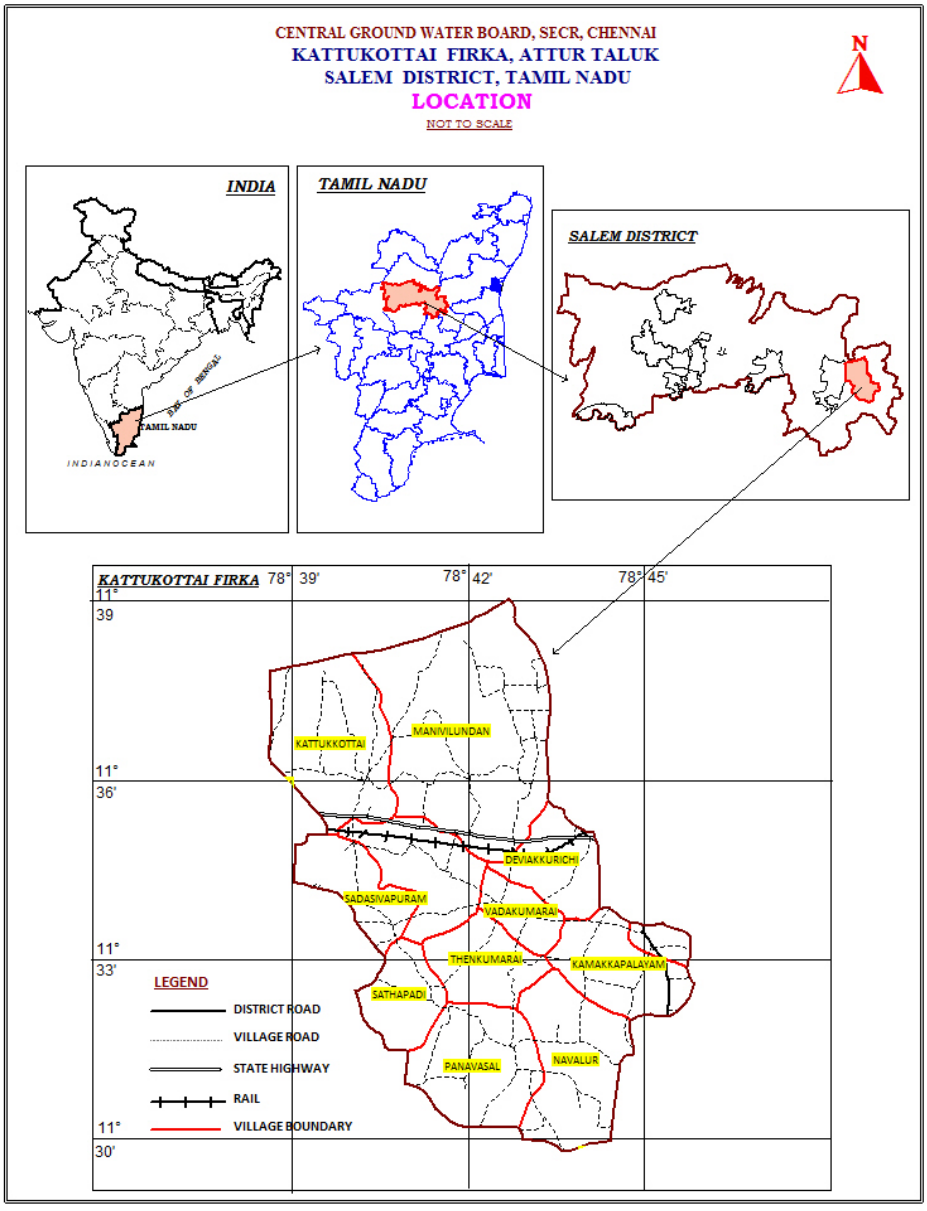


Figure 1.Location map of Kattukottai firka

3.2 Geomorphological Set up

Geomorphologically, the area consists of Pediplain , Vallyfill and hills & plates, landforms. In Pediplain landforms, (weathered) moderate and shallow are occupied major part of the firka. These landforms are influencing the ground water recharge. (*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 Kattukottai firka

LANDFORMS	% of Area
SHALLOW	18.44
DEFLECTION SLOPE	2.46
DISSECTED/UNDISSECTED	10.42
MODERATE	67.87
HILLS AND PLATES	0.50
PIEDMONT ZONE	0.30

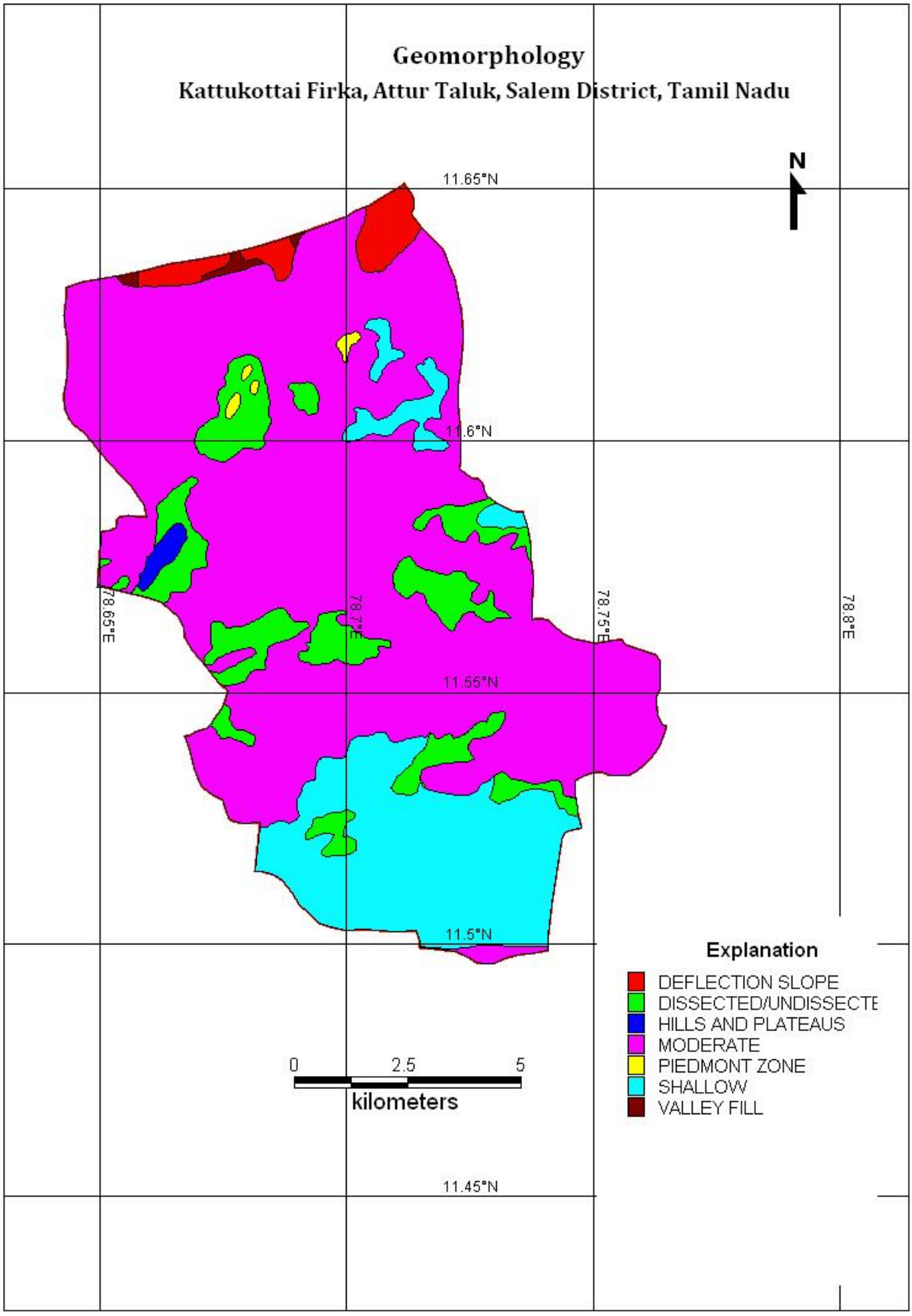


Figure 2. Geomorphology of Kattukottai Firka

3.3 Land use and soil

The land use pattern of the Kattukottai 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 about 50 % of the total area of the firka(Source: IRS, Anna university, Chennai Tamil Nadu). This area is highly suitable for water conservation and recharge.

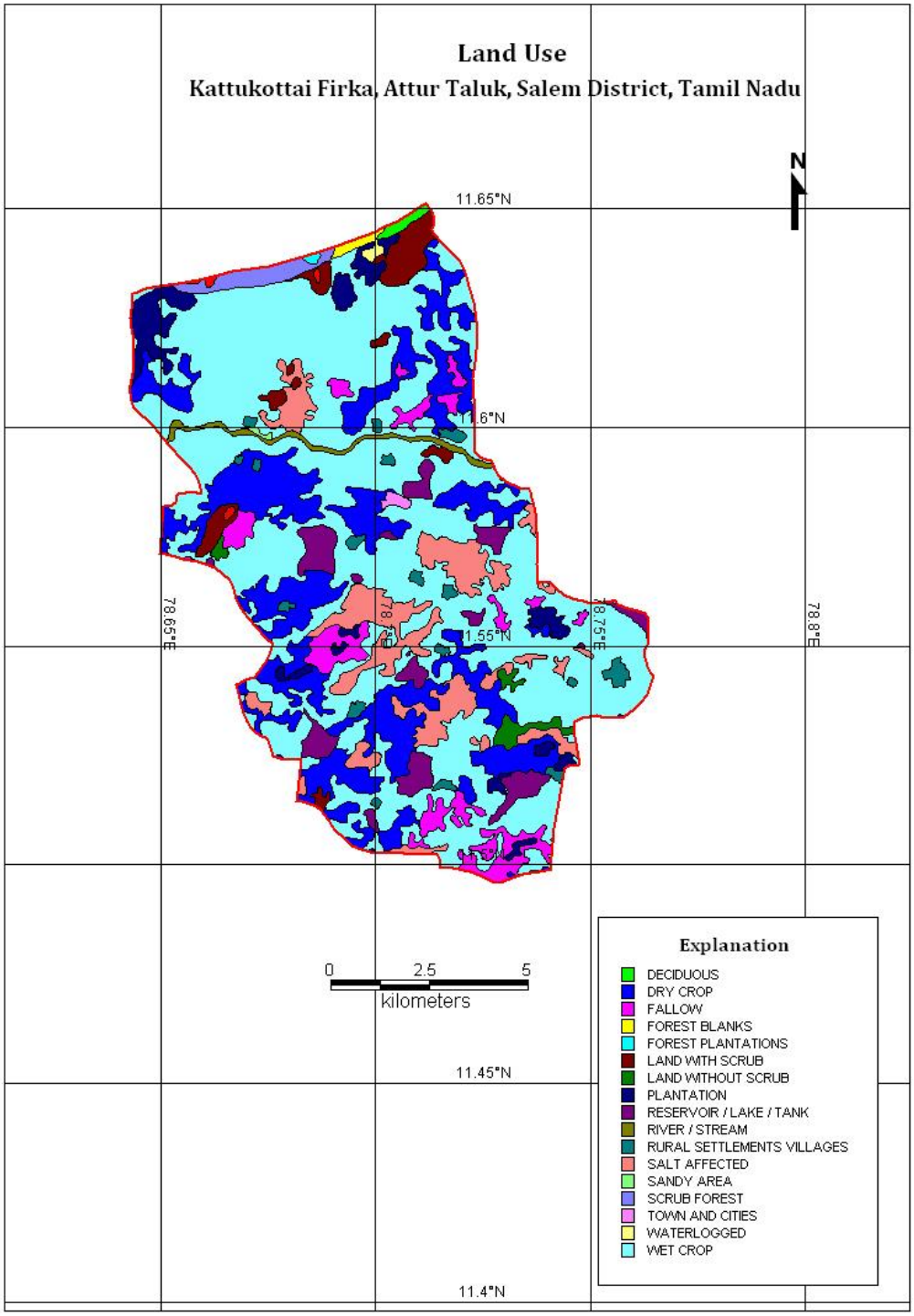
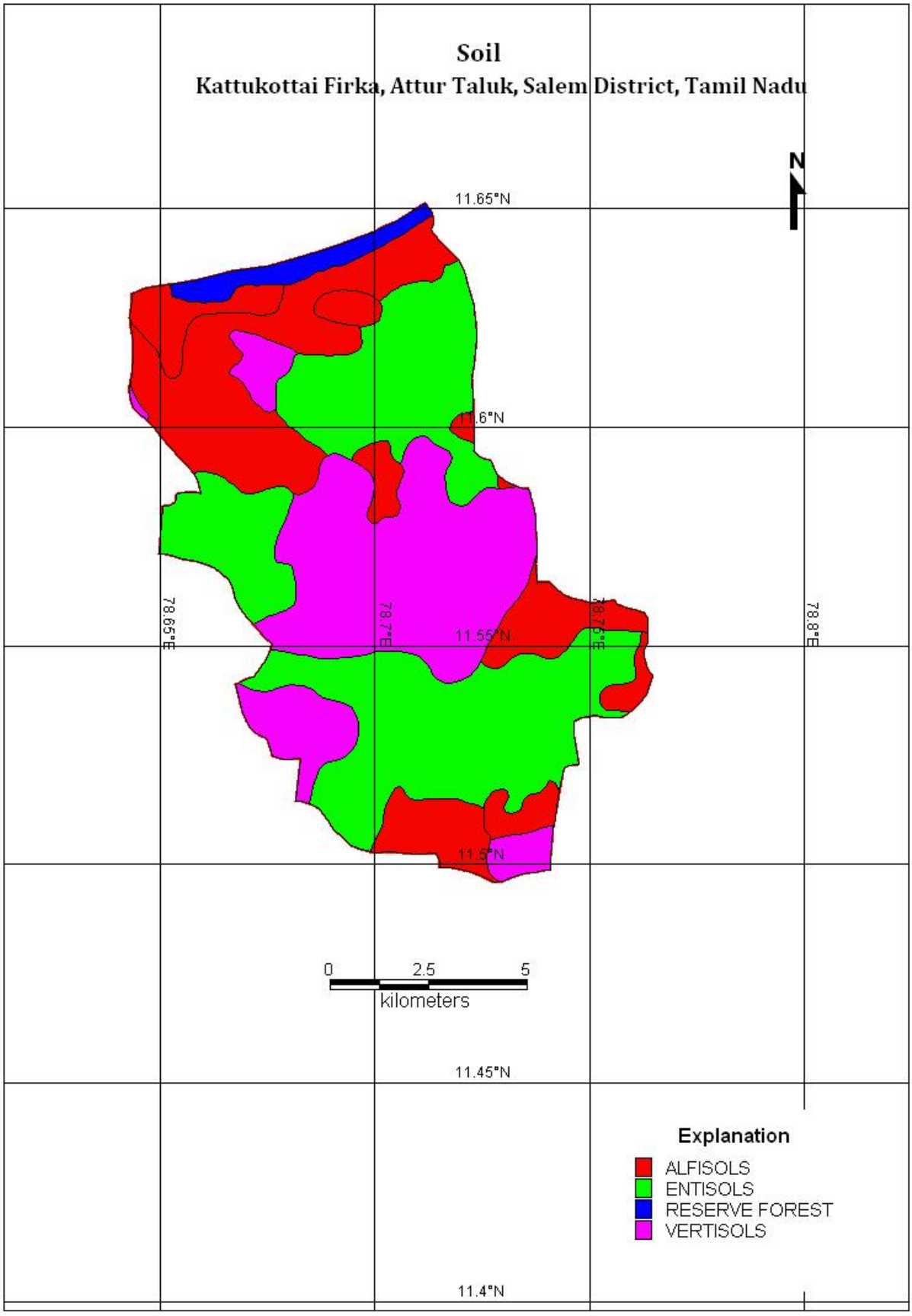


Figure 3.Landuse map of Kattukottai Firka


Soil
Kattukottai Firka, Attur Taluk, Salem District, Tamil Nadu
N
11.65°N
11.6°N
11.55°N
11.5°N
11.45°N
11.4°N
78.65°E
78.7°E
78.75°E
78.8°E
0
2.5
5
kilometers
Explanation
ALFISOLS
ENTISOLS
RESERVE FOREST
VERTISOLS

3.4 Drainage

The entire Firka area is within the Vasishta nadi river basin and number of small streams originate from the hills located in the Kattukottai 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 Kattukottai firka is given in Fig 4.

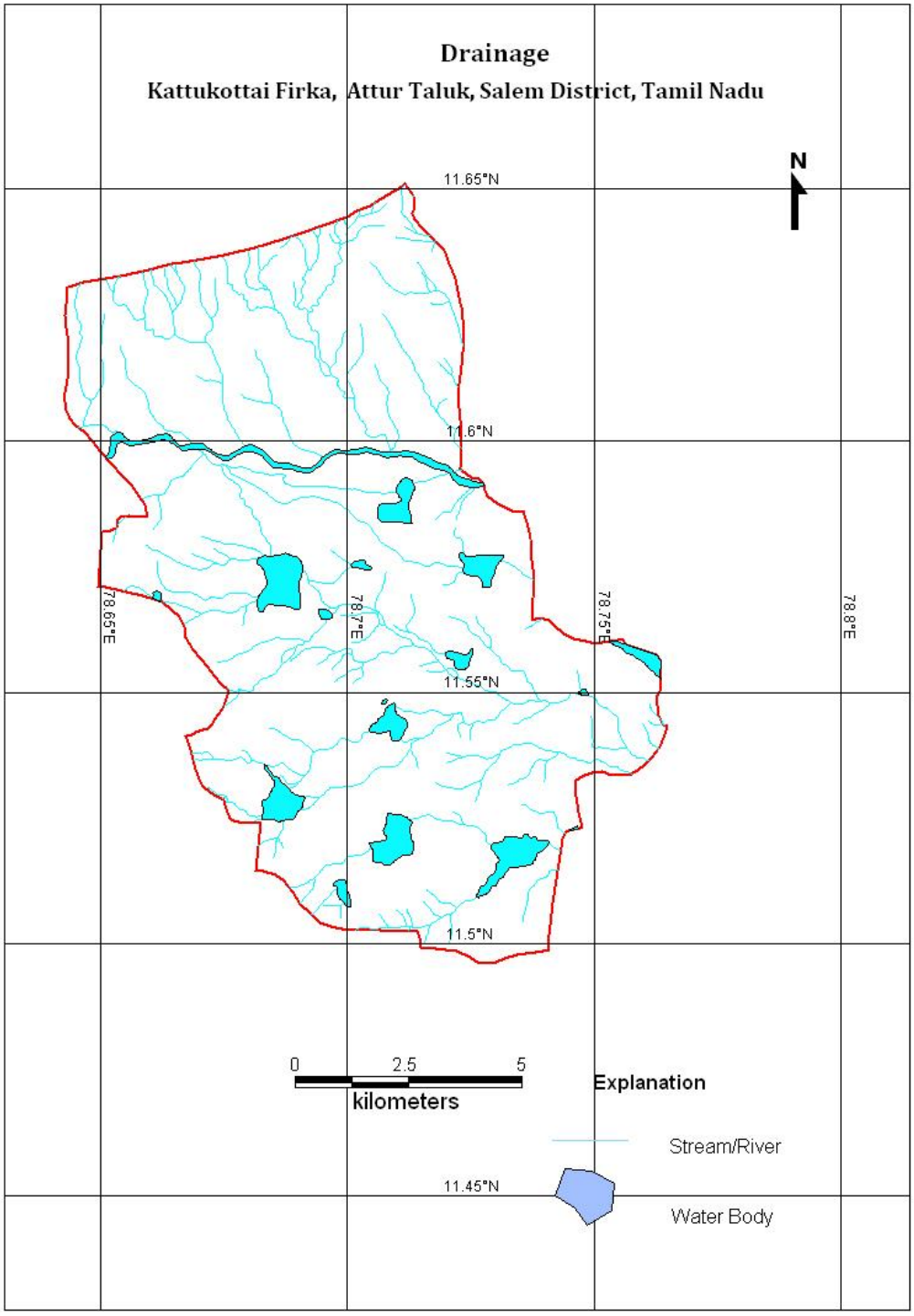


Figure 4. Drainage map of Kattukottai Firka

3.5 Rainfall

The Attur 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
Kattukottai	Kattukottai	126.8	0.701	0.121	0.822

3.6 Hydrogeology

The entire firka is underlain by the Gneiss, Charnockite and Mylonite. 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 6 to 9 m and depth of dug wells range from 12 to 17 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 hydrogeological map of Kattukottai 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 < 5m ground water level.

The present water level in the firka is in the range of 2 to 10.4 m bgl.(May 2016)

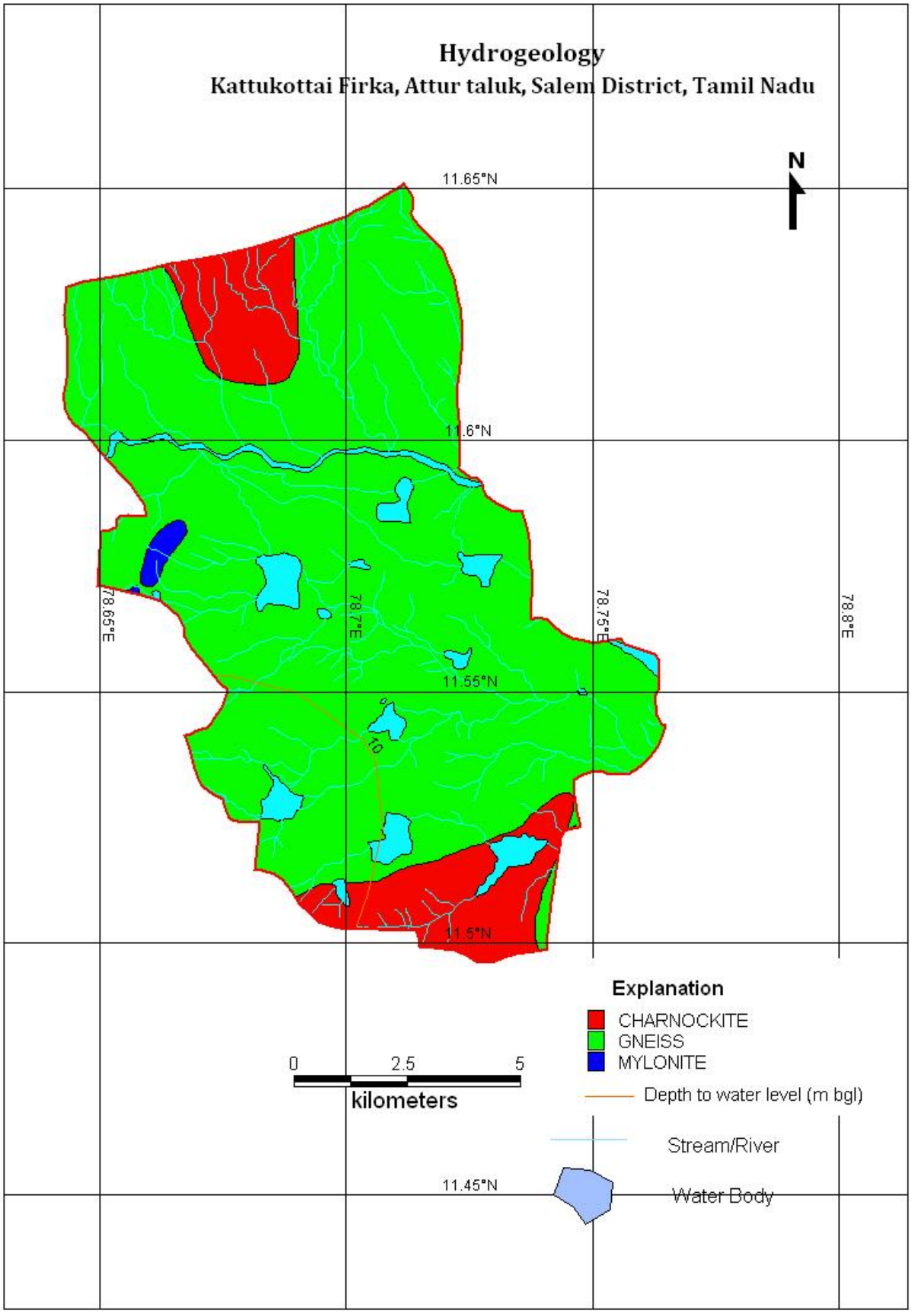


Figure 5: Hydrogeological Map of Kattukottai Firka

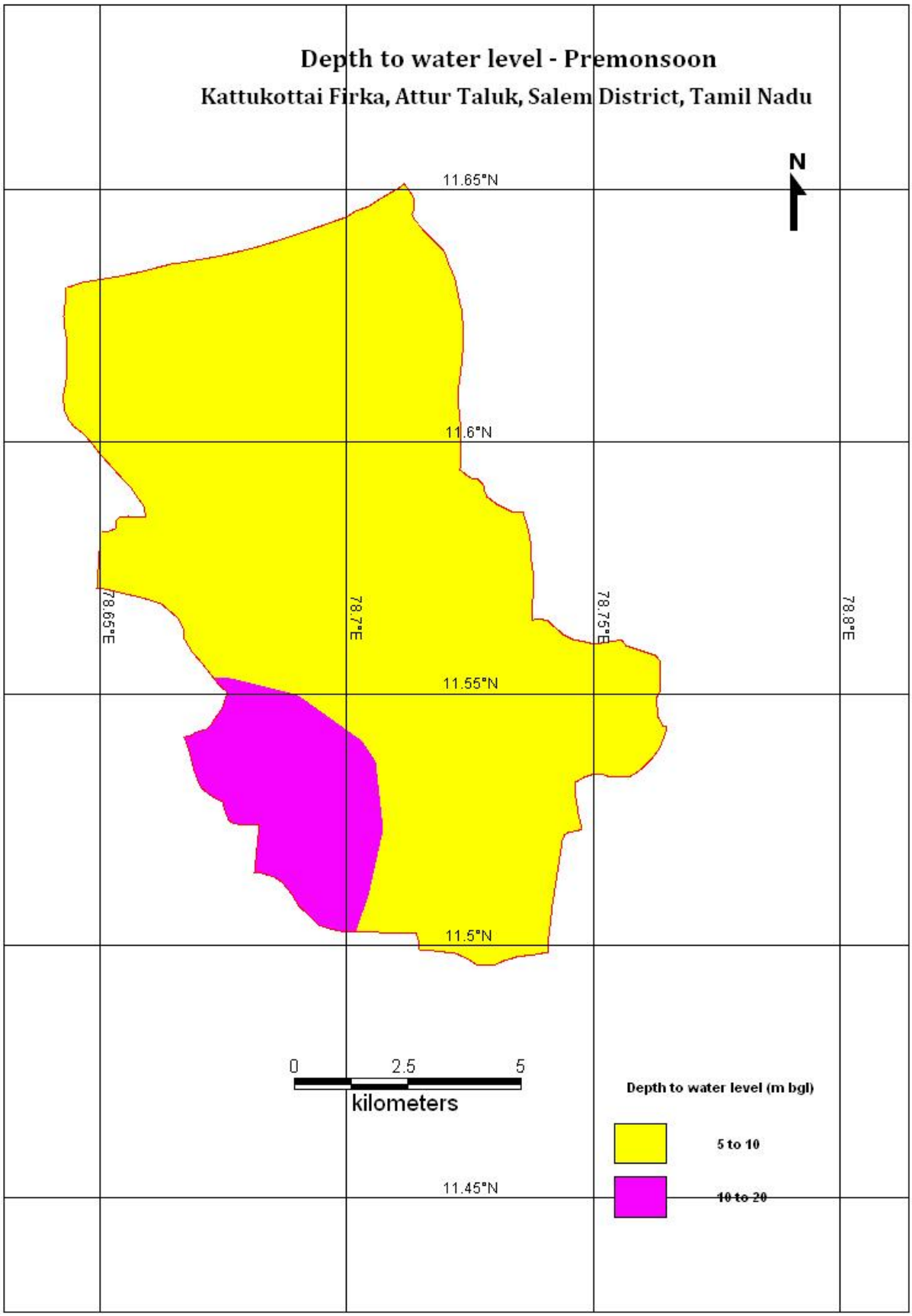


Figure 6a.Pre -monsoon water level in Kattukottai firka (Decadal mean)

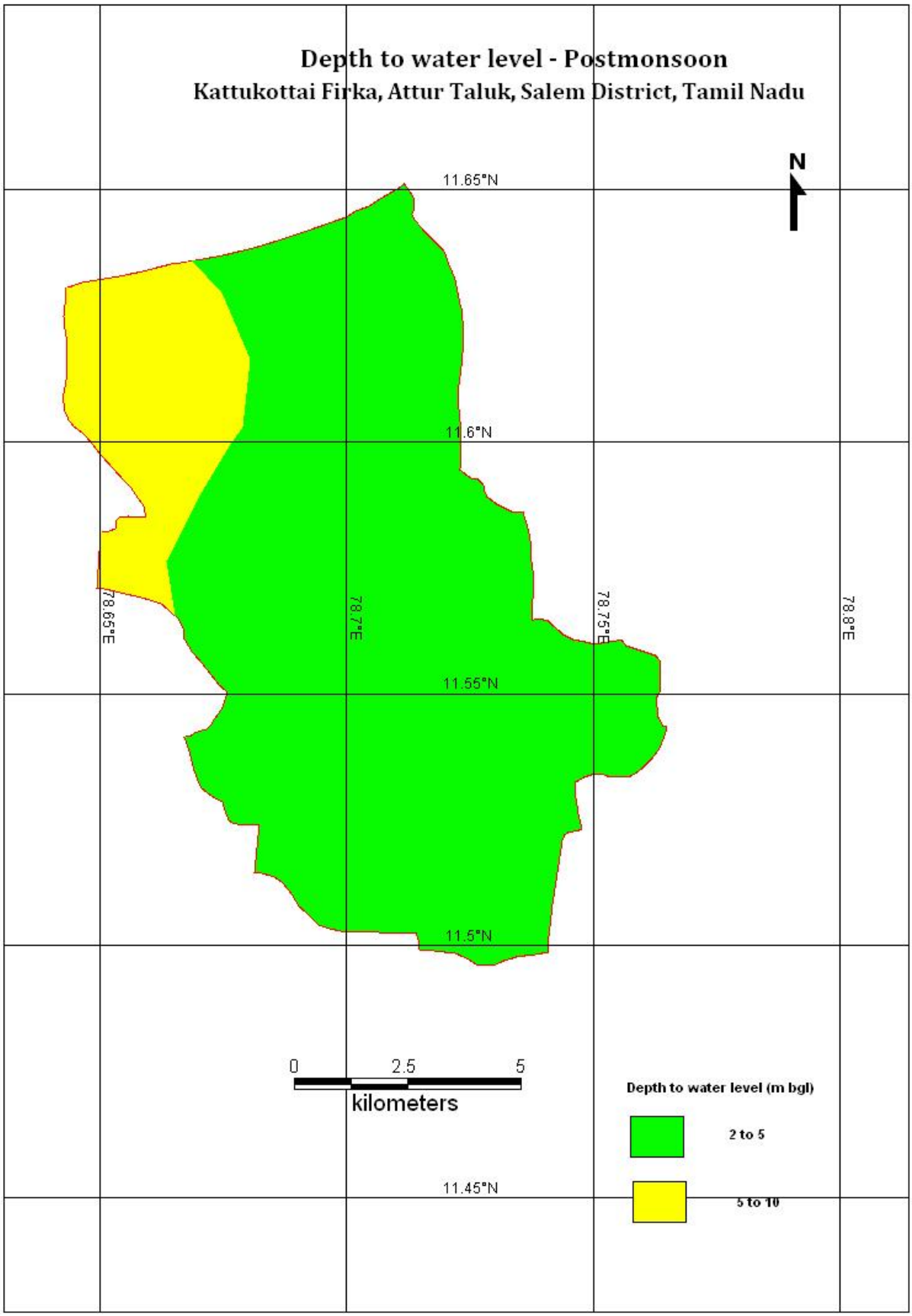


Figure 6 b. Post-monsoon water level in Kattukottai firka (Decadal mean)

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 Kattukottai 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)					%	
Kattukottai	126.8	21.5278	19.375	32.1165	0.77378	32.8903	169.756	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	08	Suitable for all major recharge structures like Percolation pond and Nallabund, check dam etc.,
High	17	Suitable for all major recharge structures like Nallabund, check dam etc.,
Moderate	60	Suitable for all major recharge structures like earthen check dam, Boulder check dam and Nala bund etc.,
Poor	15	Hilly/Forest /Catchment area

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

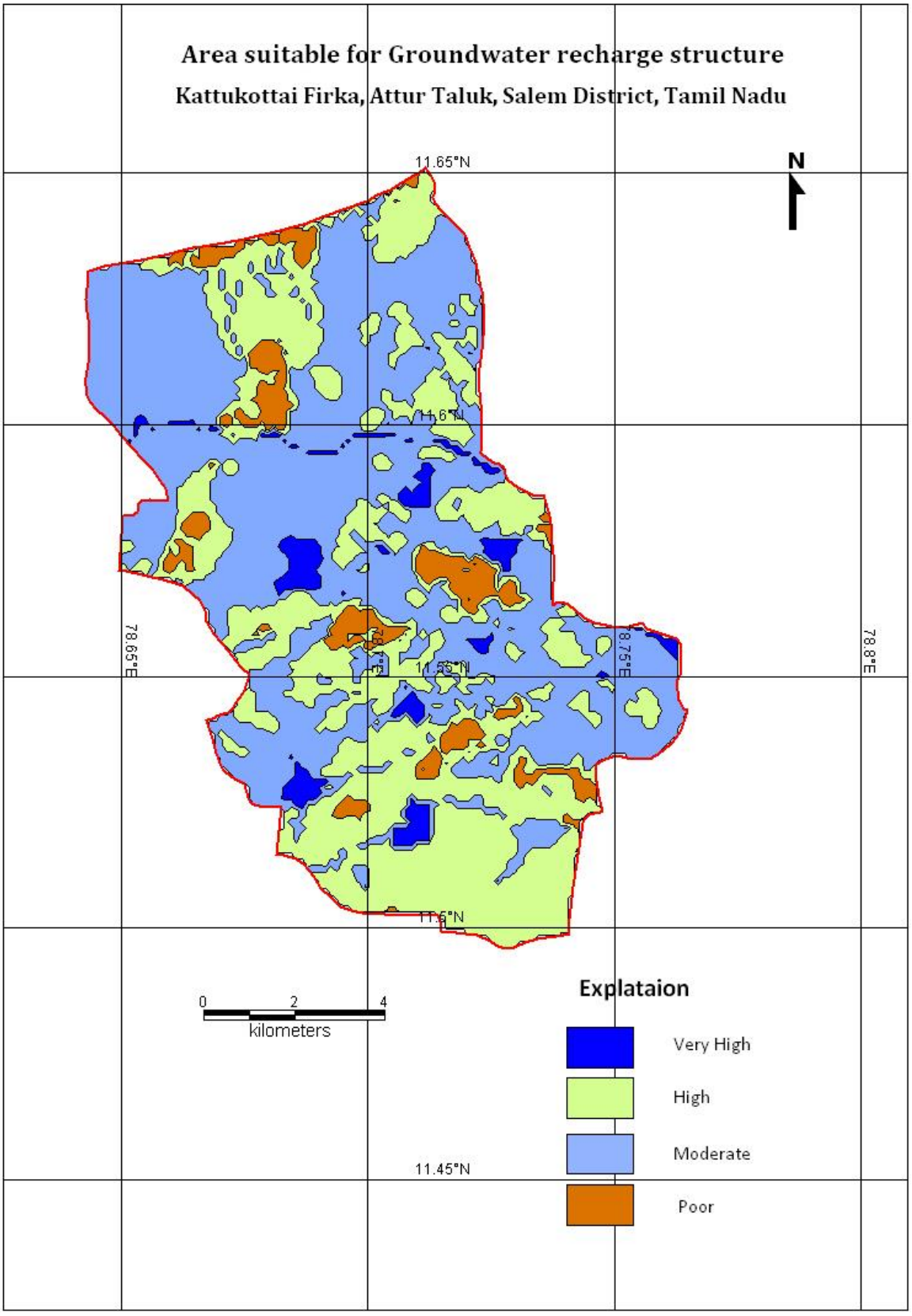


Figure 7 : Showing the recharge worthy area Kattukottai firka

5. Planning for groundwater recharge /conservation

5.1 Justification of the artificial recharge & conservation measures

- The Kattukottai Firka is with high stage of groundwater development i.e, 169.756 % and with sufficient amount of uncommitted surface runoff/flow of 13.35 MCM.
- The total weathered zone available beneath the ground in the firka is 1269.3MCM. Out of these total volume available for recharge (considering 7m depth from 3mbgl) is 888.51MCM.
- The Kattukottai Firka consists of No. of surface 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.
- 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 kattukottai areas reveals that about 85 % of areas are suitable for recharge.
- In Kattukottai firka more than 50 % 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 Kattukottai 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 Kattukottai Firka is 13.35 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 /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/Nalla bund

Kattukottai firka area is covered by the seasonal nallas/drains which carry heavy discharge during monsoon period this is debauched into the water bodies within a short duration. It is proposed that such seasonal nalla rivers will be identified and the rain water will be harnessed through construction of series of check dams, nalla 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 firka areas are suitable for these structures. It is proposed to construct 8 Check dam and 30 Nalla bunds. The tentative location of these 38 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 Nalla bund and Check dams in Kattukottai firka

S.No	Longitude	Latitude	Structure
1	78.6456	11.6175	Nalla bund
2	78.659	11.6089	Nalla bund
3	78.66	11.6214	Nalla bund
4	78.6648	11.6235	Nalla bund
5	78.6707	11.6265	Nalla bund
6	78.6845	11.6295	Nalla bund
7	78.6937	11.6357	Nalla bund
8	78.7151	11.6289	Nalla bund
9	78.7116	11.6422	Nalla bund
10	78.7009	11.6145	Nalla bund
11	78.7145	11.6129	Nalla bund
12	78.7081	11.6062	Nalla bund
13	78.6985	11.6371	Nalla bund
14	78.7146	11.5034	Nalla bund
15	78.7372	11.5109	Nalla bund
16	78.6946	11.5148	Nalla bund
17	78.6774	11.5365	Nalla bund
18	78.689	11.5405	Nalla bund
19	78.6857	11.5538	Nalla bund
20	78.6686	11.5662	Nalla bund
21	78.7044	11.556	Nalla bund
22	78.6686	11.5696	Nalla bund
23	78.6718	11.5746	Nalla bund
24	78.6624	11.5897	Nalla bund
25	78.7292	11.5352	Nalla bund
26	78.7271	11.537	Nalla bund
27	78.7546	11.5385	Nalla bund
28	78.7384	11.5362	Nalla bund
29	78.7292	11.5584	Nalla bund
30	78.6868	11.6058	Nalla bund

S.No	Longitude	Latitude	Structure
1	78.6477	11.6055	Check Dam
2	78.6746	11.6101	Check Dam
3	78.6911	11.6195	Check Dam
4	78.6922	11.6238	Check Dam
5	78.7214	11.6253	Check Dam
6	78.7493	11.536	Check Dam
7	78.7312	11.5491	Check Dam
8	78.7086	11.5626	Check Dam

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 one existing ponds/tanks have been identified with latitude and longitude given below and marked on Plate 1.The above 1 tanks/ponds could be taken up for the renovation with recharge shaft.

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

S.No	Longitude	Latitude	Structure
1	78.7478	11.55	Desiltation with recharge shaft

5.3.2 Water conservation measure

5.3.2.1 Farm Pond

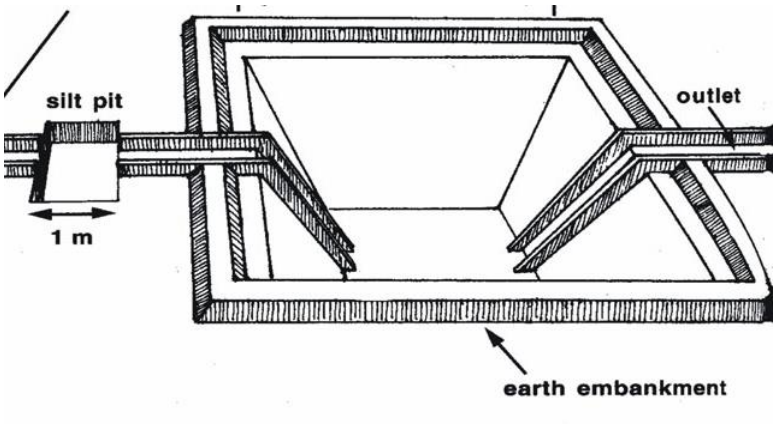
A farm pond is a large dug out in the earth, usually square or rectangular in shape, which harvests rainwater and stores it for future use. It has an inlet to regulate inflow and an outlet to discharge excess water. The pond is surrounded by a small bund, which prevents erosion on the banks of the pond.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

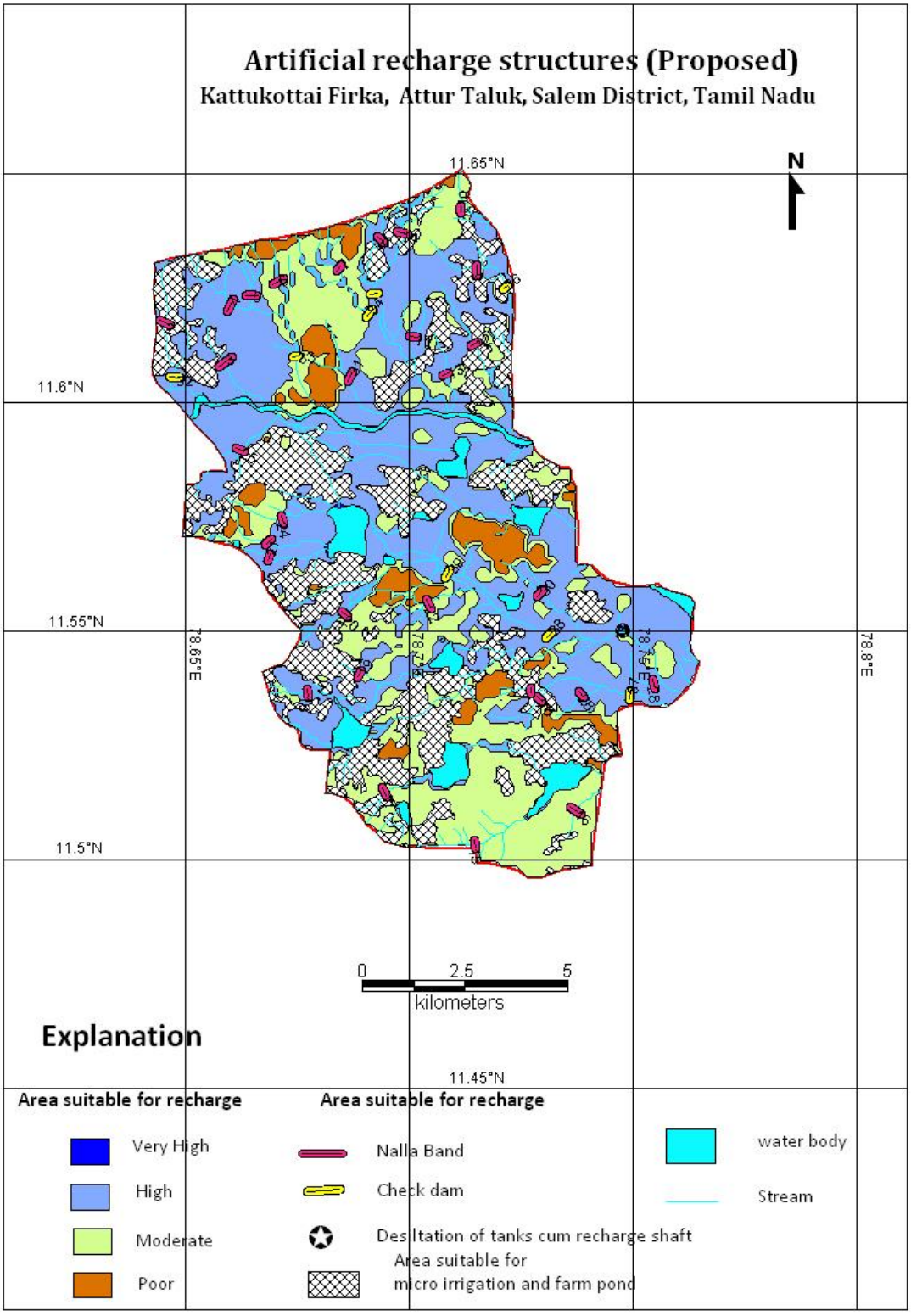


Figure 8. Location map showing the proposed AR Structures in Kattu kottai firka

6. Tentative Cost Estimation

A tentative number of feasible structures, its cost and expected annual ground water recharge /water saving is given in the table 7. The unit rates are as followed by the PWD, Govt. of Tamil Nadu (Sources: Schedule of rates, Govt. of Tamil Nadu 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 to 1.5 m	8	136000	9	72	108800
Nala bunds/ Gabion (4 Fillings)	Width: 5 to 15 m	30	90000	2.0	60	72000
Revival, repair of water bodies (3 fillings)	(~100mx100mx2.5m)	1	75000	12.0	12	60000
Recharge shaft (within pond /tank)	Recharge shaft of 1.5 m dia. with 2 m depth with filter media in lower 1 m Bore dia 10" Casing 6" Depth 30 m	1		2	2	
Water Conservation Activities						
Farm Pond (in ha) (5 filling)	(30 m x 30m x 1.5 m)	100 unit	600000	1	100	510000
Sprinkler/ drip/ HDPE pipes	For 1 ha with 5 m interval HDPE pipe	100 ha	1000000	0.6 /ha	60	700000
				Sub total	**306**	**1450800**
Impact assessment and O & M						
PiezometersUp to 50 m bgl – 5 nos. @ 0.6 lakh					**3**	
Total cost of the project					**309**	
O & M - 5 % of total cost of the scheme					**15.45**	
Impact assessment -5 % of total cost of the scheme					**15.45**	
				TOTAL	**339.9**	

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 ground water recharge as well as effective utilisation of the artificial recharge structures.

7. Implementation 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 Coimbatore district 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								

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 to have impact assessment at the rate of 5 % of the total cost of the project for 5 years from the completion of artificial recharge structures.

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CONSERVE WATER FOR SUSTENANCE, PROSPERITY AND HAPPINESS

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