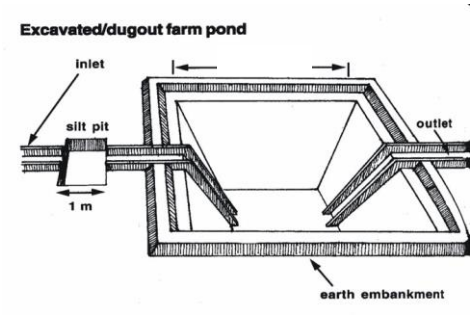
Plan on Artificial Recharge to Groundwater and Water Conservation in Thirumalagiri Firka, Salem Taluk, SalemDistrict, Tamil Nadu



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AT GLANCE	
Name of Firka	Thirumalagiri
Taluk	Salem
District	Salem
State	Tamil Nadu
Total area	66.96
Total Area suitable for recharge	50.22
Lat. & Lon.	11°36’58” to 11°41’44” & 78° 01’07”to78°06’ 18”.
Rainfall	0.980 m
Monsoon	0.795 m
Non- Mon soon	0.185 m
Geology	Gneiss, Quartzite &Ultramafic/Ultrabasic rocks
WATER LEVEL	
Pre - Monsoon	2.5 to 15.5 m bgl.
Post - Monsoon	1.5 to 11.5 m bgl.
GROUND WATER RESOURCES ESTIMATION	
Replenish able ground water resources	6.00 MCM
Net ground water available	5.40 MCM
Ground water draft for irrigation	8.00 MCM
Groundwater draft for domestic & industrial water supply	0.266 MCM
Total ground water draft	8.27 MCM
Stage of ground water development (%)	153 %
Uncommitted surface runoff available for the Firka	7.98 MCM
Total volume of weathered zone	669.6 MCM
Total aquifer volume available for recharge	468.72MCM
ARTIFICIAL RECHARGE /CONSERVATION MEASURES	
Structures Proposed (tentative) Masonry Check dam Nalla Bund Revival, repair of pond, tanks with recharge shaft .	 5 8 6
Improving Water Efficiency /saving (Micro irrigation system for 100 ha)	0.7 MCM
Excepted ground water recharge	0.95 MCM
Excepted total ground water recharge/saving	1.65 MCM
Tentative total cost of the project	Rs.3.37Cr
Expected raise in water level by recharging /saving	1.26 m

Plan on Artificial Recharge to Groundwater and Water Conservation in ThirumalagiriFirka, Salem 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 firkaoverexploited, 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 Thirumalagirifirka is 49.003 sq.km lies between North latitudes 11°36’58“to 11°41’44” and east longitudes 78°01’07”to 78°06’18”. Location map of Thirumalagirifirka is given in Figure 1.

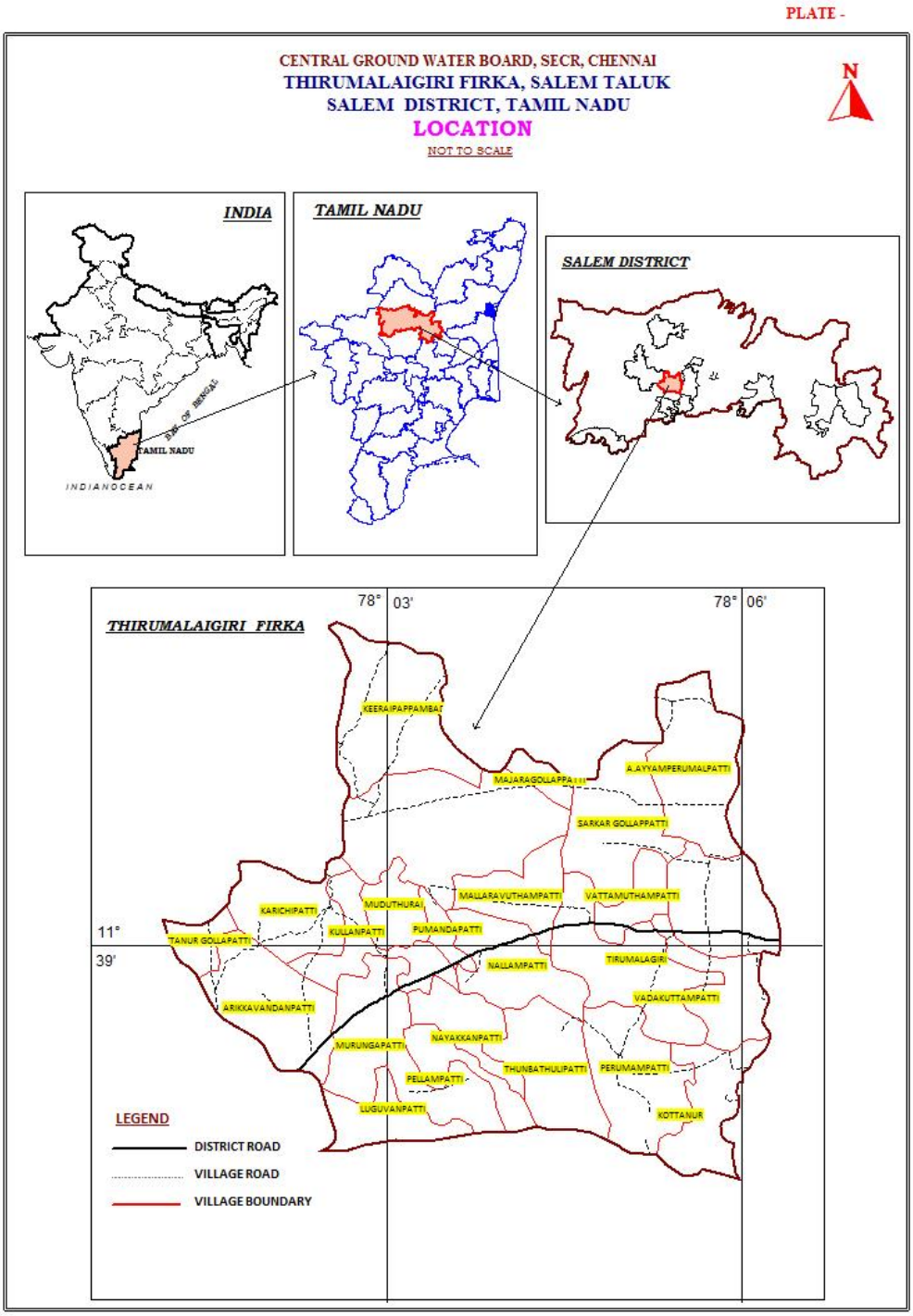


Figure 1. Location map of Thirumalagirifirka

3.2 Geomorphological Set up

Geomorphologically, the area consists of hills and plain landforms. In plain landforms, Pediplainweathered 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 Thirumalagiri firka

LAND FORM	**AREA (Sq.km)**	**% AREA**
SHALLOW	24.97	51.84
DISSECTED/UNDISSECTED	5.95	12.35
PEDIMENT-INSELBERG COMPLEX	8.58	17.82
MODERATE	3.73	7.74
STRUCTURAL HILLS	4.94	10.25

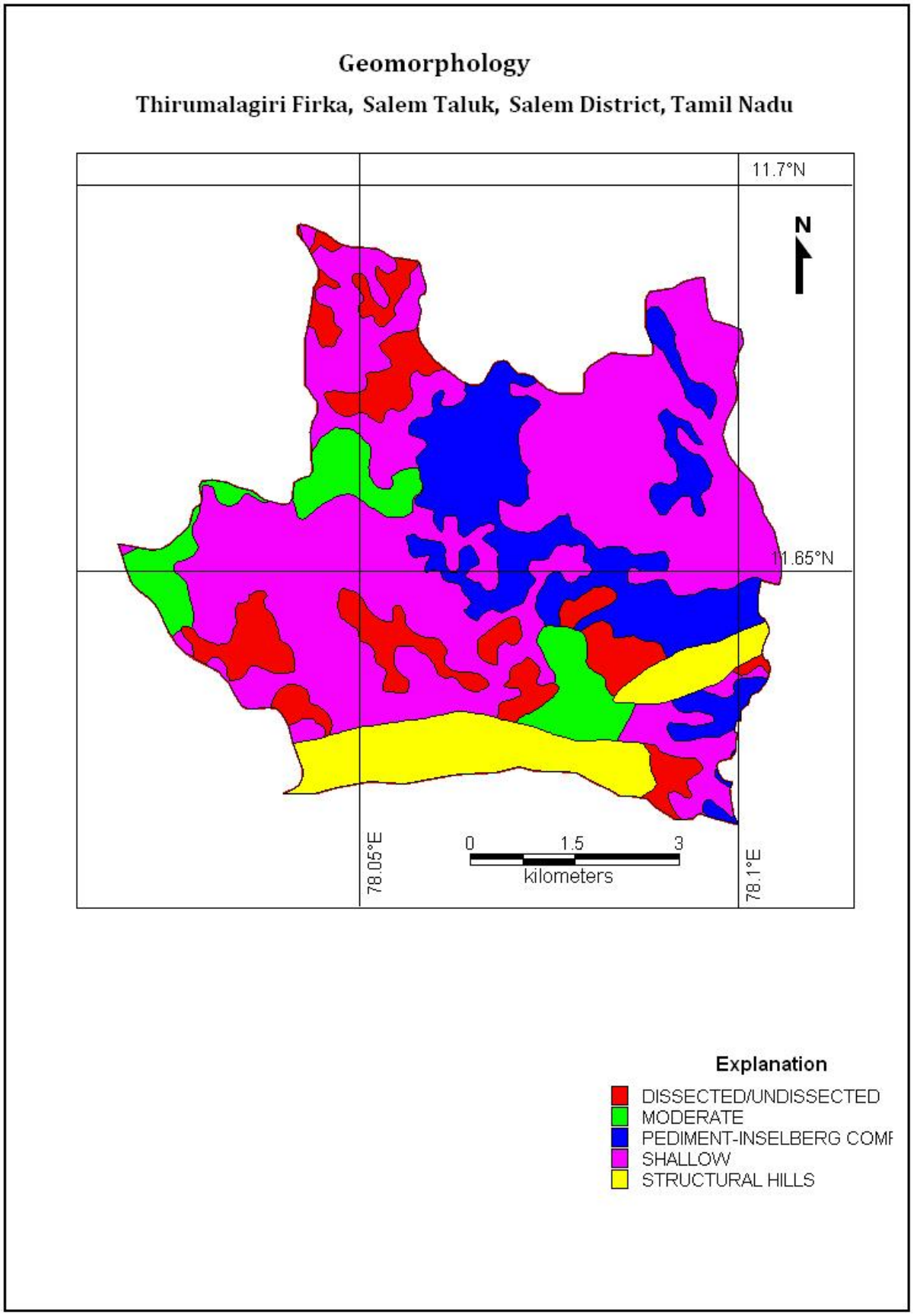


Figure 2. Geomorphology of ThirumalagiriFirka

3.3 Land use and soil

The land use pattern of theThirumalagiriFirka 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 63 % 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 rock outcrops withalfisols soil andvertisolssoil.

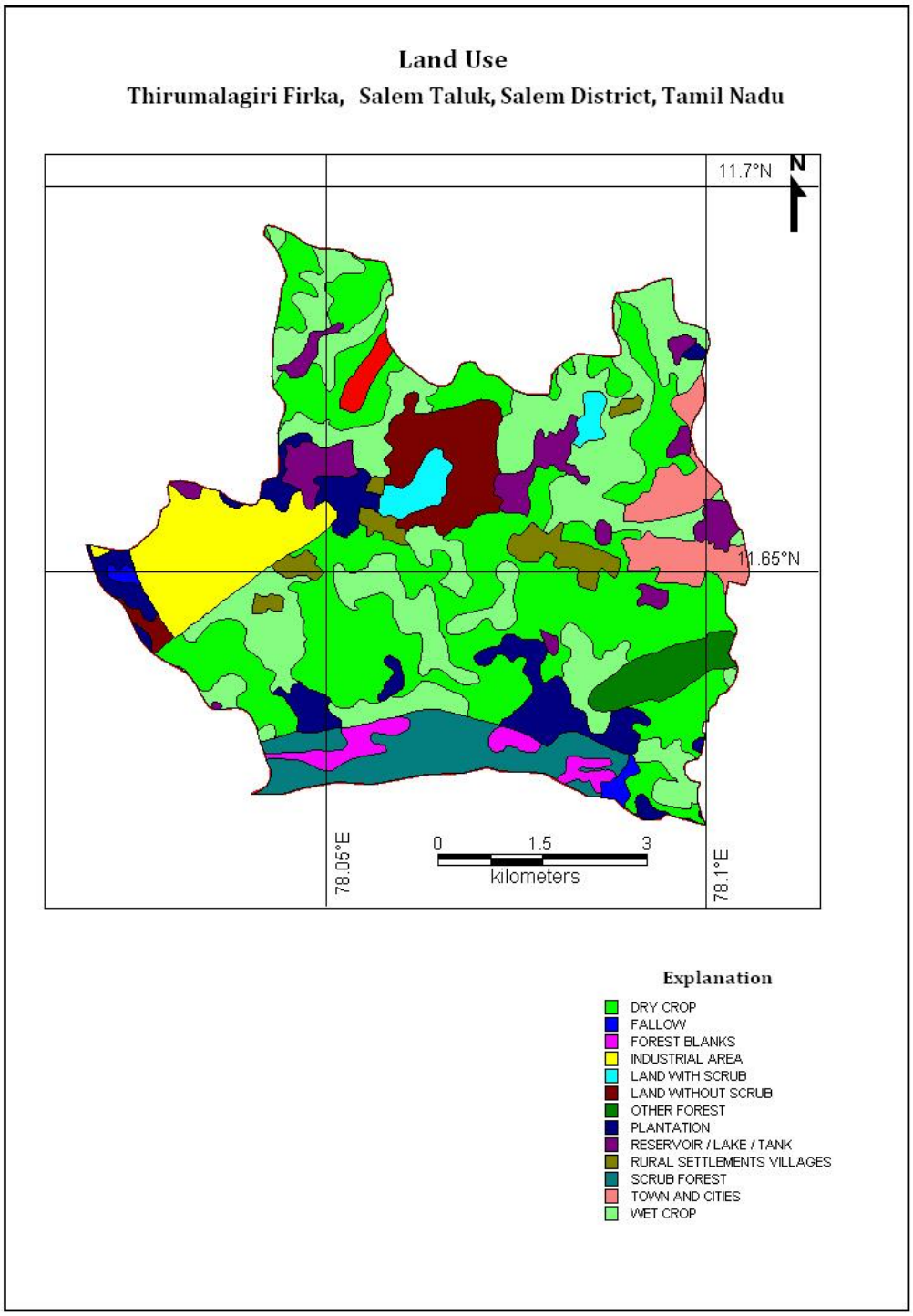
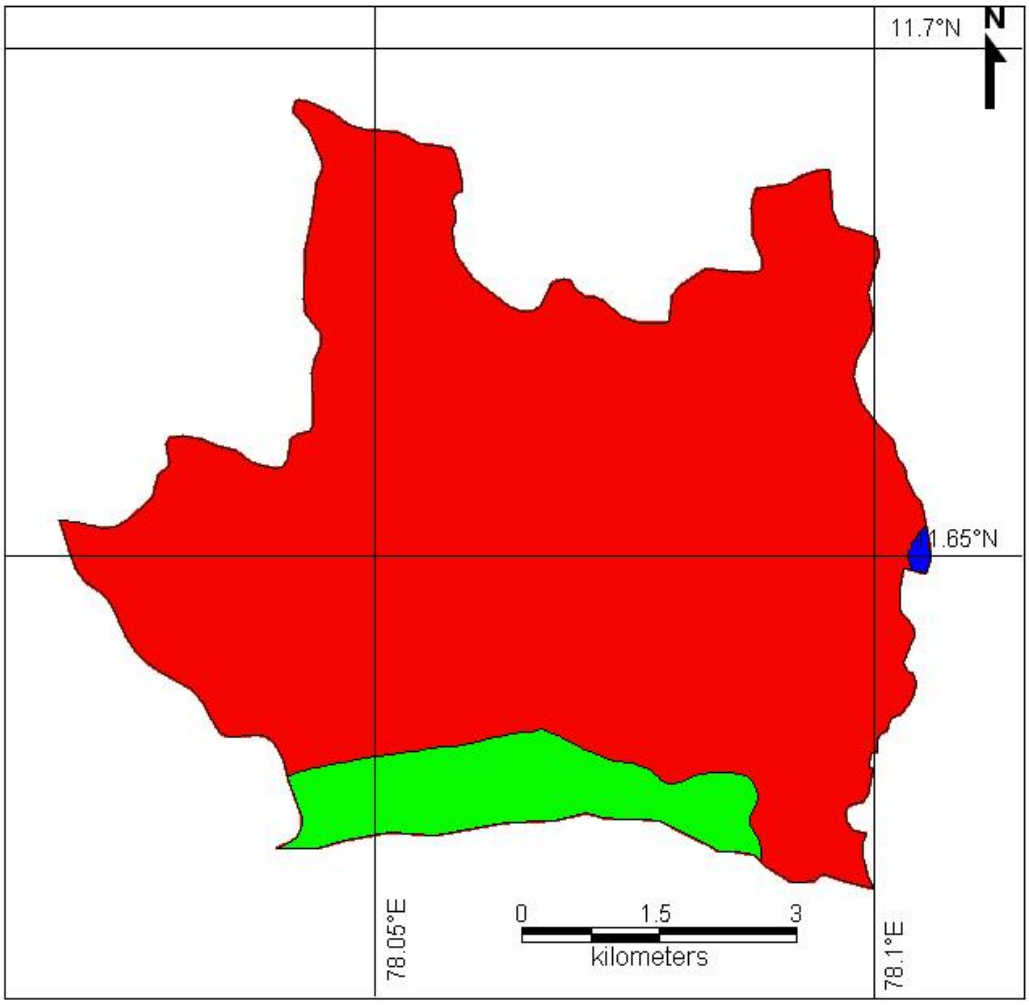


Figure 3.Landuse map of ThirumalagiriFirka

Soil

Thirumalagiri Firka, Salem Taluk, Salem District, Tamil Nadu



Explanation

- ALFISOLS
- RESERVE FOREST
- VERTISOLS

3.4 Drainage

The entire Firka area is within the Cauvery river basin.Thirumanimuttarriver. 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 Thirumalagirifirka is given in Fig 4.

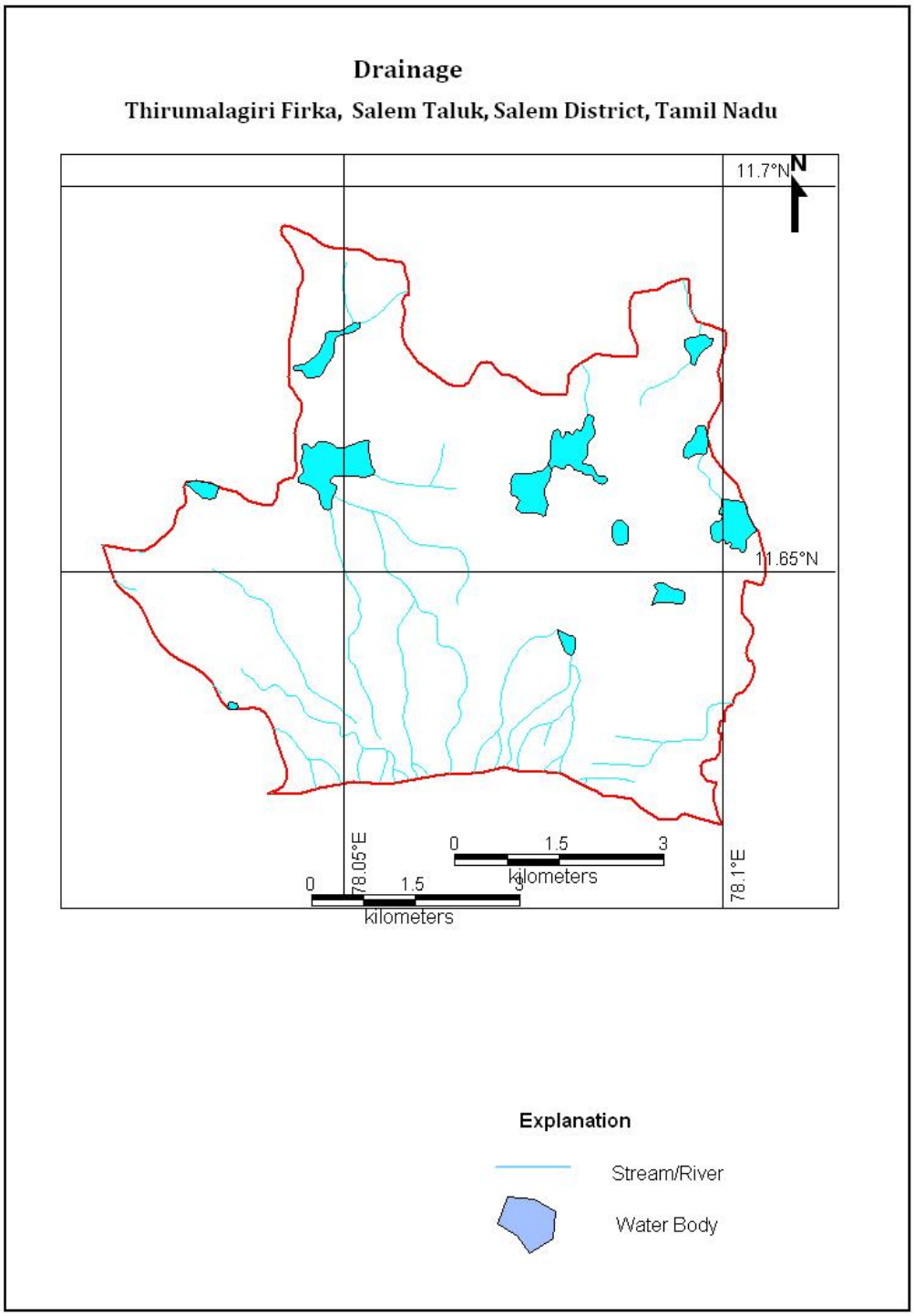


Figure 4.Drainage map of ThirumalagiriFirka

3.5 Rainfall

TheThirumalagirifirka 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
Salem	Thirumalagiri	66.96	0.795	0.185	0.980

3.6 Hydrogeology

The entire firka is underlain by gneiss,quartzite and ultramafic rocks.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 4 to 6 m and depth of dug wells range from 14 to 19m 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 Thirumalagiri firka is given in Figure 5.Decadal mean water level ofpre-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> 6 m bgllikewise during post monsoon majority part is under <10m ground water level.

The present water level in the firka is in the range of 1.5 to 11.5 m bgl.(May 2016)

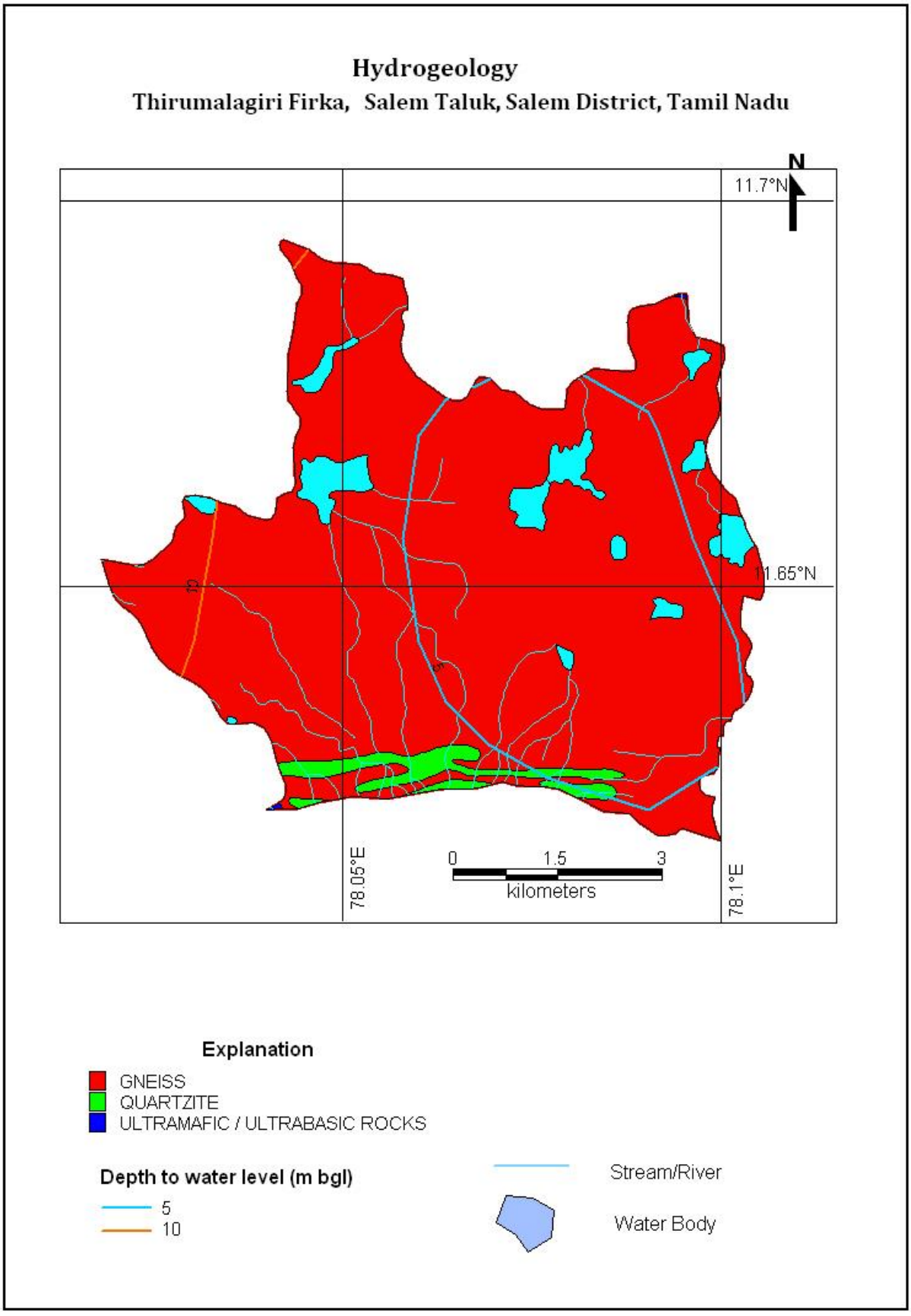


Figure 5Hydrogeological Map of ThirumalagiriFirka

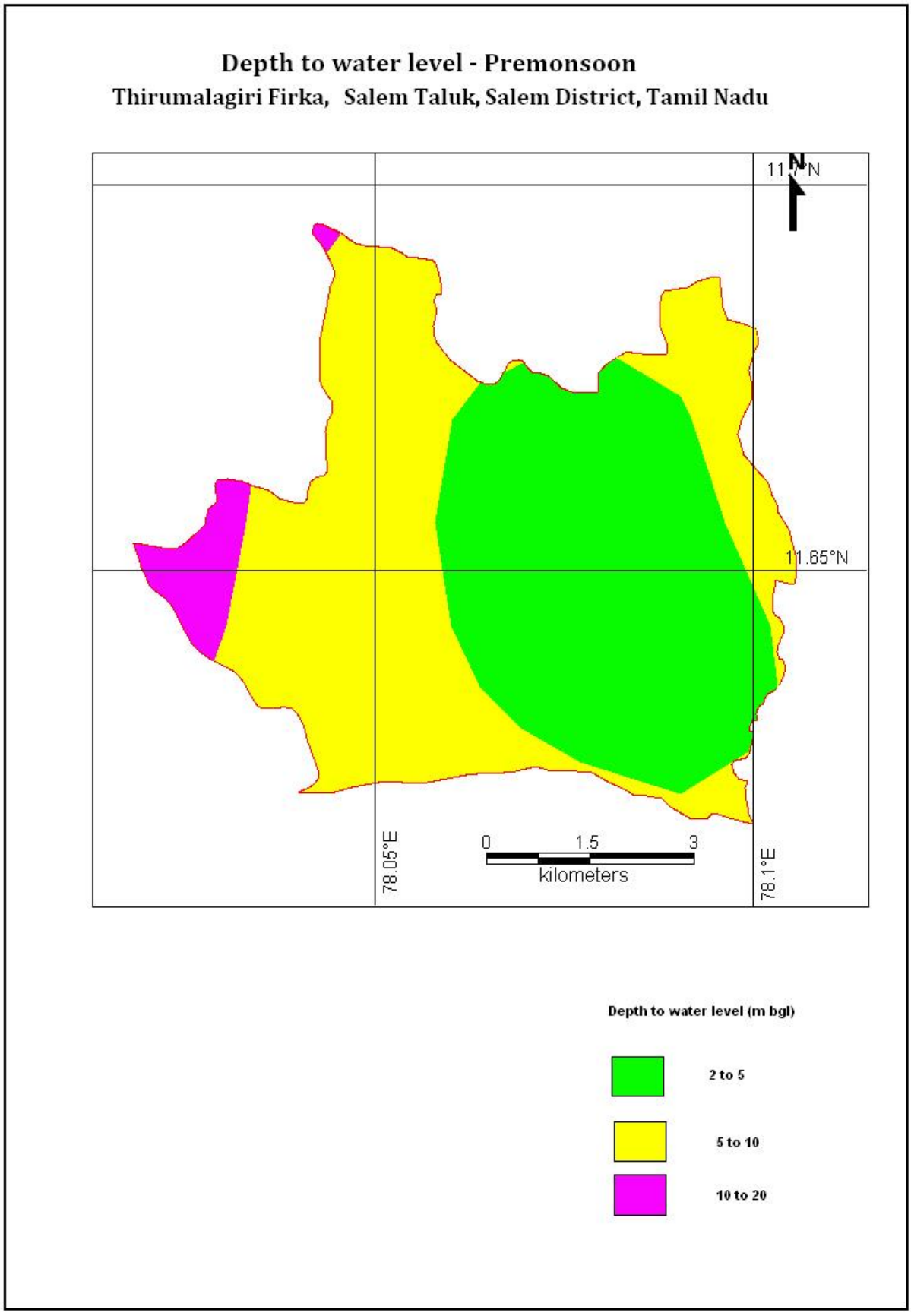


Figure 6a.Pre -monsoon water level in Thirumalagirifirka (Decadal Mean)

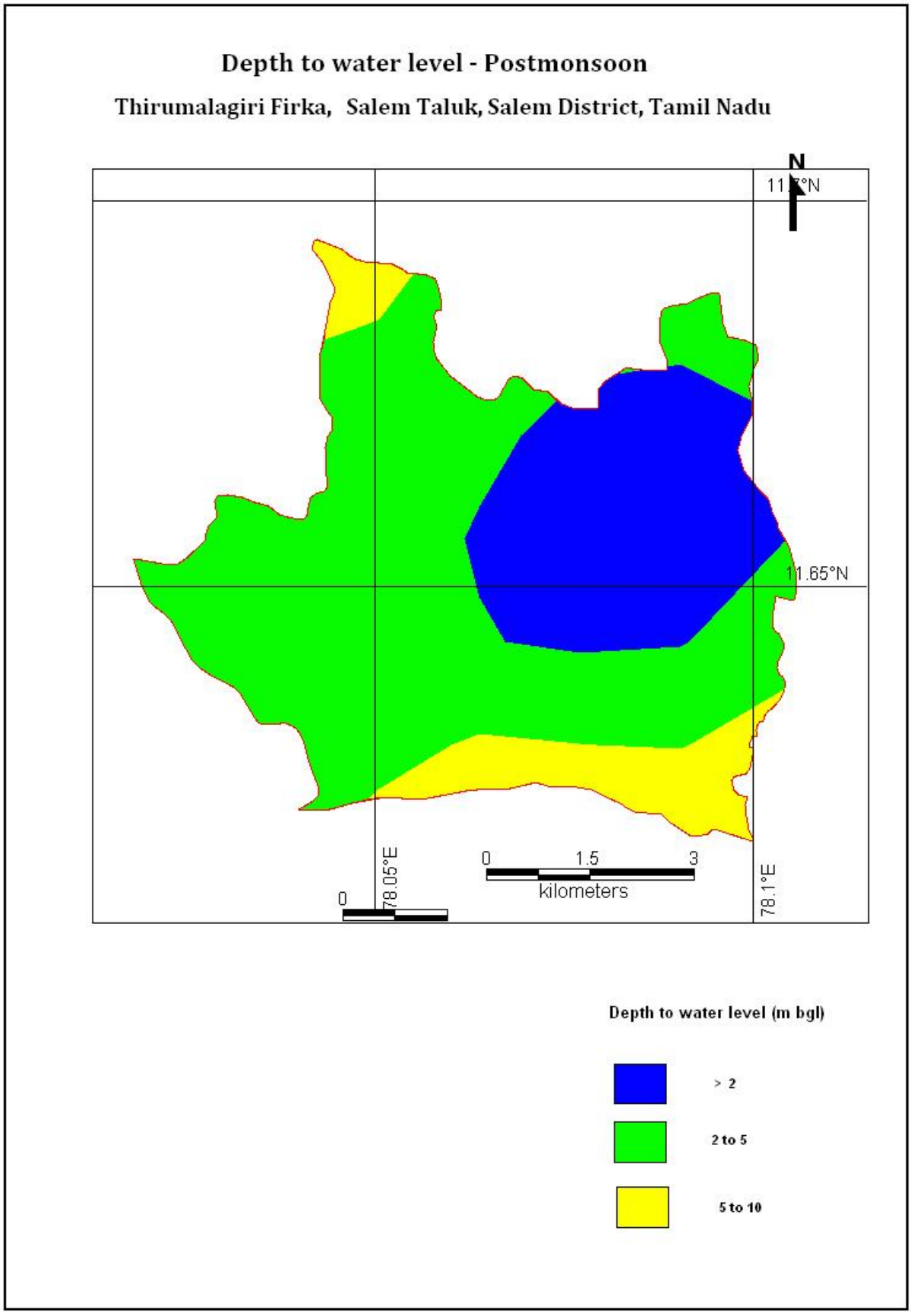


Figure 6 b. Post-monsoon water level in Thirumalagirifirka(Decadal Mean)

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 Veerapandi 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)					%	
Veerapandy	66.96	6.00	5.4	8.00	0.266	8.26	153	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,aboveseven layers have been integrated byassigningweightage 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	3	Suitable for all major recharge structures like Percolation pond and nalla bund, check dam etc.,
High	25	Suitable for all major recharge structures like nalla bund, check dam etc.,
Moderate	47	Suitable for all major recharge structures like earthen check dam, Boulder check dam and Nalla bund etc.,
Poor	25	Hilly/Forest /Catchment area

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

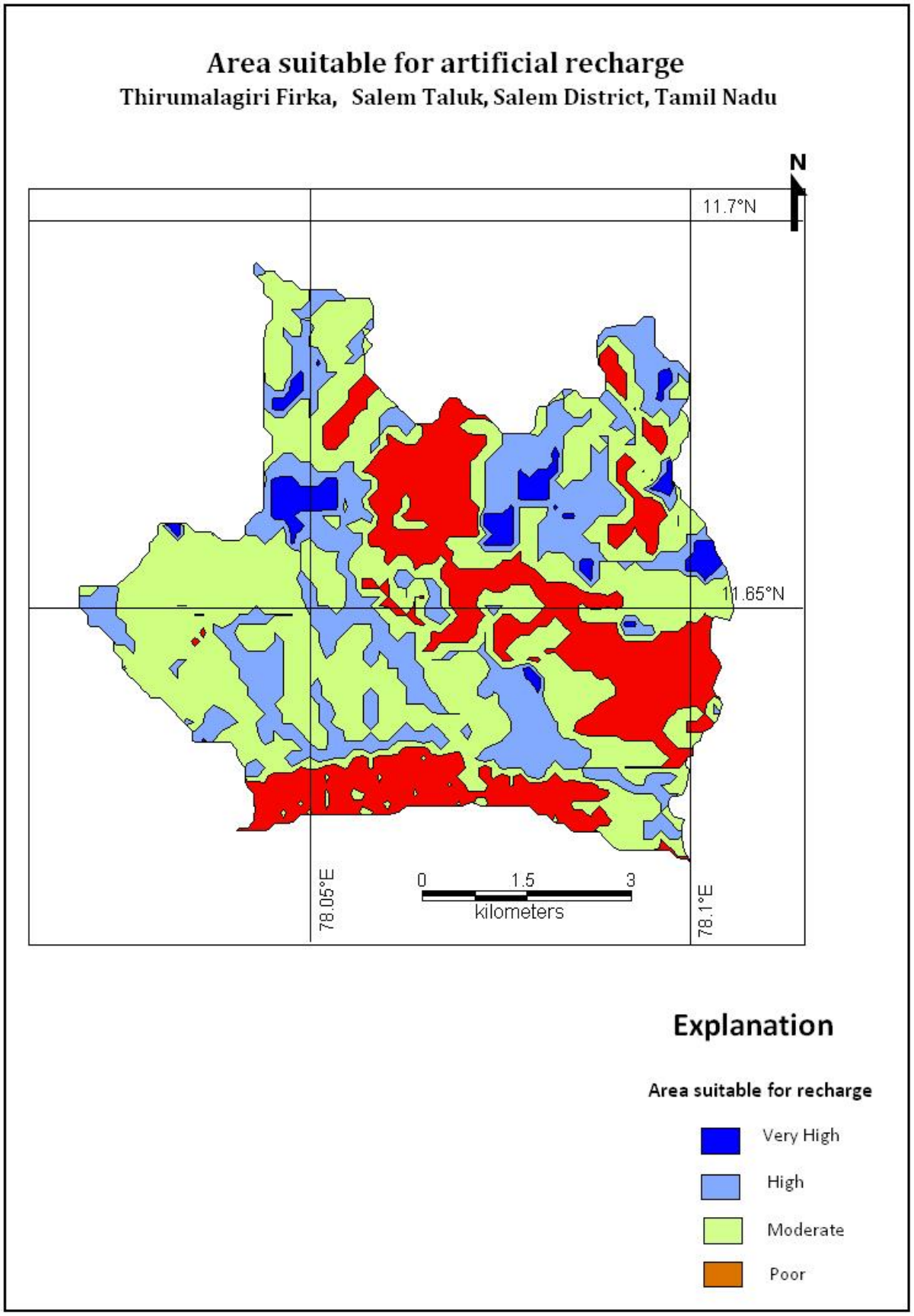


Figure. 7. Showing the recharge worthy area Thirumalagirifirka

5. Planning for groundwater recharge /conservation

5.1 Justification of the artificial recharge & conservation measures

- The ThirumalagiriFirka is with high stage of groundwater development i.e, 153 % and with sufficient amount of uncommitted surface runoff/flow of 7.985 MCM.
- The total weathered zone available beneath the ground in the firka is 10 m. Out of this total volume available for recharge is 468.72 MCM.
- The ThirumalagiriFirka consists number 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 theThirumalagiriareas reveals that more than 75 % of areas are suitable for recharge.
- In Thirumalagirifirka63 % 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 ThirumalagiriFirka 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 ThirumalagiriFirka is 7.985 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/Nala bund

Thirumalagirifirka area is covered by the seasonal nallahs/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 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. It is proposed to construct 5Check dam and 8Nala bunds. 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 five Check dam in Thirumalagirifirka

S.No	Longitude	Latitude	Structure
1	78.0477	11.6304	Check Dam
2	78.0578	11.6487	Check Dam
3	78.0804	11.6338	Check Dam
4	78.098	11.6315	Check Dam
5	78.0715	11.6361	Check Dam

Tentative location of proposed eightNalla bunds in Thirumalagirifirka

S.No	Longitude	Latitude	Structure
1	78.0468	11.6257	Nalla Bund
2	78.0504	11.6399	Nalla Bund
3	78.0583	11.6355	Nalla Bund
4	78.0654	11.6384	Nalla Bund
5	78.0753	11.6322	Nalla Bund
6	78.0743	11.6288	Nalla Bund
7	78.0901	11.6253	Nalla Bund
8	78.0596	11.6537	Nalla 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 six existing ponds/tanks have been identified with latitude and longitude given below and marked on Plate 1.The above sixtanks/ponds could be taken up for the renovation with recharge shaft.

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

S.No	Longitude	Latitude	Structure
1	78.0306	11.661	Desiltation with recharge shaft
2	78.0969	11.6672	Desiltation with recharge shaft
3	78.0794	11.6403	Desiltation with recharge shaft
4	78.0863	11.6551	Desiltation with recharge shaft
5	78.0928	11.6471	Desiltation with recharge shaft
6	78.0967	11.6795	Desiltation with recharge shaft

5.3.2 Water conservation measure

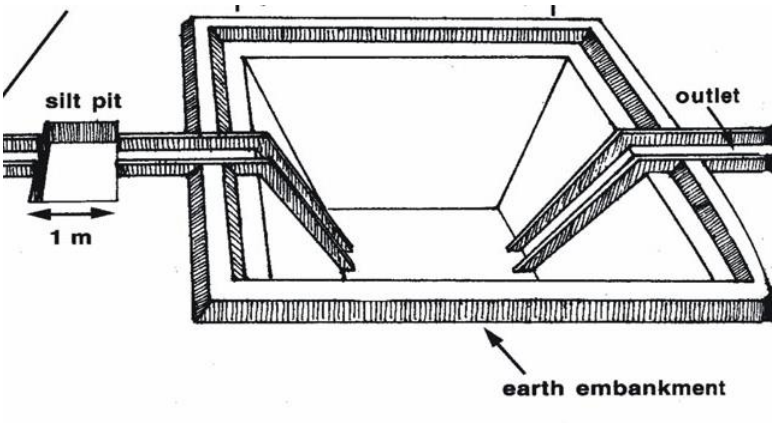
5.3.2.1 Farm Pond

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 Landuseclassification 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).



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. The cost estimation for this component has been taken from SOR of Agricultural Engineering Department (AED), Govt. of Tamil Nadu.Tentativelocations of proposed micro irrigation are shown in Plate 1.

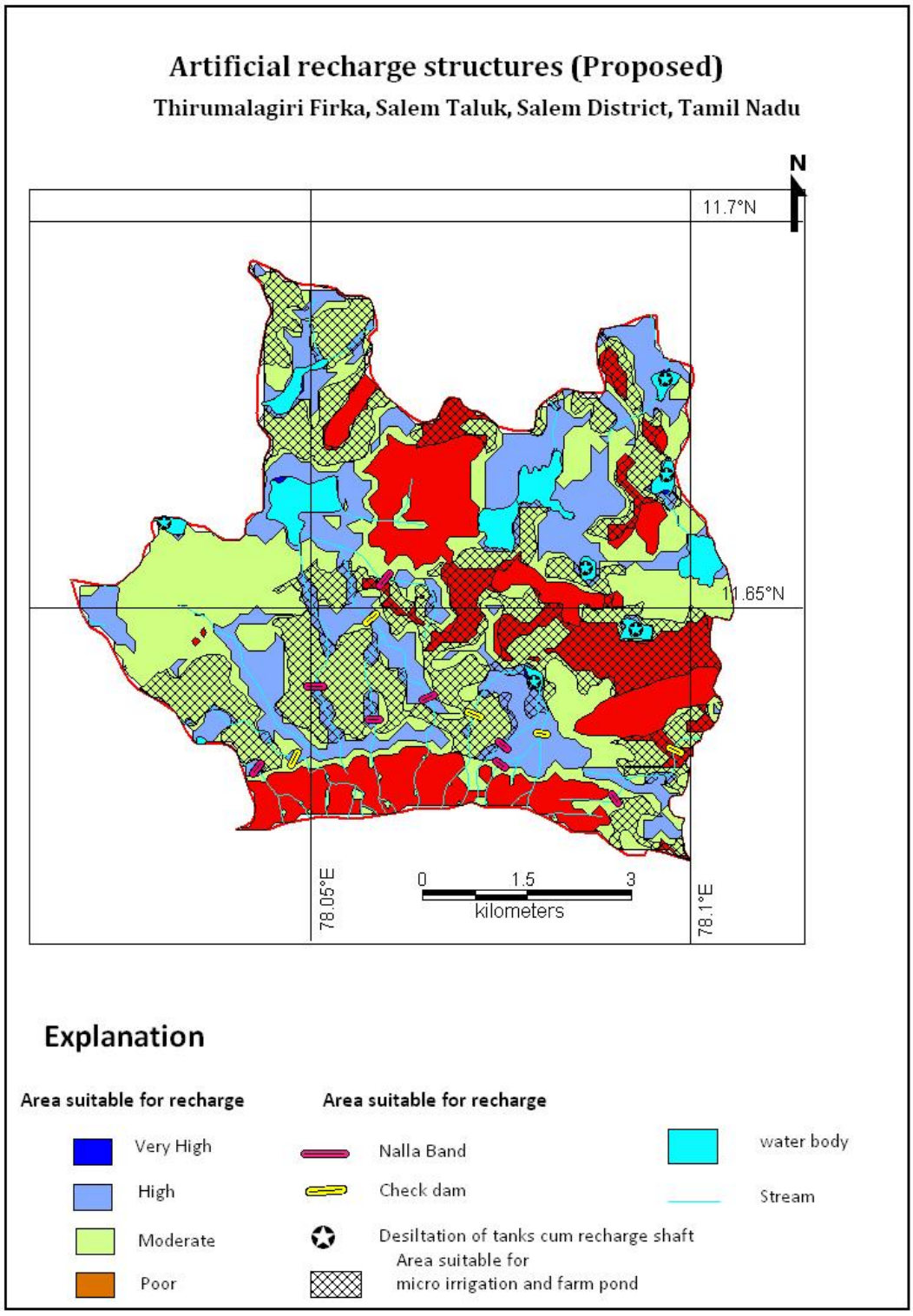


Figure8. Location map showing the proposed AR Structures in Thirumalagirifirka

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 ofrates, 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	5	85000	9	45	68000
Nala bunds/ Gabion (4 Fillings)	Width: 5 to 15 m	8	24000	2.0	16	19200
Revival, repair of water bodies (3 fillings)	(~100mx100mx2.5m)	6		12.0	72	
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	6	450000	2	12	360000
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	**305**	**1657200**
Impact assessment and O & M						
PiezometersUp to 50 m bgl – 3 nos. @ 0.6 lakh					**1.8**	
Total cost of the project					**306.8**	
O & M - 5 % of total cost of the scheme					**15.34**	
Impact assessment -5 % of total cost of the scheme					**15.34**	
				TOTAL	**337.48**	

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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