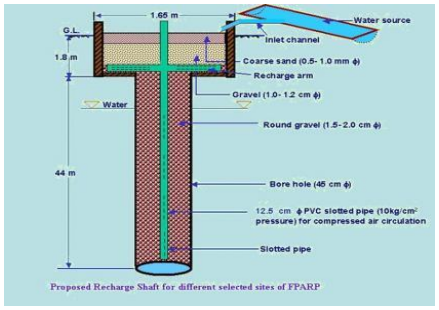
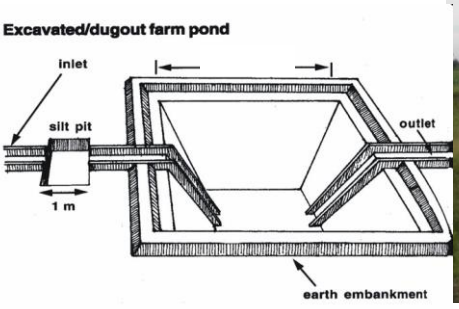
Plan on Artificial Recharge to Groundwater and Water Conservation in Attur Firka, Attur Taluk, Salem District, Tamil Nadu



Proposed Recharge Shaft for different selected sites of FPARP



By

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

Content

AT GLANCE	
Name of Firka	Attur
Taluk	Attur
District	Salem
State	Tamil Nadu
Total area	132.32
Total Area suitable for recharge	105.85
Lat. & Lon.	11°27’ 33 “to 11° 39’44” & 78° 31’ 57”to 78°39’ 31”.
Rainfall	0.821m
Monsoon	0.701 m
Non- Mon soon	0.121 m
Geology	Gneiss, Charnockite and basic rock
WATER LEVEL	
Pre - Monsoon	1.1 to 20.15 m bgl.
Post - Monsoon	2.2 to 12.15 m bgl.
GROUND WATER RESOURCES ESTIMATION	
Replenish able ground water resources	21.24 MCM
Net ground water available	19.12 MCM
Ground water draft for irrigation	33.16 MCM
Groundwater draft for domestic & industrial water supply	0.69 MCM
Total ground water draft	33.85 MCM
Stage of ground water development (%)	177 %
Uncommitted surface runoff available for the Firka	13.92 MCM
Total volume of weathered zone	1323 MCM
Total aquifer volume available for recharge (considering 7 m depth from 3 m bgl	926.1 MCM
ARTIFICIAL RECHARGE /CONSERVATION MEASURES	
Structures Proposed (tentative) Masonry Check dam Nalla Bund Revival, repair of pond, tanks with recharge shaft .	 13 60 6
Improving Water Efficiency /saving (Micro irrigation system for 100 ha)	0.7 MCM
Excepted ground water recharge	1.19 MCM
Excepted total ground water recharge/saving	1.89 MCM
Tentative total cost of the project	Rs.5.33 Cr
Expected raise in water level by recharging /saving	1.29 m

Plan on Artificial Recharge to Groundwater and Water Conservation in Attur 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, 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 Attur firka is 132.32 sq.km and Attur firka lies between North latitudes 11°27’ 33 “to 11° 39’44” and east longitudes 78° 31’ 57”to 78°39’ 31”. Location map of Attur firka is given in Figure 1.

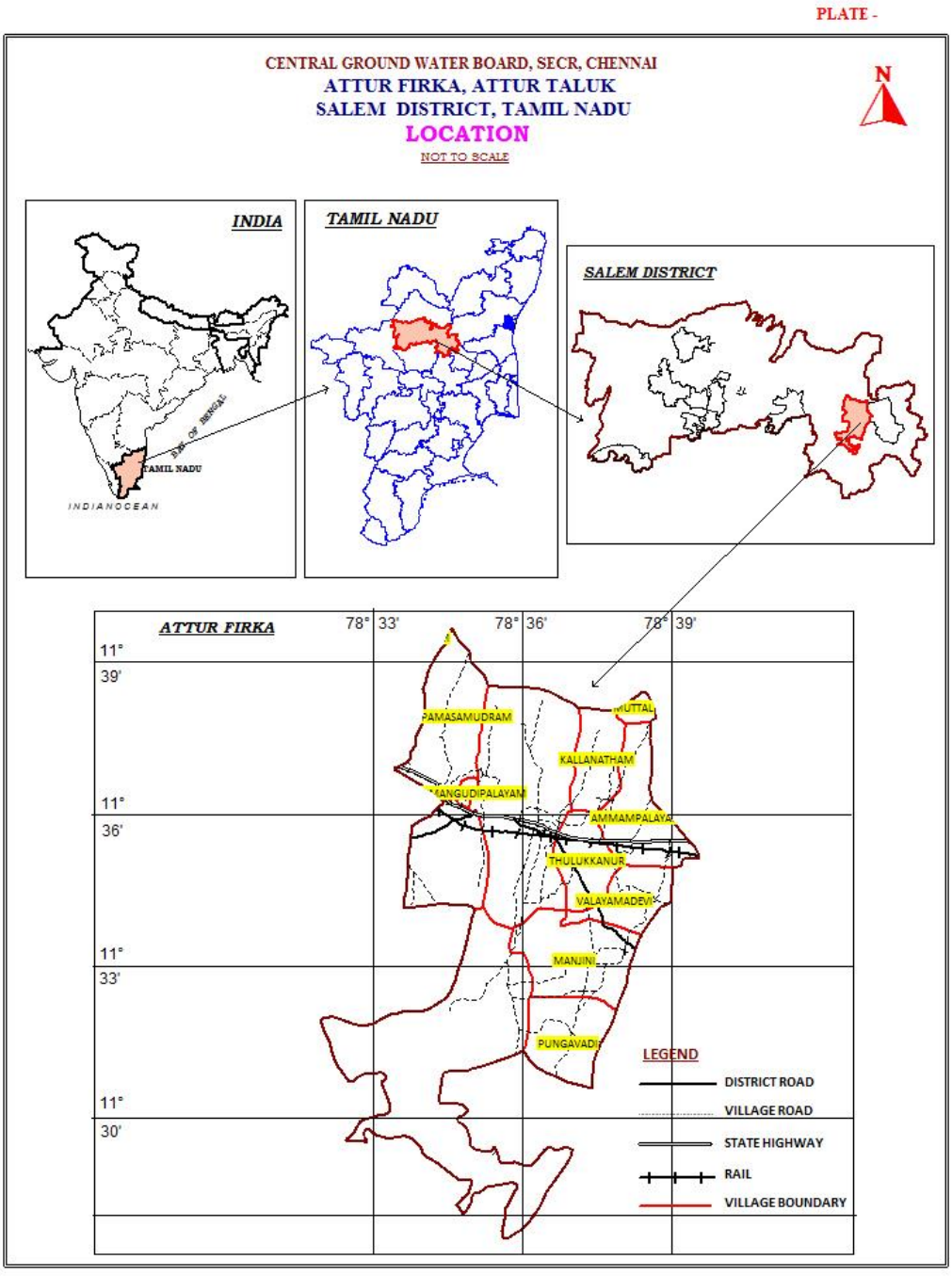


Figure 1. Location map of Attur firka

3.2 Geomorphological Set up

Geomorphologically, the area consists of hills and Pedi plain landforms. In Pedi plain landforms, weathered (moderate and shallow) are occupied major part of the firka. These landforms are influencing the ground water recharge. Hill landform like residual and denudation 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 hills tract on the South West part of firka are known as Godumalai Hills. The hill range consists of a series of detached hills covered by scrubbed forest. 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 Attur firka

LANDFORMS	% of Area
SHALLOW	3.18
DISSECTED/UNDISSECTED	13.86
DENUDATIONAL HILLS / RESIDUAL HILLS	15.99
BAJADA	0.26
MODERATE	62.76
INSELBERG	0.18
VALLEYFILL - MODERATE	3.77

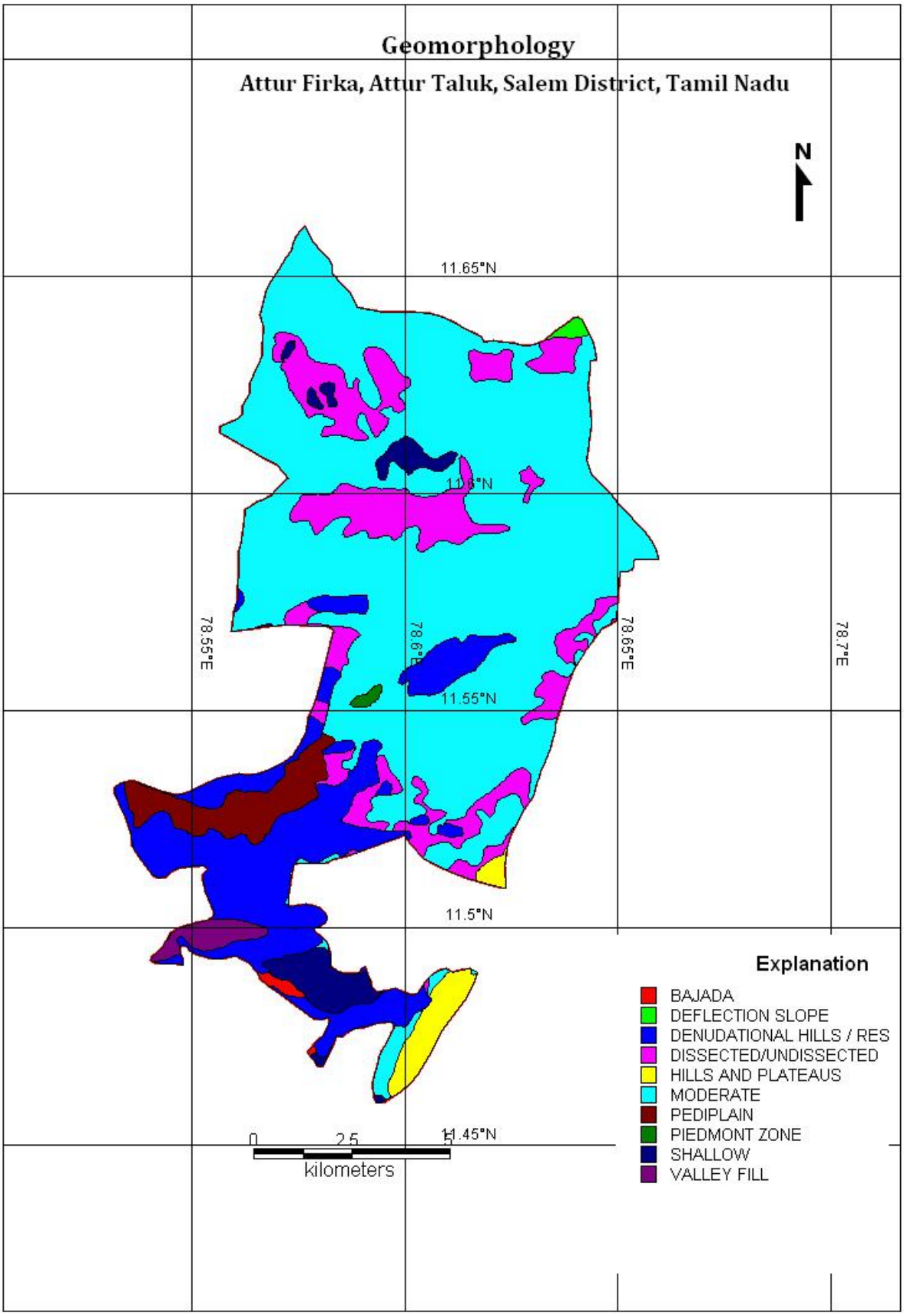


Figure 2. Geomorphology of Attur Firka

3.3 Land use and soil

The land use pattern of the Attur 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 80 % 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 with black soil and mixed soil.

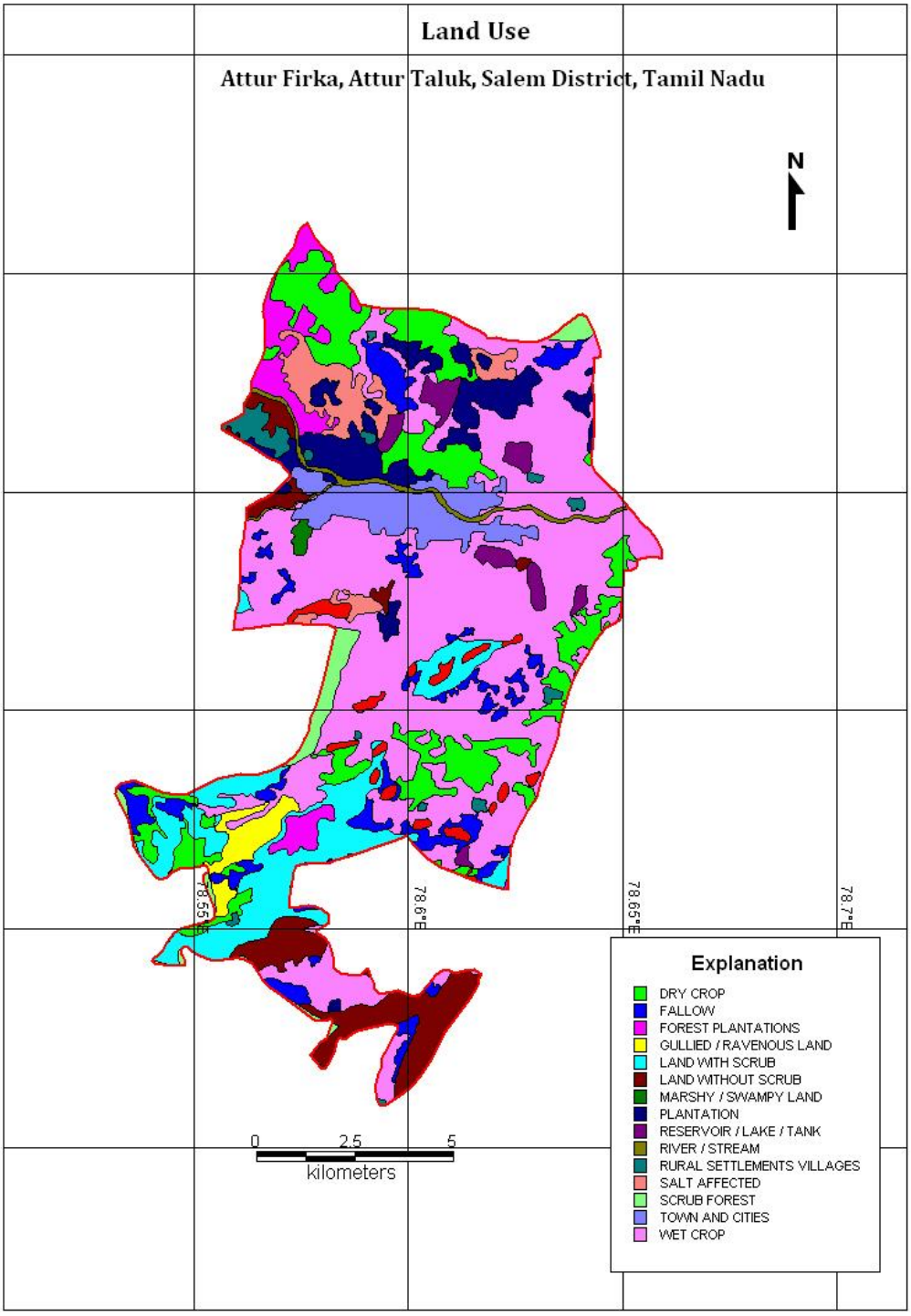
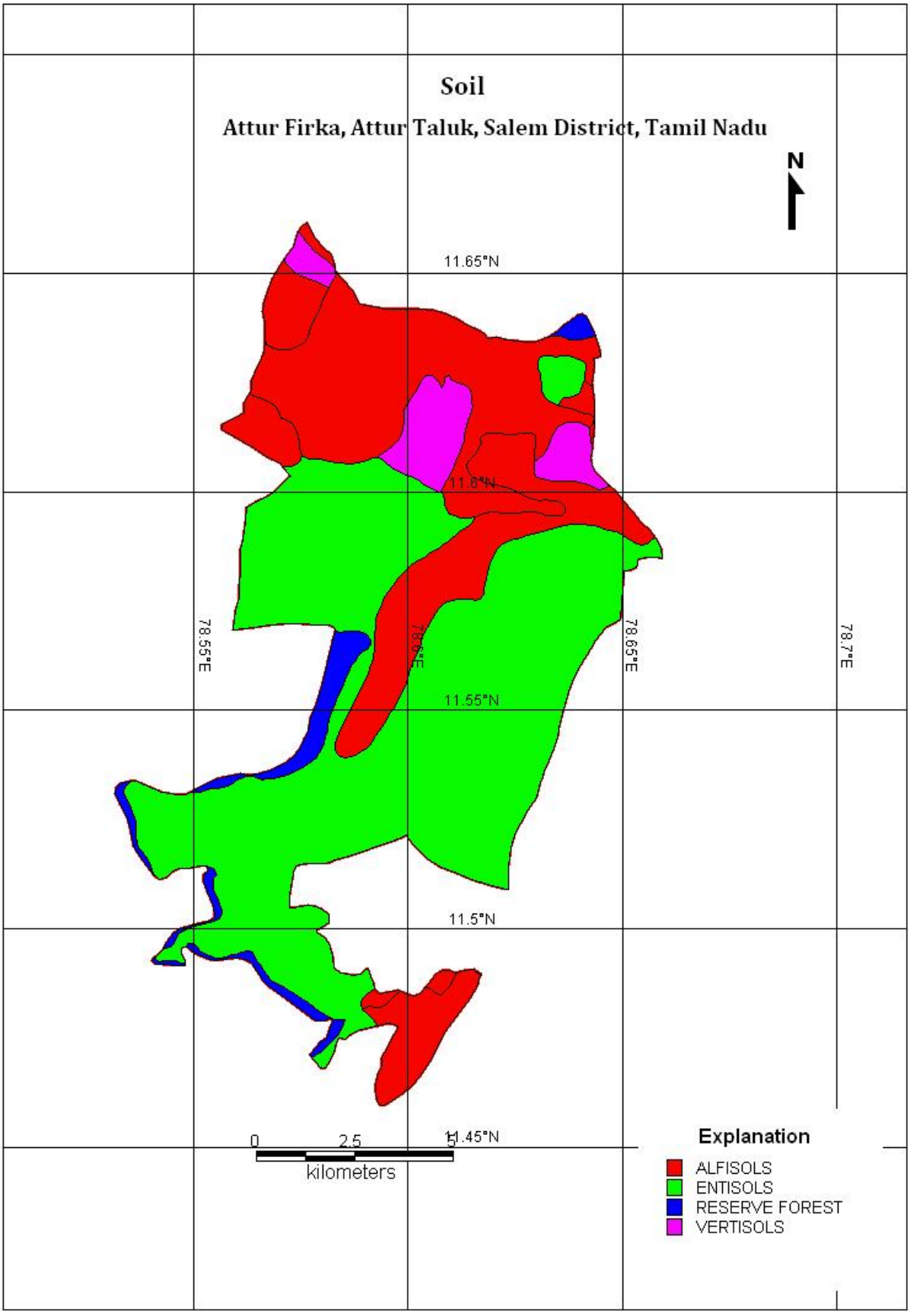


Figure 3.Landuse map of Attur Firka


Soil
Attur Firka, Attur Taluk, Salem District, Tamil Nadu
N
11.65°N
11.6°N
11.55°N
11.5°N
11.45°N
78.55°E
78.6°E
78.65°E
78.7°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 Attur 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 existing in the firka. The drainage pattern is the dendritic and sub- dendritic. The drainage map of Attur firka is given in Fig 4.

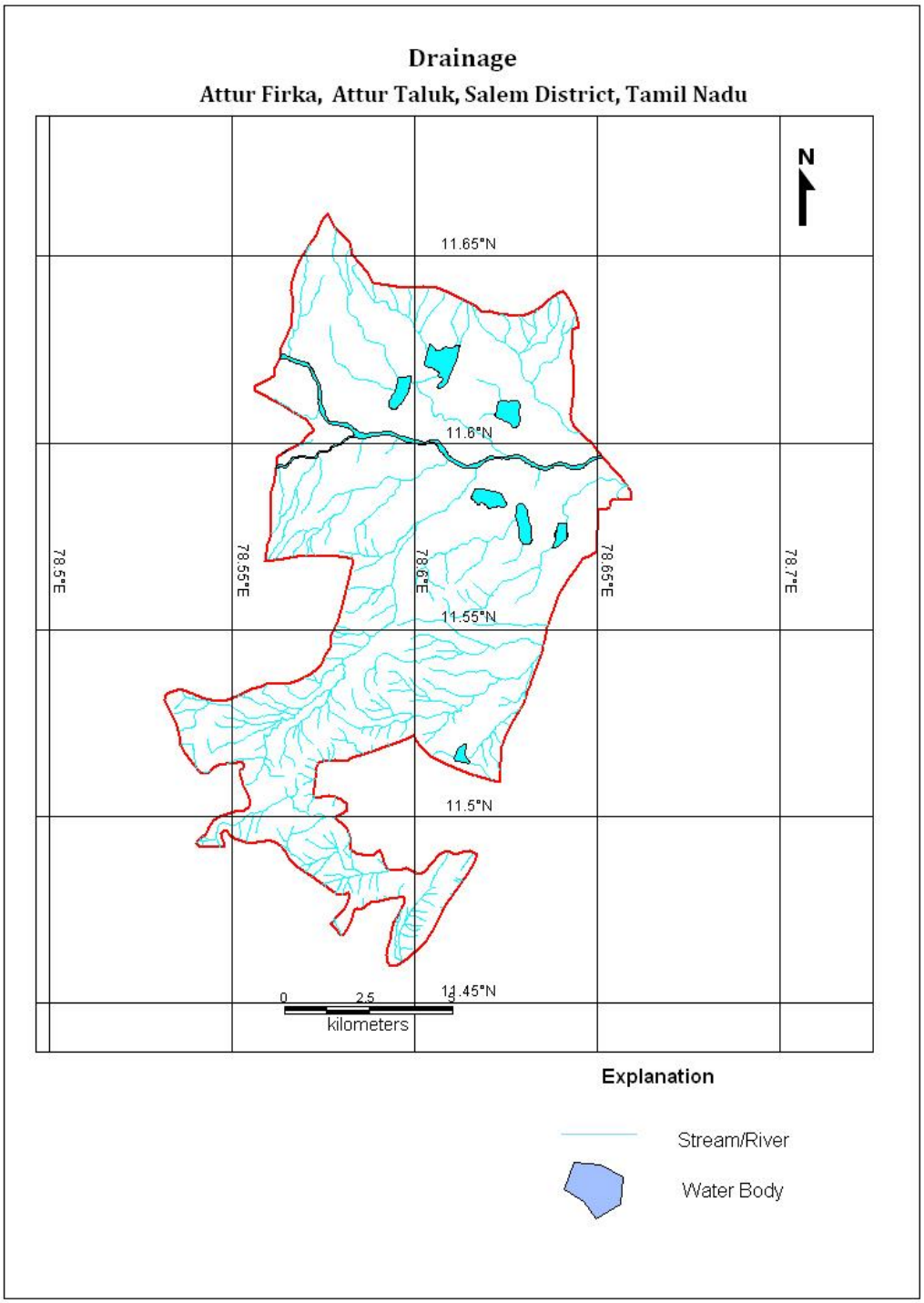


Figure 4.Drainage map of Attur Firka

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
Attur	Attur	132.32	0.701	0.121	0.822

3.6 Hydrogeology

The whole firka is underlain by the Gneiss, Charnockite and basic rock. Ground water is occurring in phreatic 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 hydrogeological map of Attur 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 major area is < 10 m bgl likewise during post monsoon major part is under > 5m ground water level.

The present water level in the firka is in the range of 2.2 to 12.15 m bgl.(May 2016)

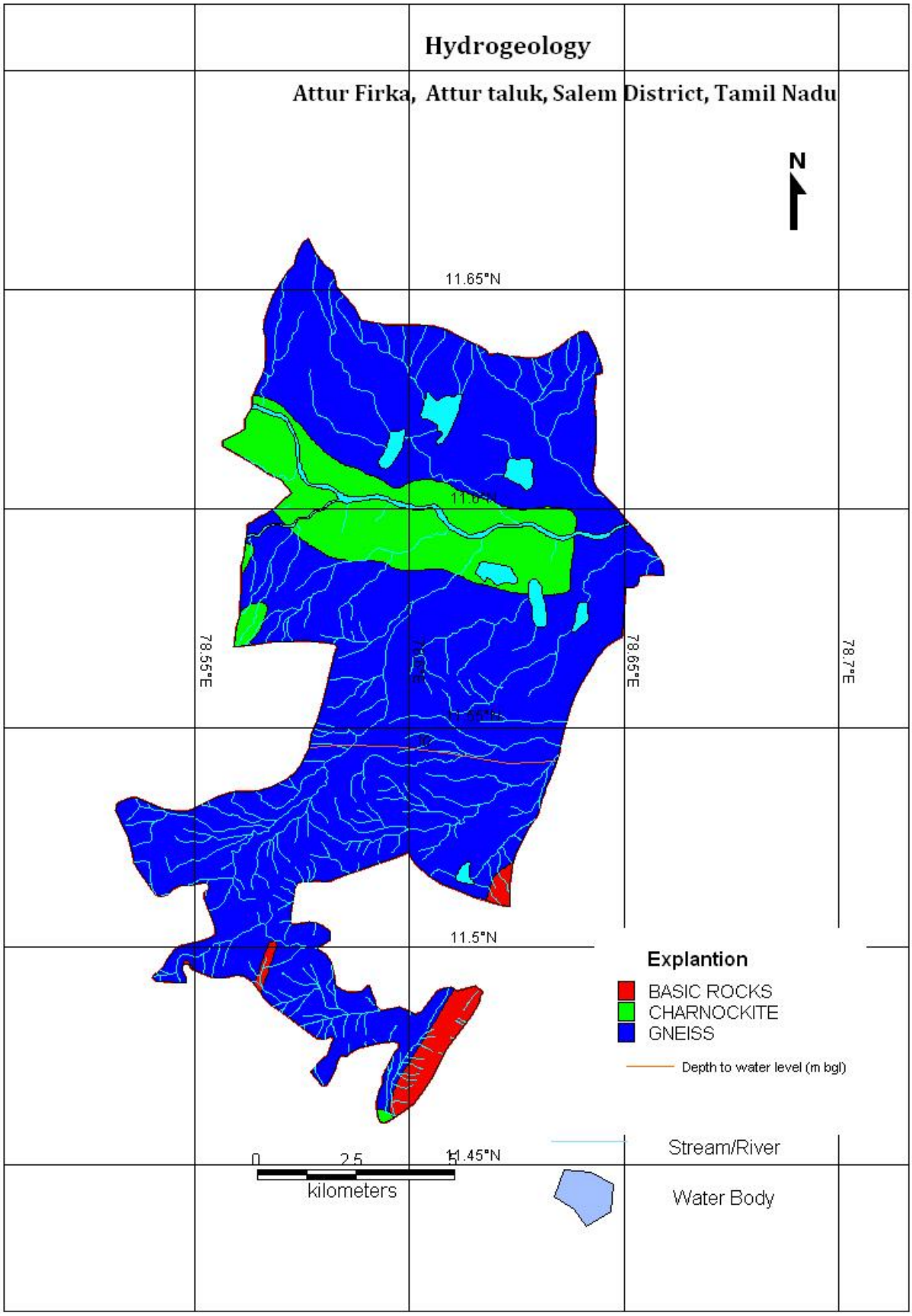


Figure 5: Hydrogeological Map of Attur Firka

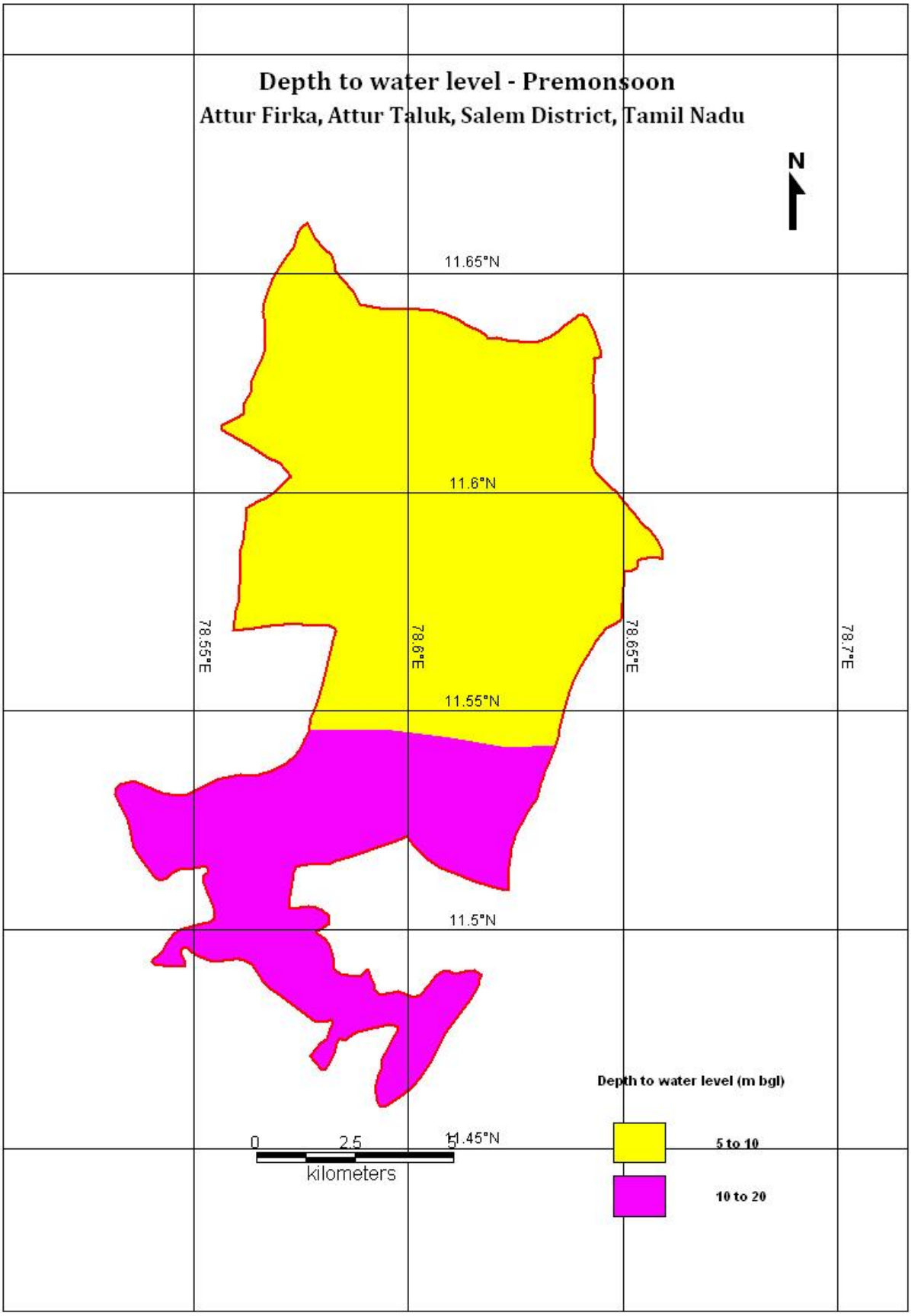


Figure 6a.Pre -monsoon water level in Attur firka (Decadal mean)

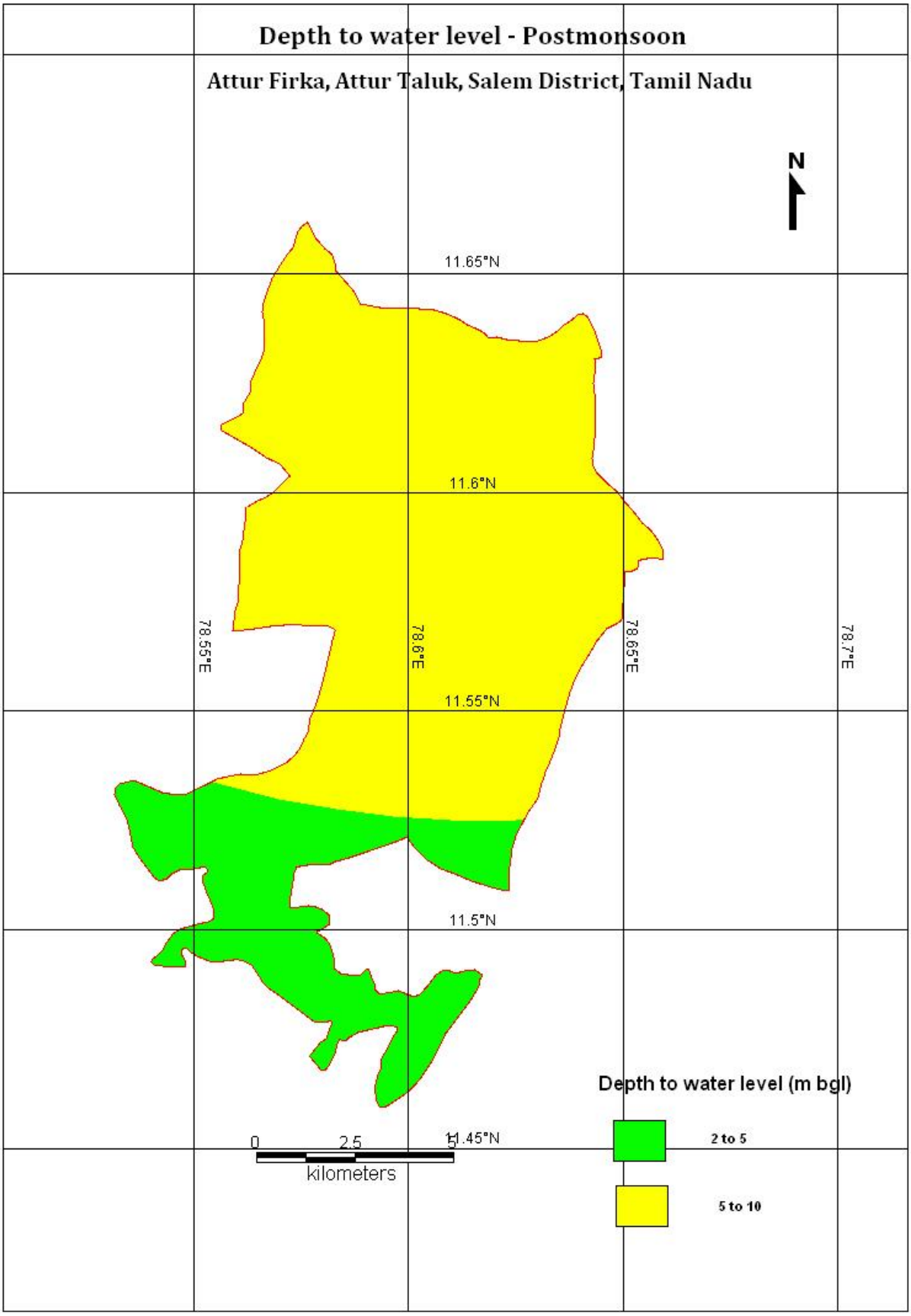


Figure 6 b. Post-monsoon water level in Attur firka(Decadal mean)

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 Attur 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	132.32	21.2401	19.1161	33.1607	0.692368	33.8531	177.092	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	6	Suitable for all major recharge structures like Percolation pond and Nalla Bund, check dam etc.,
High	27	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 Nala bund etc.,
Poor	20	Hilly/Forest /Catchment area

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

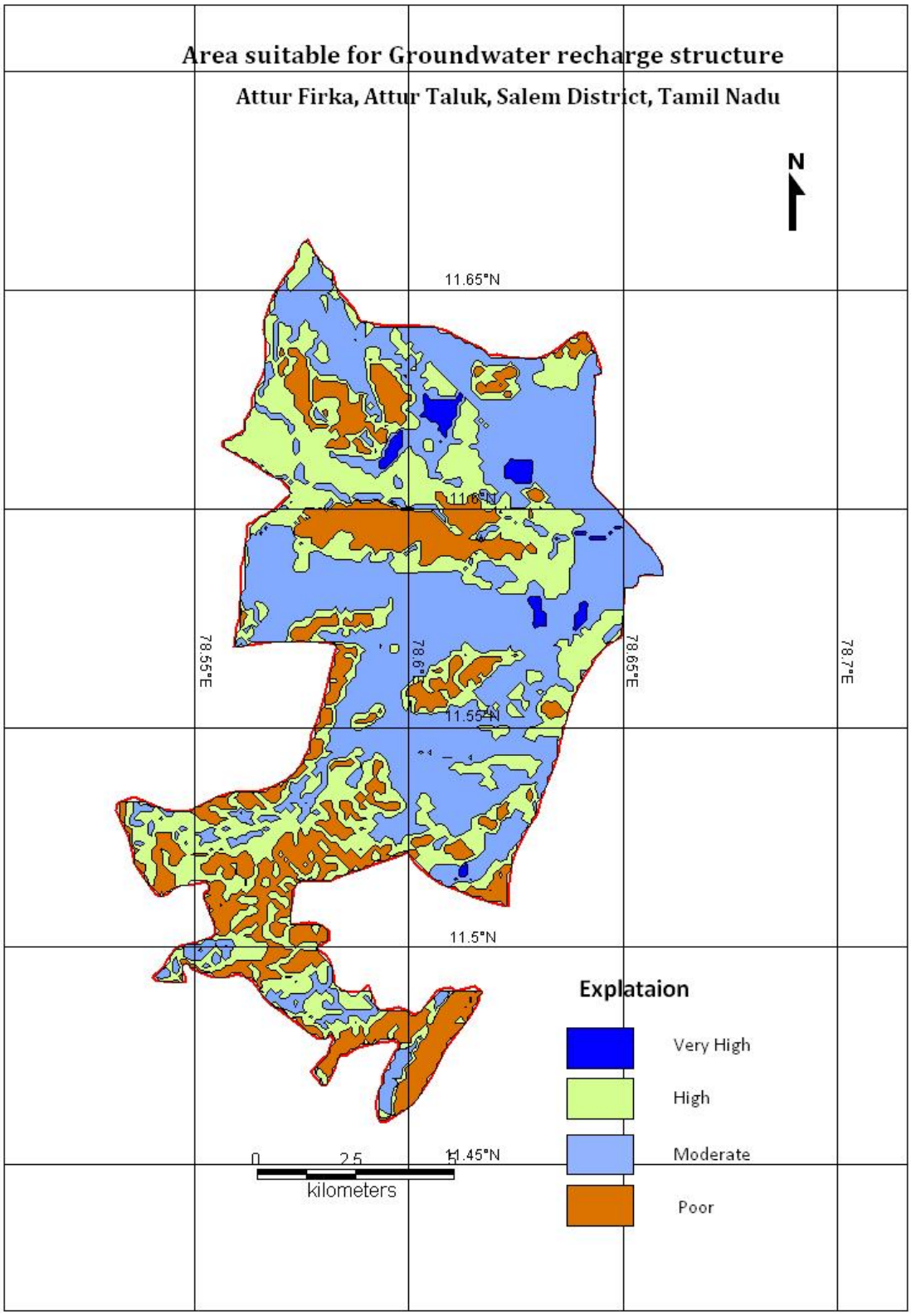


Figure 7: Showing the recharge worthy area Attur firka

5. Planning for groundwater recharge /conservation

5.1 Justification of the artificial recharge & conservation measures

- The Attur Firkas is with high stage of groundwater development i.e, 177 % and with sufficient amount of uncommitted surface runoff/flow of 13.92 MCM.
- The total weathered zone available beneath the ground in the firka is 1323 MCM. Out of these total volume available for recharge considering 7 m depth from 3 mbgl) is 926.1 MCM.
- The Attur 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 Attur areas reveals that about 65 -70% of areas are suitable for recharge.
- In Attur firka more than 45 % 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 Attur 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 Attur Firka is 13.92 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

Attur 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 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 70 % of the firkas areas are suitable for these structures. It is proposed to construct 13 Check dam and 60 Nala bunds. The tentative location of these 73 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 13 Check dam in Attur firka

S.No	Longitude	Latitude	Structure
1	78.5783	11.5349	check dam
2	78.5868	11.5462	check dam
3	78.6139	11.5294	check dam
4	78.5573	11.5009	check dam
5	78.5913	11.4849	check dam
6	78.6251	11.5629	check dam
7	78.6241	11.5365	check dam
8	78.5681	11.6308	check dam
9	78.6331	11.6129	check dam
10	78.6005	11.5904	check dam
11	78.579	11.5807	check dam
12	78.6034	11.5795	check dam
13	78.6095	11.5712	check dam

Tentative location of proposed 60 Nalla bund in Attur firka

S.No	Longitude	Latitude	Structure
1	78.5459	11.53	Nallabund
2	78.5593	11.5182	Nallabund
3	78.5647	11.52	Nallabund
4	78.5458	11.4953	Nallabund
5	78.5721	11.4873	Nallabund
6	78.5789	11.491	Nallabund
7	78.5827	11.4838	Nallabund
8	78.6	11.4758	Nallabund
9	78.596	11.4676	Nallabund
10	78.5764	11.4999	Nallabund
11	78.5844	11.5173	Nallabund
12	78.5939	11.5251	Nallabund
13	78.6076	11.5238	Nallabund
14	78.6076	11.5469	Nallabund
15	78.5974	11.5362	Nallabund
16	78.6151	11.5475	Nallabund
17	78.5747	11.5367	Nallabund
18	78.5864	11.5491	Nallabund

19	78.6052	11.6357	Nallabund
20	78.6024	11.6377	Nallabund
21	78.5786	11.6216	Nallabund
22	78.5713	11.5767	Nallabund
26	78.5732	11.5759	Nallabund
23	78.5855	11.5701	Nallabund
24	78.6189	11.5555	Nallabund
25	78.631	11.6264	Nallabund
27	78.6362	11.6269	Nallabund
28	78.5638	11.5259	Nallabund
29	78.5674	11.5289	Nallabund
30	78.5805	11.6435	Nallabund
31	78.5831	11.6342	Nallabund
32	78.5914	11.6376	Nallabund
33	78.64	11.626	Nallabund
34	78.6264	11.6251	Nallabund
35	78.5683	11.5893	Nallabund
36	78.574	11.5895	Nallabund
37	78.5637	11.5877	Nallabund
38	78.5922	11.5835	Nallabund
39	78.5914	11.5696	Nallabund
40	78.5943	11.564	Nallabund
41	78.5712	11.5301	Nallabund
42	78.5699	11.5261	Nallabund
43	78.5955	11.5274	Nallabund
44	78.6199	11.5209	Nallabund
45	78.583	11.4872	Nallabund
46	78.5665	11.4898	Nallabund
47	78.5411	11.5286	Nallabund
48	78.5537	11.5212	Nallabund
49	78.59	11.5606	Nallabund
50	78.5946	11.5574	Nallabund
51	78.6028	11.5676	Nallabund
52	78.6185	11.5687	Nallabund
53	78.6266	11.5513	Nallabund
54	78.6196	11.6014	Nallabund
55	78.6121	11.6367	Nallabund
56	78.6147	11.6355	Nallabund
57	78.5854	11.6431	Nallabund
58	78.6142	11.5386	Nallabund
59	78.6295	11.5326	Nallabund
60	78.5879	11.5393	Nallabund

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 6 existing ponds/tanks have been identified with latitude and longitude given below and marked on Plate 1.The above 6 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 Attur firka.

S.No	Longitude	Latitude	Structure
1	78.5952	11.6114	Desiltation with recharge shaft
2	78.6087	11.6208	Desiltation with recharge shaft
3	78.6245	11.6076	Desiltation with recharge shaft
4	78.6206	11.585	Desiltation with recharge shaft
5	78.63	11.5769	Desiltation with recharge shaft
6	78.64	11.5753	Desiltation with recharge shaft

5.3.2 Water conservation measure

5.3.2.1 Farm Pond

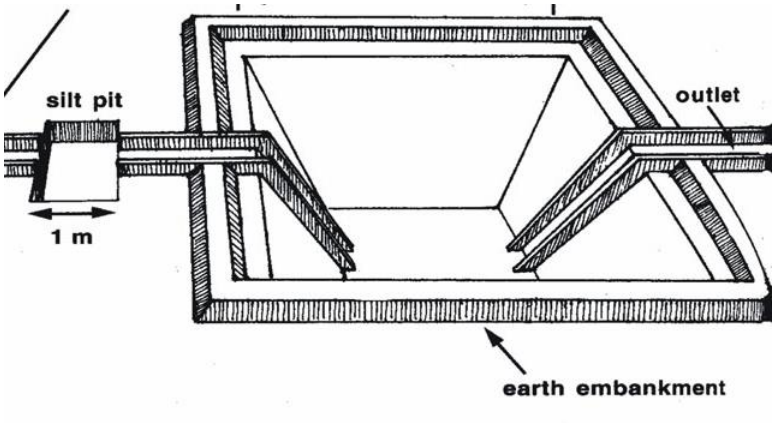
A farm pond is a large dug out in the earth, usually square or rectangular in shape, which harvests rainwater and stores it for future use. It has an inlet to regulate inflow and an outlet to discharge excess water. The pond is surrounded by a small bund, which prevents erosion on the banks of the pond. 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 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. Tentative locations of proposed micro irrigation are shown in Plate 1.

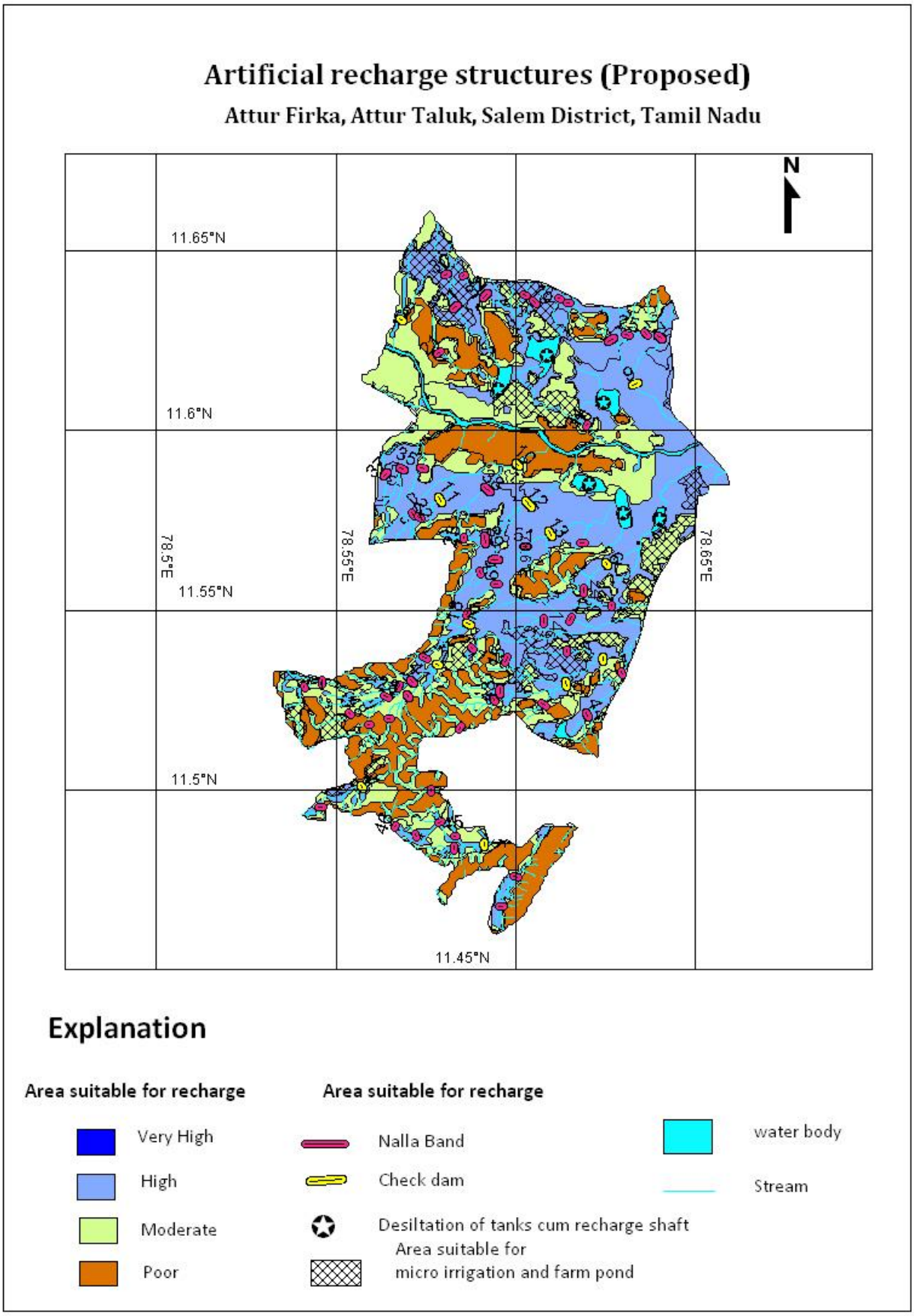


Figure 8. Location map showing the proposed AR Structures in Attur firka

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	13	221000	9	117	176800
Nala bunds/ Gabion (4 Fillings)	Width: 5 to 15 m	60	180000	2.0	120	144000
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	**481**	**1890800**
Impact assessment and O & M						
PiezometersUp to 50 m bgl – 6 nos. @ 0.6 lakh					**3.6**	
Total cost of the project					**484.6**	
O & M - 5 % of total cost of the scheme					**24.23**	
Impact assessment -5 % of total cost of the scheme					**24.23**	
				TOTAL	**533.06**	

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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