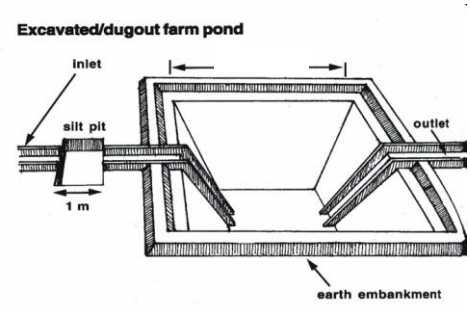
Plan on Artificial Recharge to Groundwater and Water Conservation in Avinashipalayam Firka, Tiruppur Taluk, Tiruppur District, Tamil Nadu



By

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South Eastern Coastal Region
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Chennai

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Content

AT GLANCE	
Name of Firka	Avinashipalayam
Taluk	Tirupur
District	Tirupur
State	Tamil Nadu
Total area	159.43 sq.km
Total area suitable for Recharge	136.74 sq.km
Lat. & Lon.	77°20’ 43” to 77° 30’ 10” and 10° 55’ 40” to 11° 05’ 40”
Rainfall	647 mm
Monsoon	492 mm
Non- Mon soon	155 mm
Geology	Weathered & Fractured Gneiss, Granites and Charnockites
WATER LEVEL	
Pre – Monsoon(May 2015)	1.964 to 21.628
Post - Monsoon (Jan 2016)	1.769 to 22.763
GROUND WATER RESOURCES ESTIMATION	
Replenish able ground water resources	13.2678 MCM
Net ground water available	11.941 MCM
Ground water draft for irrigation	25.349 MCM
Groundwater draft for domestic & industrial water supply	55.1645 MCM
Total ground water draft	25.9006 MCM
Stage of ground water development (%)	216.904 %
Uncommitted surface runoff available for the Firka	11.766 MCM
Total volume of weathered zone	19.13171 MCM
Total aquifer volume available for recharge	10.5344 MCM
ARTIFICIAL RECHARGE /CONSERVATION MEASURES	
Structures Proposed (tentative) Masonry Check dam Nalla Bund Revival, repair of pond, tanks with recharge shaft	 7 14 20
Improving Water Efficiency /Saving Micro irrigation system for 100 ha)/ Farm Pond – 100 Unit	0.70 MCM
Excepted groundwater recharge	2.35 MCM
Excepted groundwater recharge / saving	3.05 MCM
Tentative total cost of the project	8.74 Cr
Expected raise in water level by recharge	1.47 m

Plan on Artificial Recharge to Groundwater and Water Conservation in AvinashipalyamFirka, Tirpur Taluk, Tirupurdistrict, 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 Avinashipalayam Firka is 159.431 sq.km and Avinashipalayam Firka lies between North latitudes 10° 55’ 53 “to 11° 05’ 40” and east longitudes 77° 20’ 43”to 77° 30’ 10”.Location map of Avinashipalayam Firka is given in Figure 1.

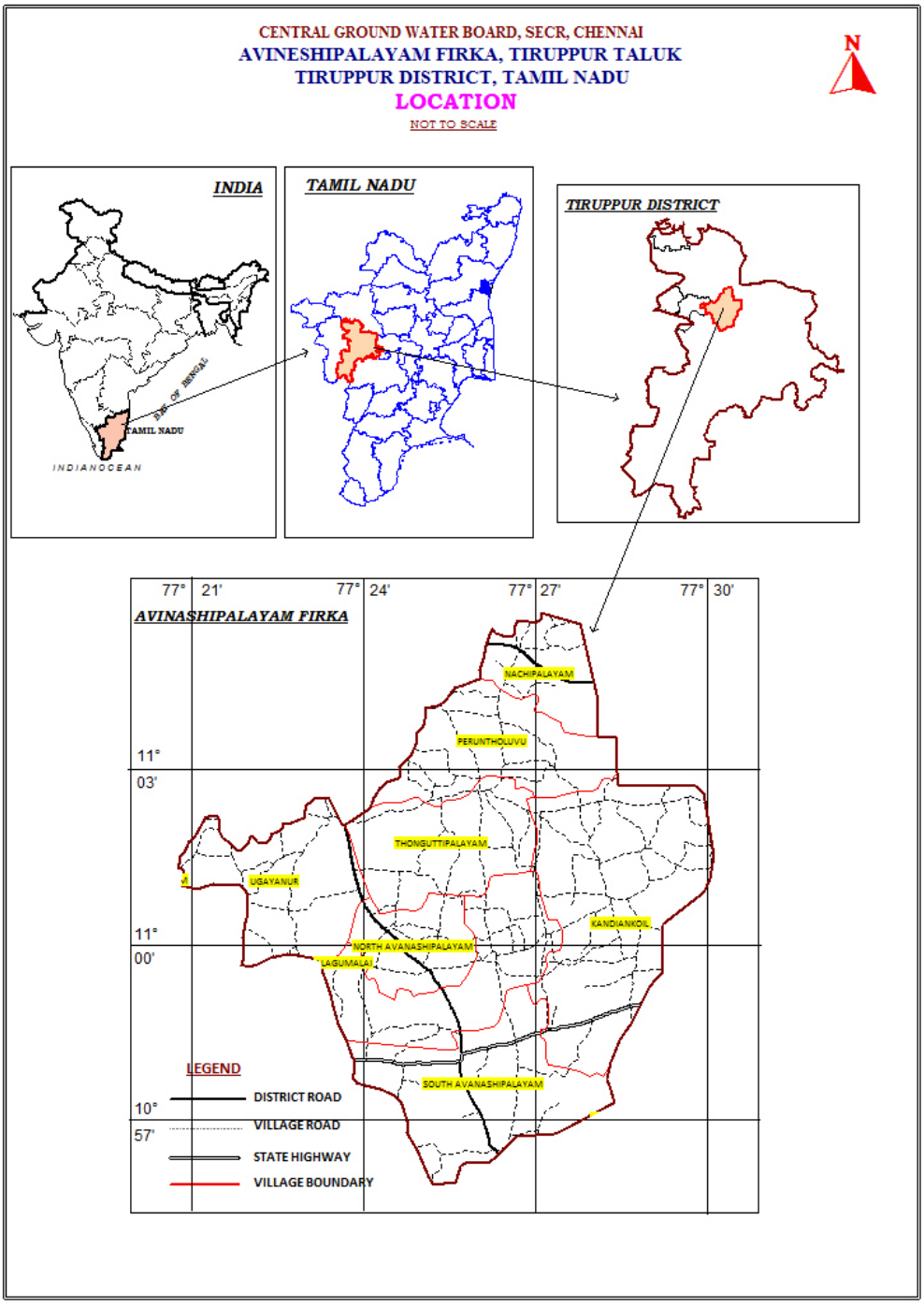


Figure 1. Location map of Avinashipalayam Firka

3.2 Geomorphological Set up

In the Avinashipalayam Firka area it is seen that Shallow Burried Pediment and Dissected/Undissected area dominates with 40% and 35 % respectively. Moderate Burried Pediments occupies the rest of the 24% area. The various geomorphological units with its % of coverage area are given in table 1 and shown in figure 2. Dissected/Undissected area forms the catchment and runoff zone.

Table 1. Various geomorphological units with its % of coverage area in Avinashipalayam Firka

LANDFORMS	Area (Sq.Km)	% Area
BURRIED PEDIMENT MODERATE	37.8036	24.38
DISSECTED/UNDISSECTED	54.5224	35.16
BURRIED PEDIMENT SHALLOW	62.7165	40.45

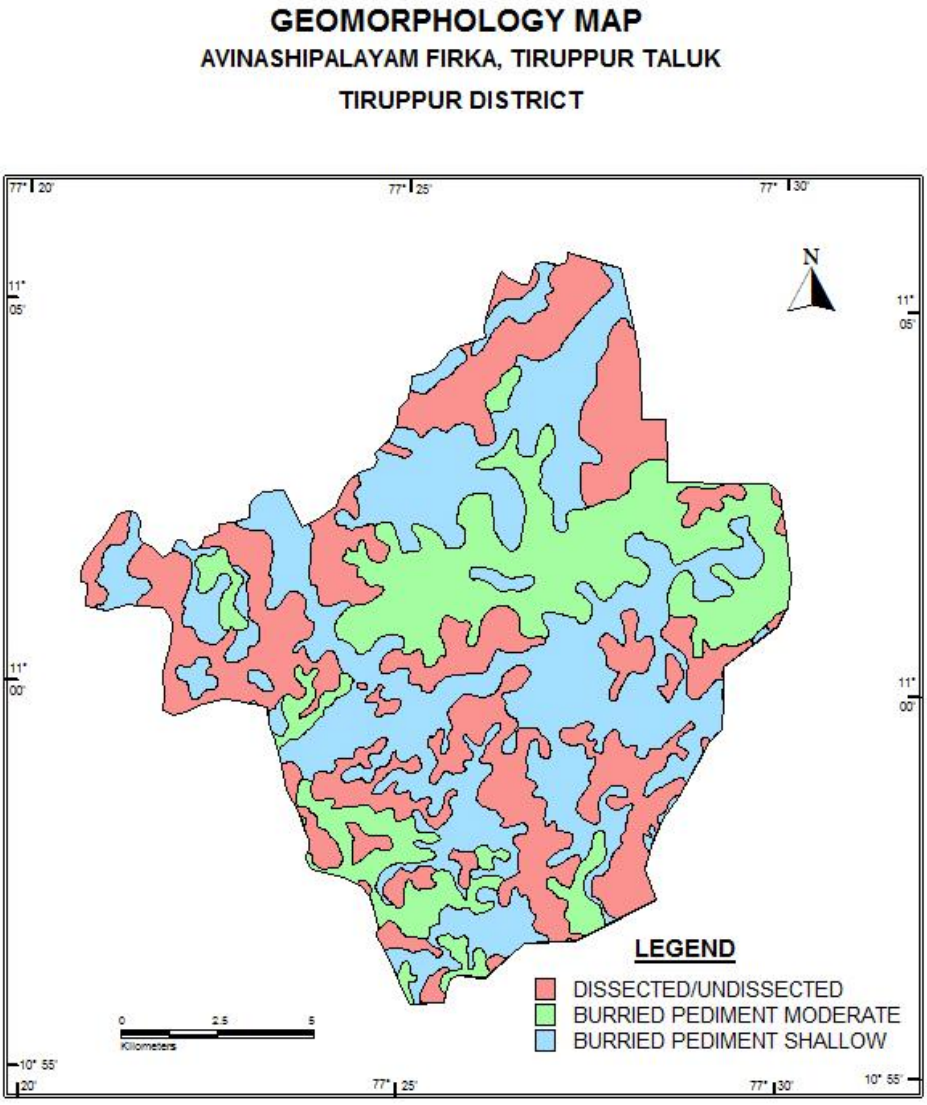


Figure 2 showing Geomorphology of Avinashipalayam Firka

3.3 Land use and soil

The land use pattern of the Avinashipalayam Firka is given in figure 3. Predominantly the most of the area is characterised by the wet crop with 34% followed by plantations in 33% and dry crop accounts for 14% (i.,e agricultural field). Thus total agricultural area is about 81% of the total geographical area. (Source: IRS, Anna university, Chennai Tamil Nadu). This area is highly suitable for water conservation and recharge. The entire Firkas ispredominantly occupied by sandy loamy soil and red soil.

The soil of the Avinashipalayam Firkais gravely loam soil calcareous, which is followed by gravely loam soil. Mostly sand to loamy sand and characterized by a hard and compact layer of lime. The texture varies from sandy loam to loamy sand with occurrence of quartz fragments on the surface.Due to the presence of montmorillonite type of clay minerals, the soil exhibit high cracking and swelling properties.

Table Showing type of land use in Avinashipalayam Firka

TYPE OF LAND USE	Area	% Area
RESERVOIR / LAKE / TANK	0.187858	0.121166
INDUSTRIAL AREA	0.333315	0.214983
SALT AFFECTED	0.389786	0.251406
BARREN ROCKY / STONY WASTE	0.402603	0.259672
LAND WITH SCRUB	4.706692	3.03574
RURAL SETTLEMENTS VILLAGES	7.841046	5.057347
FALLOW	11.66043	7.520786
DRY CROP	23.20366	14.96598
PLANTATION	52.6504	33.95866
WET CROP	53.66688	34.61426
	155.0427	100

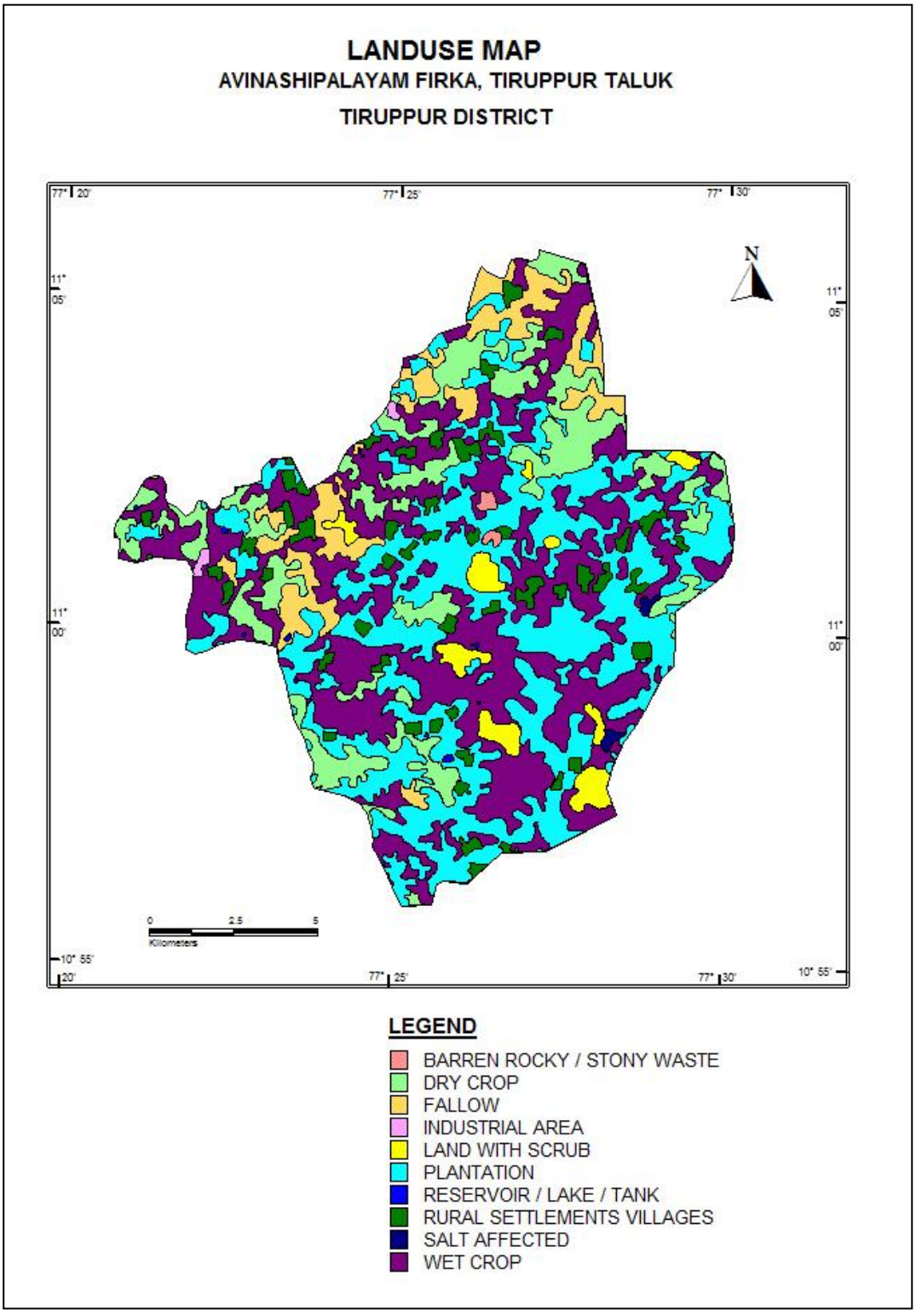


Figure 3 a showing Landuse map of Avinashipalayam Firka

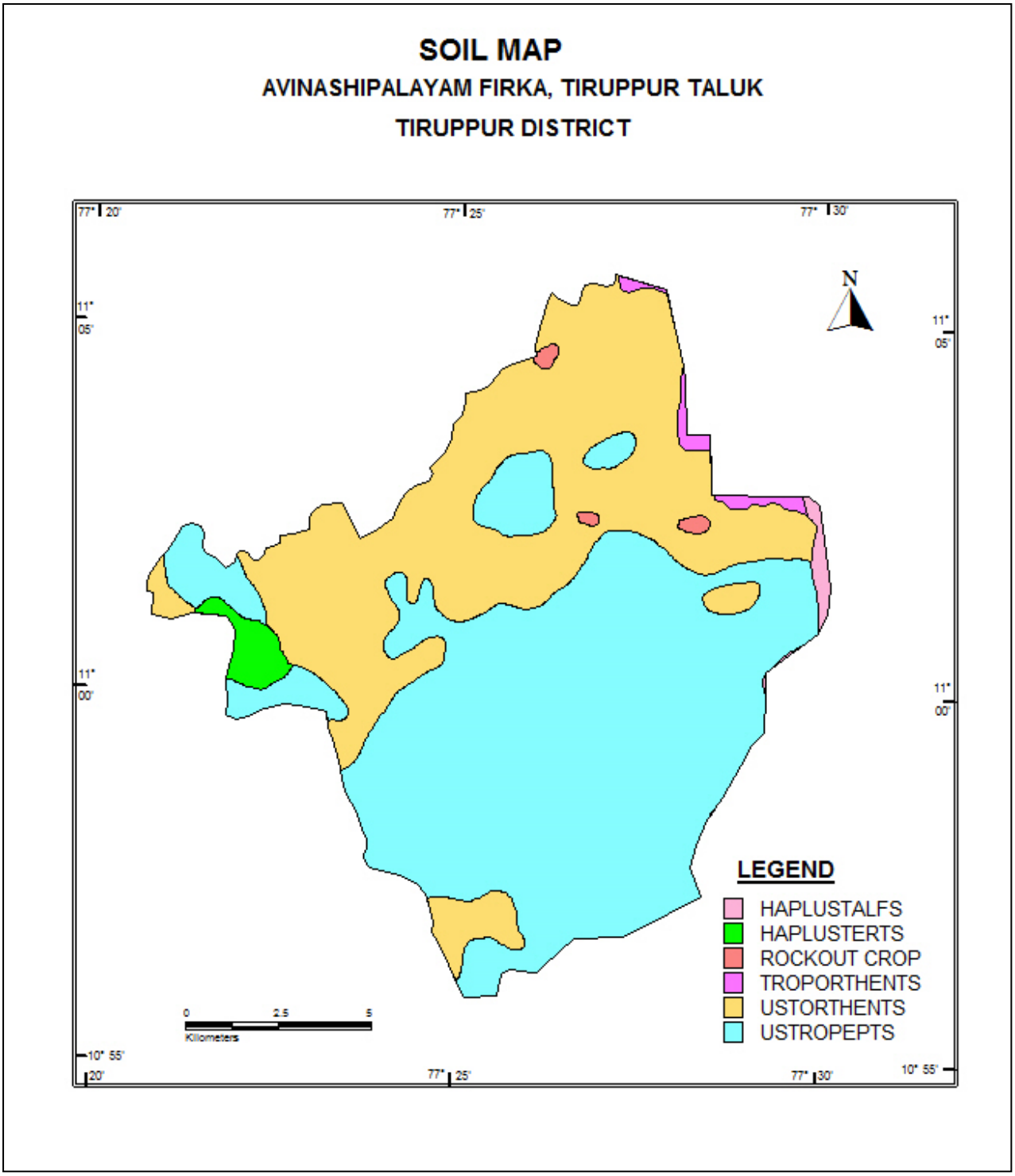


Figure 3b Showing soil map of Avinashipalayam Firka

3.4 Drainage

The area is drained by Bhavani, Noyil, Amaravthi and Ponnani rivers. The major drainage patterns observed isi) Radial, ii) Parallel and iii) Dendritic to sub - dendritic.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 Avinashipalayam Firka is given in Fig 4.

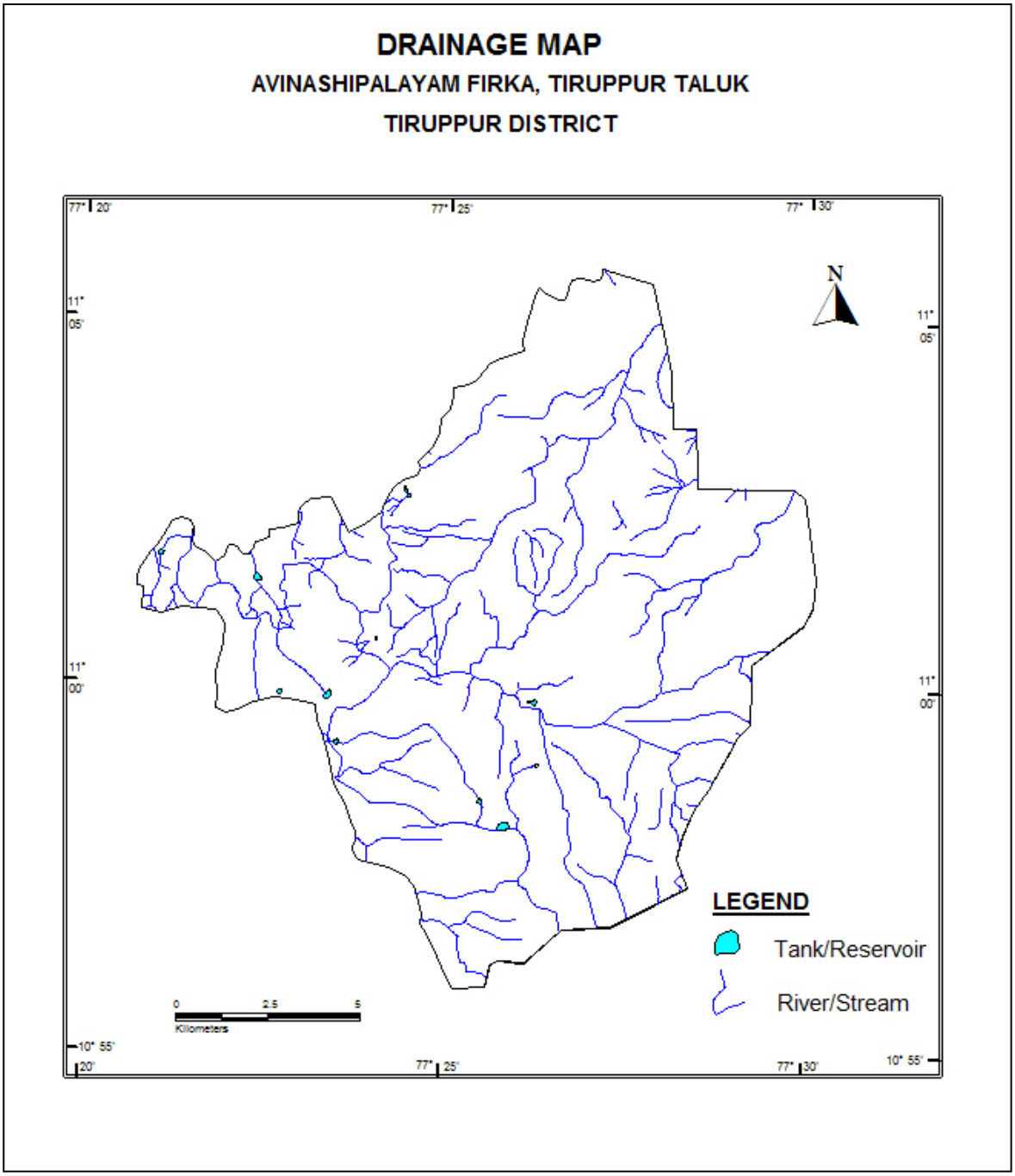


Figure 4: Showing Drainage map of Avinashipalayam Firka

3.5 Rainfall

The northeast monsoon is active between October and December, which forms the principal source for the recharge of groundwater. The southwest monsoon stretches from June to September. During the winter and hot seasons, the rainfall is scantyAvinashipalayamarea falls under tropical climate with temperature in the summer months of March to May. The average temperature varies from 26 to 40° C.The area has a hot tropical climate. Highest temperatures were recorded during the months of April and May with temperatures reaching 40°C. The weather in the plains during the summer i.e., from April to June is generally dry and hot. Mornings in general are more humid than the afternoons, with the humidity exceeding 78% on an average. In the period between June to November the afternoon humidity exceeds 66% on an average. In the rest of the year the afternoons are drier, the summer afternoons being the driest.

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
Tirupur	Avinashipalayam	159.43095	0.492	0.155	0.647

3.6 Hydrogeology

Groundwater occurs in all the crystalline formations of oldest Achaeans and Recent Alluvium. The occurrence and behaviour of groundwater are controlled by rainfall, topography, geomorphology, geology, structures etc.

Ground water is occurring in pheratic conditions in weathered and fractured gneiss rock formation.The weathering is controlled by the intensity of weathering and fracturing. Dug wells as wells as bore wells are 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.

The depth of wells varies from 6.64 to 17 m bgl. The present water levels in the firka is in the range of 1.964 to 21.628 mbgl during pre- monsoon (May 2015) and from 1.769 to 22.763 mbgl during post monsoon (January 2016). The hydrogeological map of Avinashipalayam Firka is given in Figure 5.Decadal mean water level of pre-monsoon and post monsoon are given in fig 6 a & b.

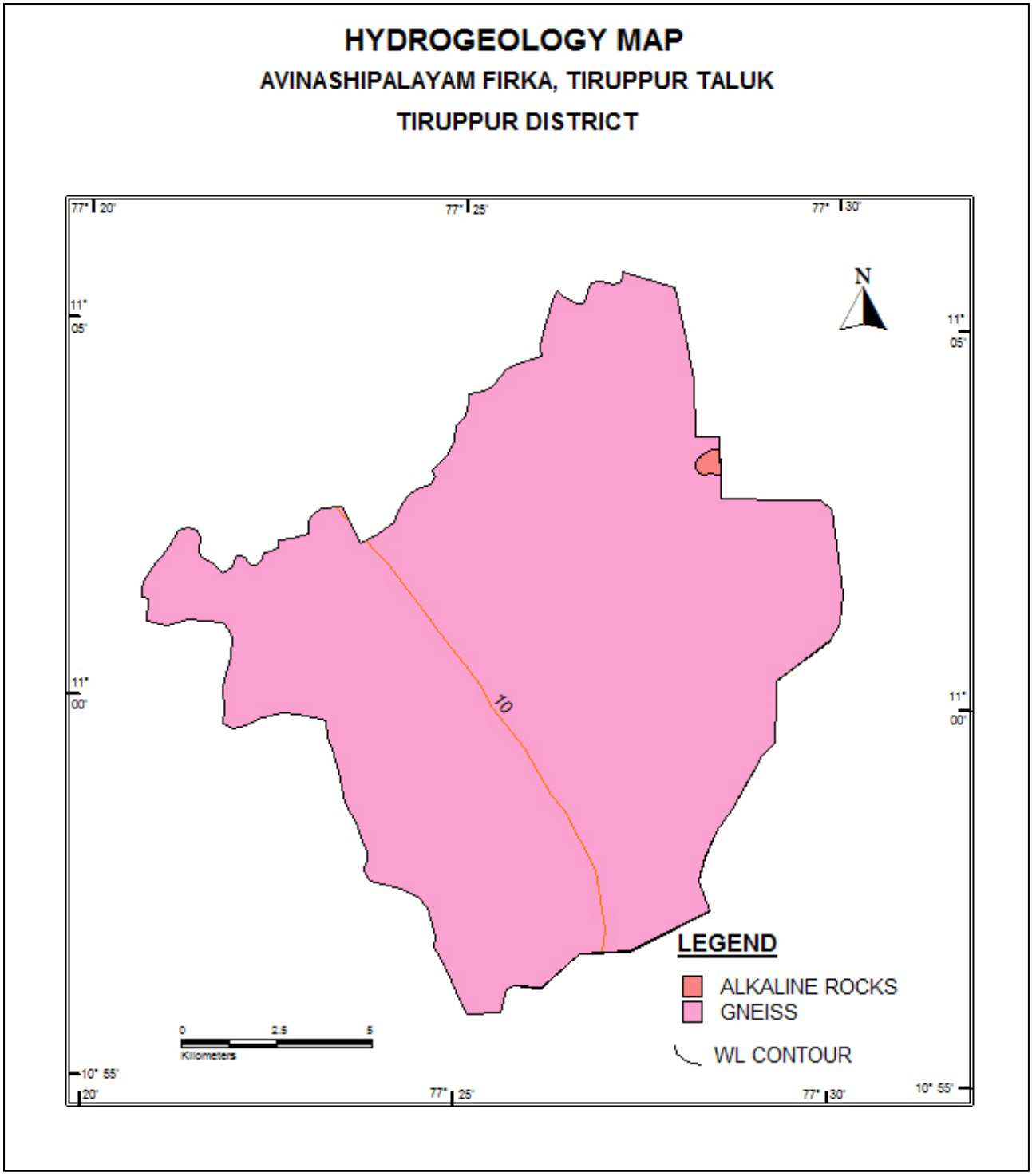


Figure 5 Showing Hydrogeological Map of Avinashipalayam Firka

DEPTH TO WATER LEVEL MAP (PRE MONSOON)

AVINASHIPALAYAM FIRKA, TIRUPPUR TALUK

TIRUPPUR DISTRICT

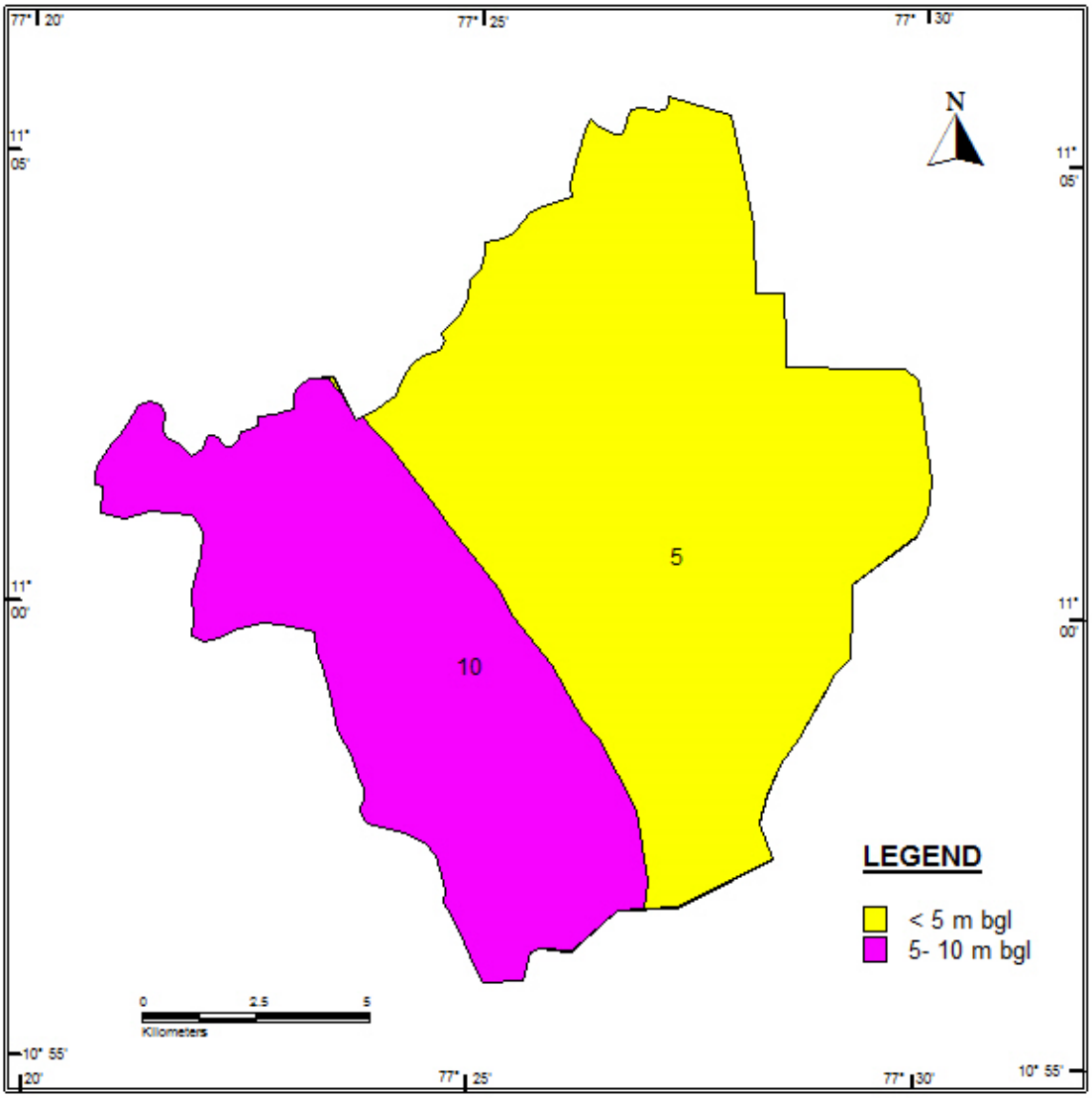


Figure 6a : Pre-monsoon Decadal water level in Avinashipalayam Firka

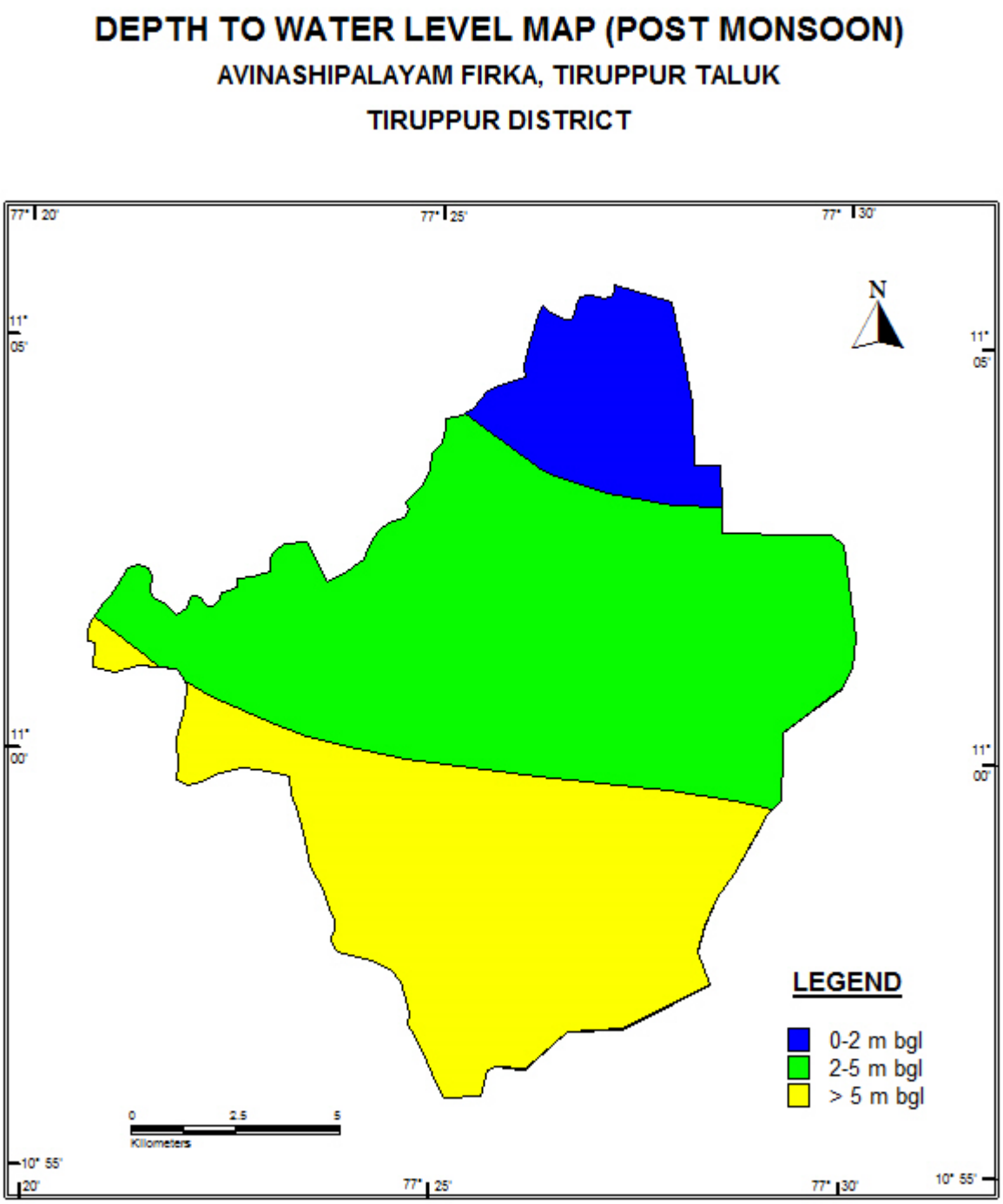


Figure 6 b : Post-monsoon Decadal water level in Avinashipalayam Firka

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 Avinashipalayam 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)					%	
Avinashi palayam	13.2678	13.2678	11.941	25.349	0.5516	25.9006	216.904	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 byassigning 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	4	Suitable for all major recharge structures like Percolation pond and stop dam, check dam etc.,
High	29	Suitable for all major recharge structures like stop dam, check dam etc.,
Moderate	53	Suitable for all major recharge structures like earthen check dam, Boulder check dam and Nala bund etc.,
Poor	14	Hilly/Forest /Catchment area

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

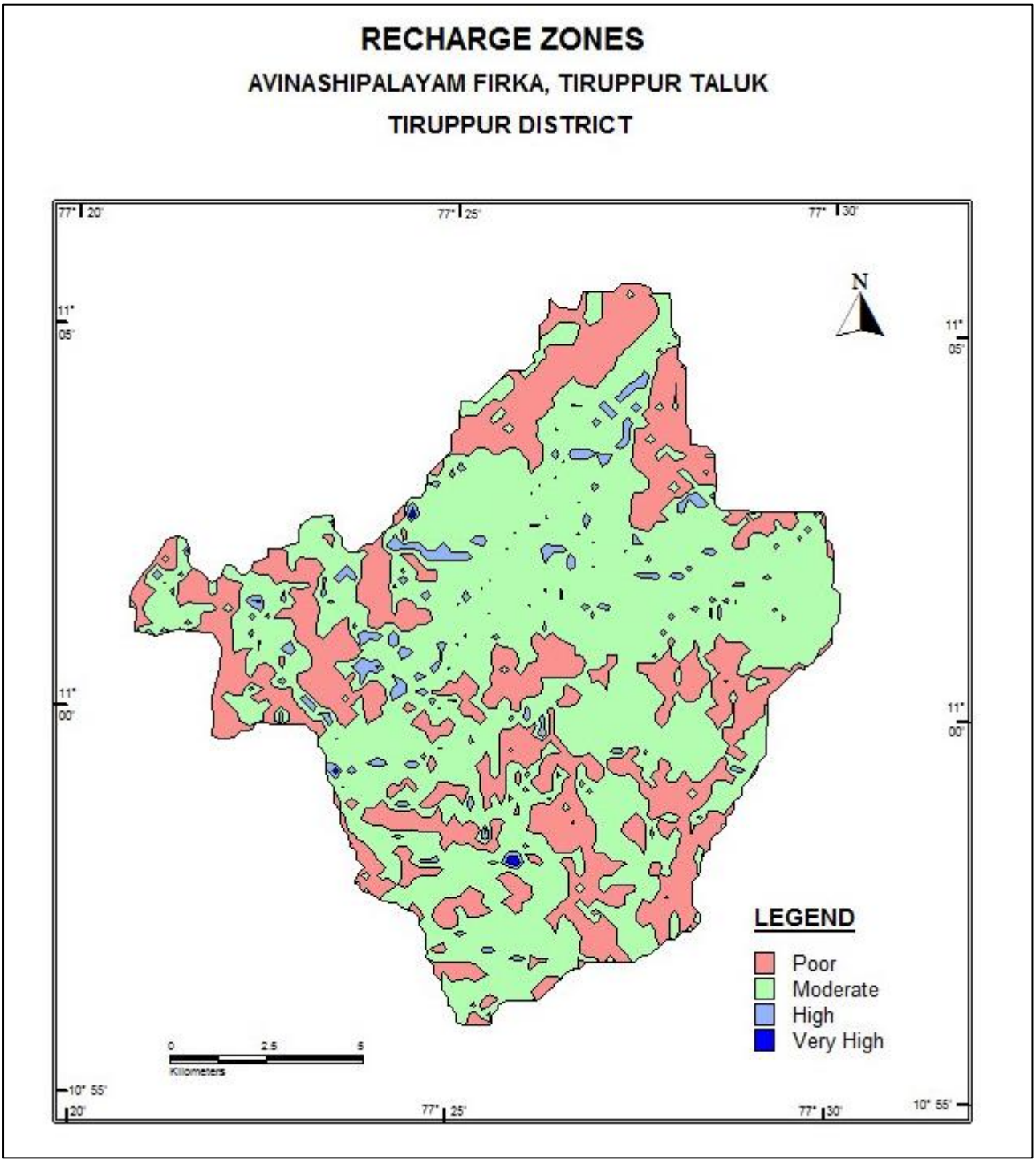


Figure 7 Showing the recharge worthy area in Avinashipalayam Firka

5. Planning for groundwater recharge /conservation

5.1 Justification of the artificial recharge & conservation measures

- The **Avinashipalayam Firka**s is with high stage of groundwater development i.e, **216.904**% and with sufficient amount of uncommitted surface runoff/flow of **11.766** MCM.

- The total weathered zone available beneath the ground in the firka is **19.13** MCM. Out of these total volume available for recharge considering 7.405 m water level is **10.5344** MCM.
- The Avinashipalayam Firka consists of **20**surface water bodies /lakes spread over the firka, 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 Avinashipalayam areas reveals that more than 33 % of areas arein High and Very High area suitable for recharge and 53% area is in moderate zone for AR.
- In Avinashipalayam Firka more than 80 % 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 Avinashipalayam 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 Avinashipalayam Firka is **11.766** MCM.

5.3 Proposed interventions including tentative location of artificial recharge /conservation measures

On basis of above description the following three type of approach have been made to propose artificial recharge or conservation structures.

a. Artificial recharge
b. Water conservation measure
c. Water Efficiency

5.3.1 Artificial recharge

The details of artificial recharge structure proposed along with justification are given below.

5.3.1.1 Check dam/Nala bund

Avinashipalayam Firka area is covered by the seasonal nallahs/drains which carry heavy discharge during monsoon. As per the integrated model prediction around 30 % of the firkas areas are suitable for these structures. It is proposed to construct **7** Check dam and **14** NallahBunds. The tentative location of these **21** ARs are given below and shown in **Plate 1**. The size and location of these structures are tentative and details field survey is essential to ascertain the exact size and location.

Tentative location of proposed 7 Check dam in Avinashipalayam Firka

S. NO.	LONGITUDE	LATITUDE	TYPE OF ARS
1	77.43712	11.02006	Check Dam
2	77.45332	11.06914	Check Dam
3	77.47257	11.02466	Check Dam
4	77.41934	11.03375	Check Dam
5	77.35429	11.02036	Check Dam
6	77.39863	10.97994	Check Dam
7	77.45941	10.96655	Check Dam

Tentative location of proposed 14 Nalla bund in Avinashipalayam Firka

SL.NO	LONGITUDE(DD)	LATITUDE (DD)	TYPE OF ARS
1	77.40740	11.04386	Nala Bund
2	77.35833	11.03415	Nala Bund
3	77.35113	11.02920	Nala Bund
4	77.40096	11.01050	Nala Bund
5	77.37889	10.99813	Nala Bund
6	77.43707	10.99652	Nala Bund
7	77.39209	10.98695	Nala Bund
8	77.43823	10.98238	Nala Bund
9	77.42526	10.97412	Nala Bund
10	77.42540	10.97390	Nala Bund
11	77.39231	10.98685	Nala Bund
12	77.40740	11.04398	Nala Bund
13	77.35091	11.02931	Nala Bund
14	77.35838	11.03390	Nala 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 **20** existing ponds/tanks have been identified with latitude and longitude given below and marked on **Plate 1**.The **20** tanks/ponds could be taken up for the renovation with recharge shaft.

Tentative location of 20 proposed de-siltation of pond/tanks with recharge shaft in Avinashipalayam Firka.

Sl.NO	LONGITUDE	LATITUDE	STRUCTURE	ACTION
1	77.46404	11.02047	TANK / RESERVOIR	DESILTTAION AND RECHARGE SHAFT
2	77.47385	11.02023	TANK / RESERVOIR	DESILTTAION AND RECHARGE SHAFT
3	77.46770	11.04074	TANK / RESERVOIR	DESILTTAION AND RECHARGE SHAFT
4	77.46319	11.05856	TANK / RESERVOIR	DESILTTAION AND RECHARGE SHAFT
5	77.44236	11.06669	TANK / RESERVOIR	DESILTTAION AND RECHARGE SHAFT
6	77.45070	11.06555	TANK / RESERVOIR	DESILTTAION AND RECHARGE SHAFT
7	77.41154	11.03243	TANK / RESERVOIR	DESILTTAION AND RECHARGE SHAFT
8	77.41513	11.02502	TANK / RESERVOIR	DESILTTAION AND RECHARGE SHAFT
9	77.39430	11.02902	TANK / RESERVOIR	DESILTTAION AND RECHARGE SHAFT
10	77.41775	11.05324	TANK / RESERVOIR	DESILTTAION AND RECHARGE SHAFT
11	77.47970	10.98908	TANK / RESERVOIR	DESILTTAION AND RECHARGE SHAFT
12	77.45028	10.98018	TANK / RESERVOIR	DESILTTAION AND RECHARGE SHAFT
13	77.47135	10.97838	TANK / RESERVOIR	DESILTTAION AND RECHARGE SHAFT
14	77.41958	10.95201	TANK / RESERVOIR	DESILTTAION AND RECHARGE SHAFT
15	77.40521	10.97318	TANK / RESERVOIR	DESILTTAION AND RECHARGE SHAFT
16	77.42549	10.94891	TANK / RESERVOIR	DESILTTAION AND RECHARGE SHAFT
17	77.40594	10.98018	TANK / RESERVOIR	DESILTTAION AND RECHARGE SHAFT

18	77.43365	10.99907	TANK / RESERVOIR	DESILTTAION AND RECHARGE SHAFT
19	77.44242	11.03207	TANK / RESERVOIR	DESILTTAION AND RECHARGE SHAFT
20	77.41617	11.00959	TANK / RESERVOIR	DESILTTAION AND RECHARGE SHAFT

5.3.2 Water conservation measure

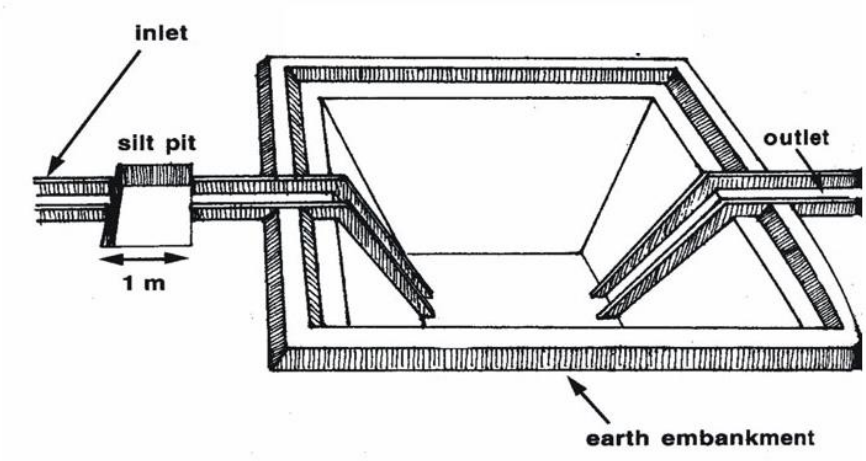
5.3.2.1 Farm Pond

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 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.

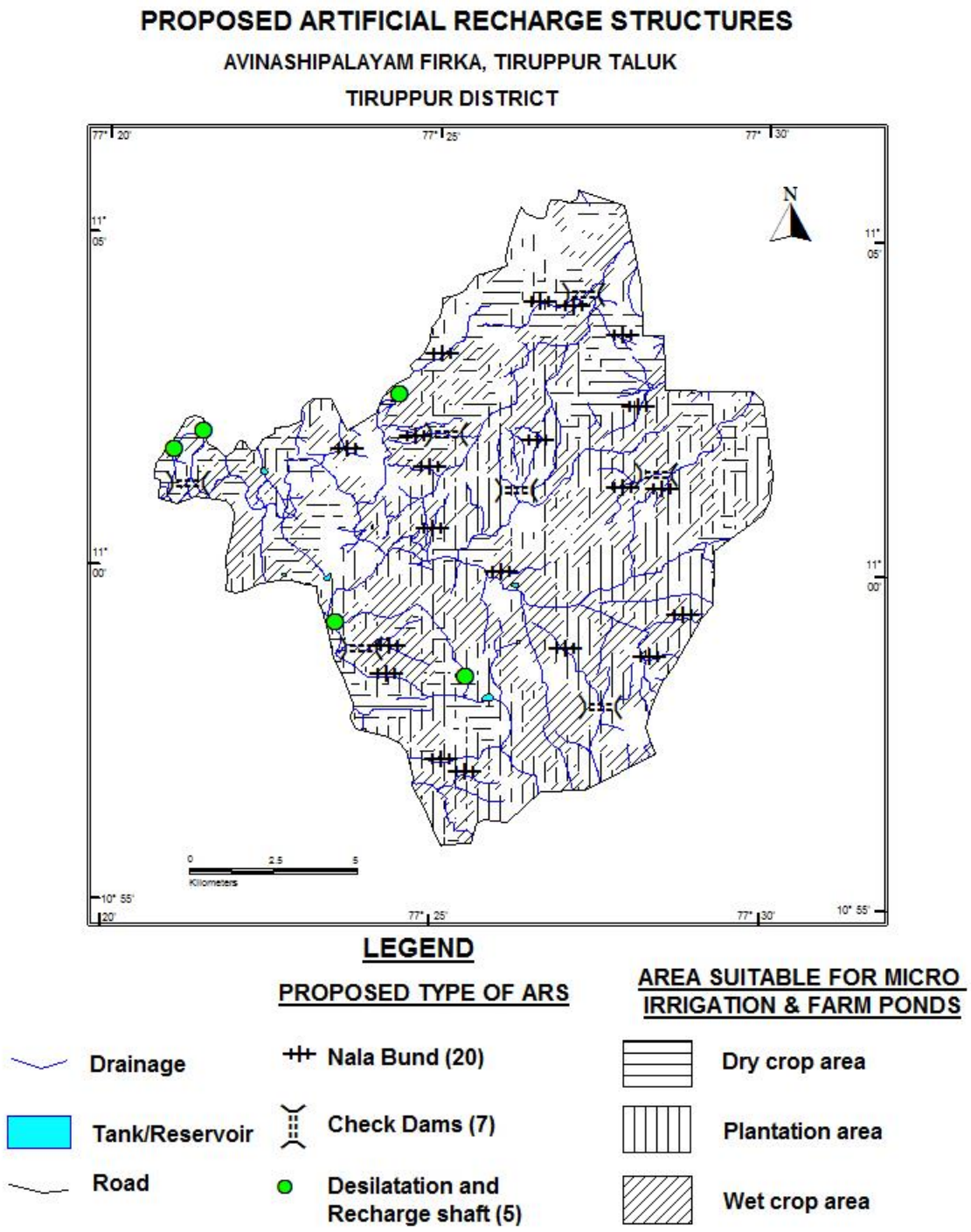


Plate 1. Location map showing the proposed AR Structures in Avinashipalayam Firka

6. Tentative Cost Estimation

The tentative number of feasible structures, its cost and expected annual groundwater recharge/water saving is given in the table 7. The unit rates are as followed by the PWD, Govt. of Tamilnadu (Sources: Scheduled rates, Govt. of Tamilnadu 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- 1.0 m to 1 .5 m	7	3400 (80%)	9.0	63	95200
Nala bunds/ Gabion (4 Fillings)	Width: 5 to 15 m	14	750 (80%)	2.0	28	33600
Revival, repair of water bodies (3 fillings)	(~150 m x150 m x1.5m)	20	33750 (80%)	25.0	500	1620000
Recharge shaft within the pond /tanks	Shaft = 1.5 m dia x 2m depth with filter media in lower 1 m . Bore dia =10", Casing = 6" Depth = 30 m)	20		2.0	40	
Farm Pond (in ha) (5 filling)	(30 m x 30m x 1.5 m)	100 unit	1200(85%)	1	100	600000
			Sub Total		**731**	**2348800**
Water Conservation Activities						
Sprinkler/ drip/ HDPE pipes	For 1 ha with 5 m interval HDPE pipe	100 ha		0.6 /ha	60	700000
			Total		**791**	**3048800**
Impact assessment and O & M						
Piezometers Up to 50 mbgl – 6 nos. @ 0.6 lakh (Impact assessment to be carried out by the implementing agencies)					**3.6**	
Total cost of the Project					**794.60**	
Add 5% for O & M on total cost of the scheme					**39.73**	
Impact assessment to be carried out by the implementing agencies @ 5% of Total cost					**39.73**	
				TOTAL	**874.06**	

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 groundwater recharge as well as effective utilization of the artificial recharge structures.

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 madebetween NationalRural Employment Guarantee Act (NREGA) (Ministry of Rural Development) & Programmes of Water Resources (MoWR , RD & GR).

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 an 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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