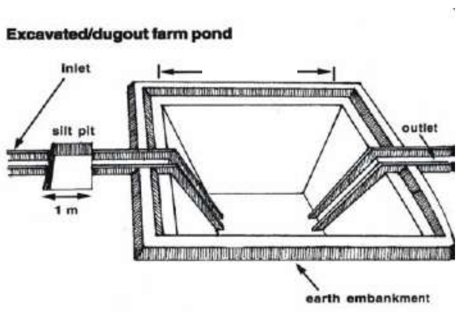
Plan on Artificial Recharge to Groundwater and Water Conservation in Karadivavi Firka, PalladamTaluk, Tirupur District, Tamil Nadu



By

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

Content

AT GLANCE	
Name of Firka	Karadivavi
Taluk	Palladam
District	Tirupur
State	Tamil Nadu
Total area	72.75 Sq.km
Total area suitable for Recharge	46.80 Sq.km
Lat. & Lon.	10°09’ 14“to 11° 00’ 52” & 77° 09’ 14”to 77° 15’ 07”.
Rainfall	546 mm
Monsoon	413 mm
Non- Mon soon	133 mm
Geology	Weathered & Fractured Gneiss, Granites and Charnockites
WATER LEVEL	
Pre – Monsoon(May 2015)	1.65 to 14.90
Post - Monsoon (Jan 2016)	1.58 and 13.45
GROUND WATER RESOURCES ESTIMATION	
Replenish able ground water resources	47.3006
Net ground water available	4.2575
Ground water draft for irrigation	6.8922 MCM
Groundwater draft for domestic & industrial water supply	0.2905 MCM
Total ground water draft	7.1828 MCM
Stage of ground water development (%)	168.708 %
Uncommitted surface runoff available for the Firka	4.506 MCM
Total volume of weathered zone	8.73MCM
Total aquifer volume available for recharge	4.80 MCM
ARTIFICIAL RECHARGE /CONSERVATION MEASURES	
Structures Proposed (tentative) Masonry Check dam Nalla Bund Revival, repair of pond, tanks Recharge shaft inside the ponds Farm Pond	 4 7 24
Improving Water Efficiency /Saving Micro irrigation system for 50 ha	0.35 MCM
Excepted groundwater recharge	2.32 MCM
Excepted groundwater recharge / saving	2.67 MCM
Tentative total cost of the project	8.57 Cr.
Expected raise in water level by recharge	3.75 m

Plan on Artificial Recharge to Groundwater and Water Conservation in Karadivavi Firka, Palladam Taluk, Tirupur taluk district, Tamil Nadu

1. Introduction

India is the largest user of groundwater in the world. Food grain security of the country is largely dependent on water resources and groundwater resources play major role in irrigation sector. Imprints of Over-Exploitation on groundwater resources are being observed as steep deepening of water levels, drying of shallow groundwater abstraction structures, ingress of salinity in fresh aquifers etc. which signal towards taking necessity of emergent action for artificial recharge and rainwater harvesting by utilizing surplus runoff and maintaining groundwater resources at sustainable stage.

In Tamil Nadu dependency on groundwater has increased many folds during the recent years and the groundwater extraction for irrigation, domestic and industries have resulted in lowering of water levels, long-term water level declining trend and even drying up of wells. In order to regulate the groundwater development, Central Ground Water Board in association with State Ground Water Departments has computed Dynamic Groundwater Resources and categorized blocks as Over Exploited, Critical, Semi Critical and Safe.

Out of 1129 firkas (assessment units) in Tamil Nadu the groundwater situation in 374 firkasoverexploited, 48 firkas critical, 235firkassemi-critical, 437 firkas safe and 35 firkas are saline. Various measures such as rainwater harvesting, artificial recharge and water use efficiency are successfully practiced by some NGOs, Central and State govts., which need replication at larger scale in close coordination with State govt. agencies and stakeholders so that capacity building of state implementing agencies and awareness of stakeholders towards artificial recharge and rainwater harvesting can be made.

2. Objectives of the scheme

Objectives of the proposed scheme are

- To upscale recharge activities, supplement additional groundwater resources by harvesting surplus runoff, sustainability of groundwater resources at shallow depths

- Recovery of over-exploited groundwater areas by implementing artificial recharge measures in groundwater stress areas.

- Conservation, development and sustainable management of natural resources including their use.

3. Study area details

3.1 Location

The total area of Karadivavi firka is 72.7505 sq.km and Karadivavi firka lies between North latitudes 10° 54’ 30 “to 11° 00’ 52” and east longitudes 77° 09’ 14”to 77° 15’ 07”. Location map of Karadivavi Firka is given in Figure 1.

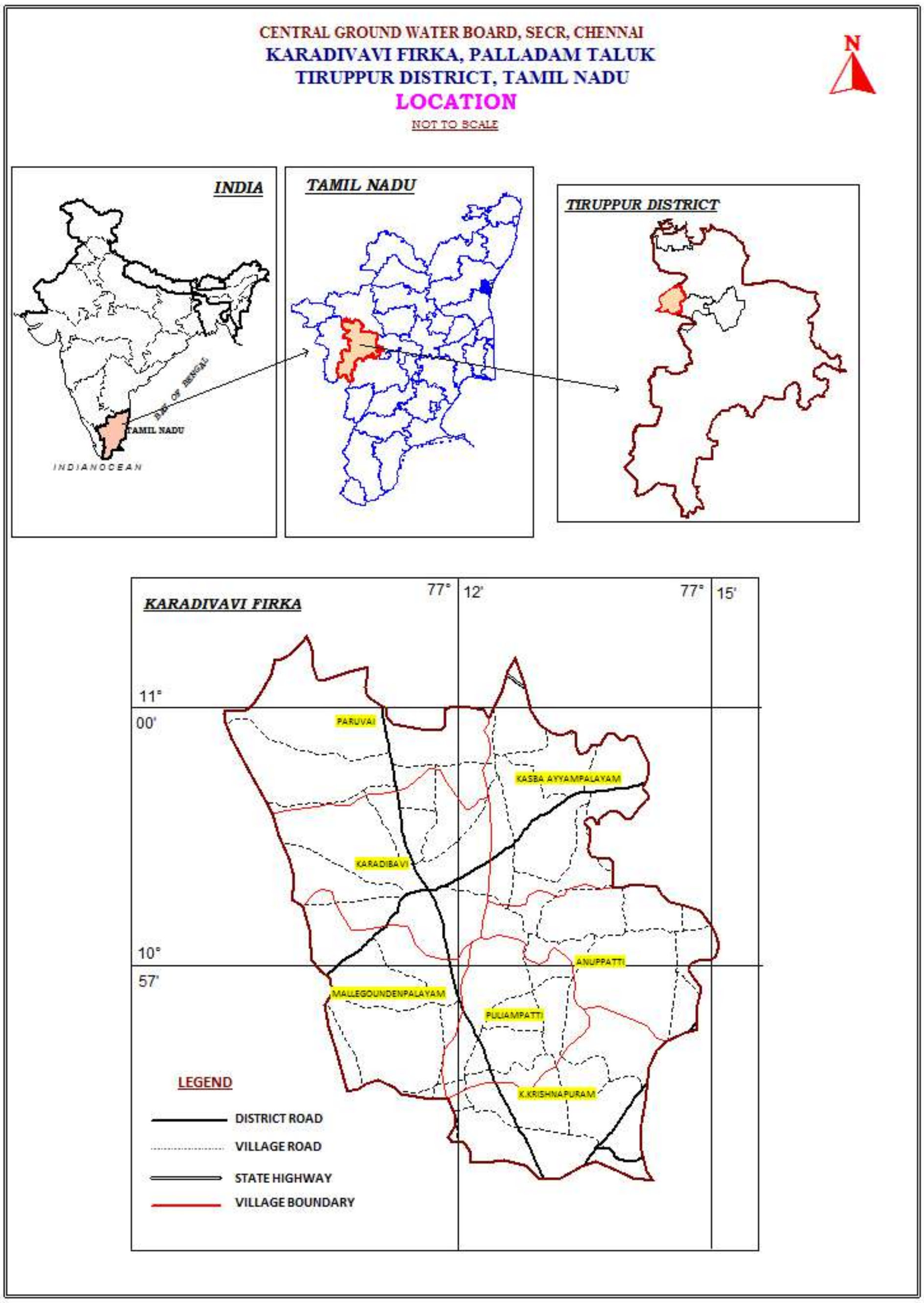


Figure 1. Location map of Karadivavi firka

3.2 Geomorphological Set up

In the Karadivavi firka area it is seen that Shallow pediplain and dissected/undissected land forms predominate the firka. The moderate pediplain occupies a considerable area. Inselberg complex is also available. 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 Karadivavi Firka

LANDFORMS	Area in Sq.Km	% of Area
PEDIMENT-INSELBERG COMPLEX	0.68	0.93
PEDIPLAIN (WEATHERED) MODERATE	6.31	8.62
DISSECTED/UNDISSECTED	30.35	41.48
PEDIPLAIN (WEATHERED) SHALLOW	35.83	48.97

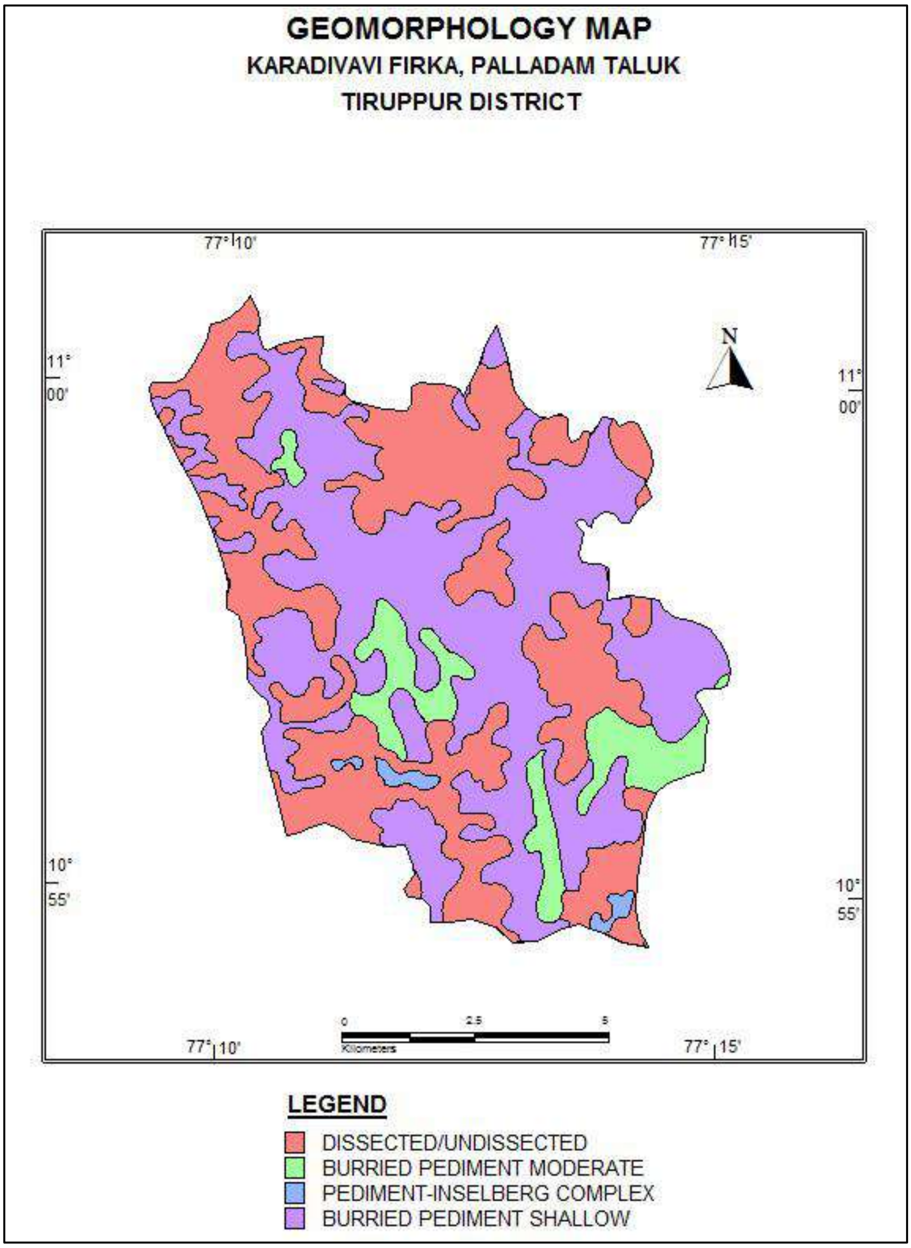


Figure 2 showing Geomorphology of Karadivavi Firka

3.3 Land use and soil

The soil of the Karadivavi firka is 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. Red soil is also occurring in the north east of the firka. Due to the presence of montmorillonite type of clay minerals, the soil exhibit high cracking and swelling properties.

Table 3 Showing the details of Land use in Karadivavi Firka

Type of Land Use	% of Area
RESERVOIR / LAKE / TANK	0.92
TOWN AND CITIES	0.96
FALLOW	1.67
BARREN ROCKY / STONY WASTE	2.47
RURAL SETTLEMENTS VILLAGES	6.32
DRY CROP	20.94
WET CROP	30.20
PLANTATION	36.53

The land use pattern of the Karadivavi Firka is given in figure 3. Predominantly the most of the area is characterised by the Plantation, wet crop and dry crop in that order. (i.,e agricultural field)and accounts for63 % of the total area of the firka (Source: IRS, Anna university, Chennai Tamil Nadu). This area is highly suitable for water conservation and recharge. Apart from that the Firka is occupied by Stoney waste, fallow and rural settlements.

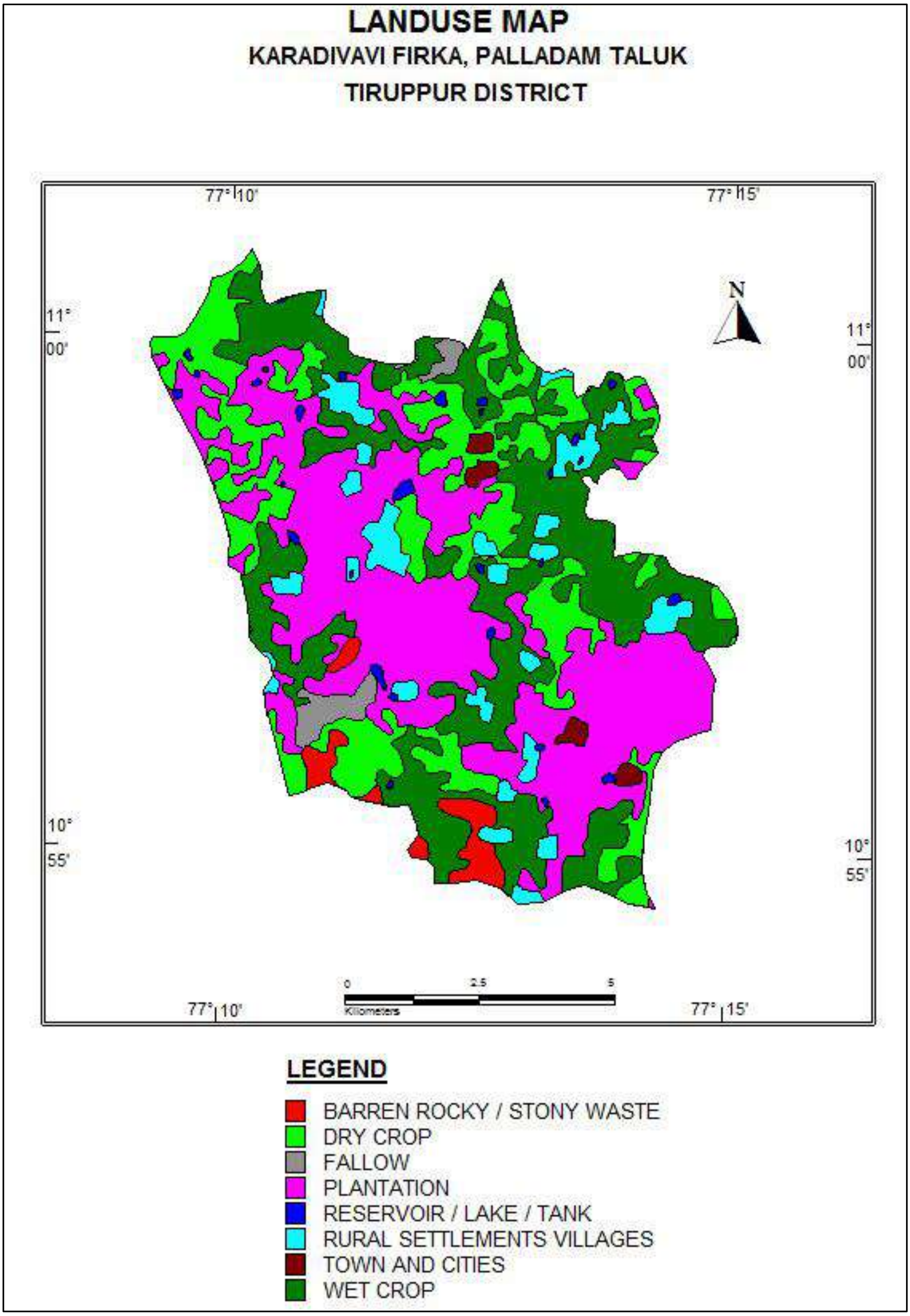


Figure 3 a : Landuse map of Karadivavi Firka

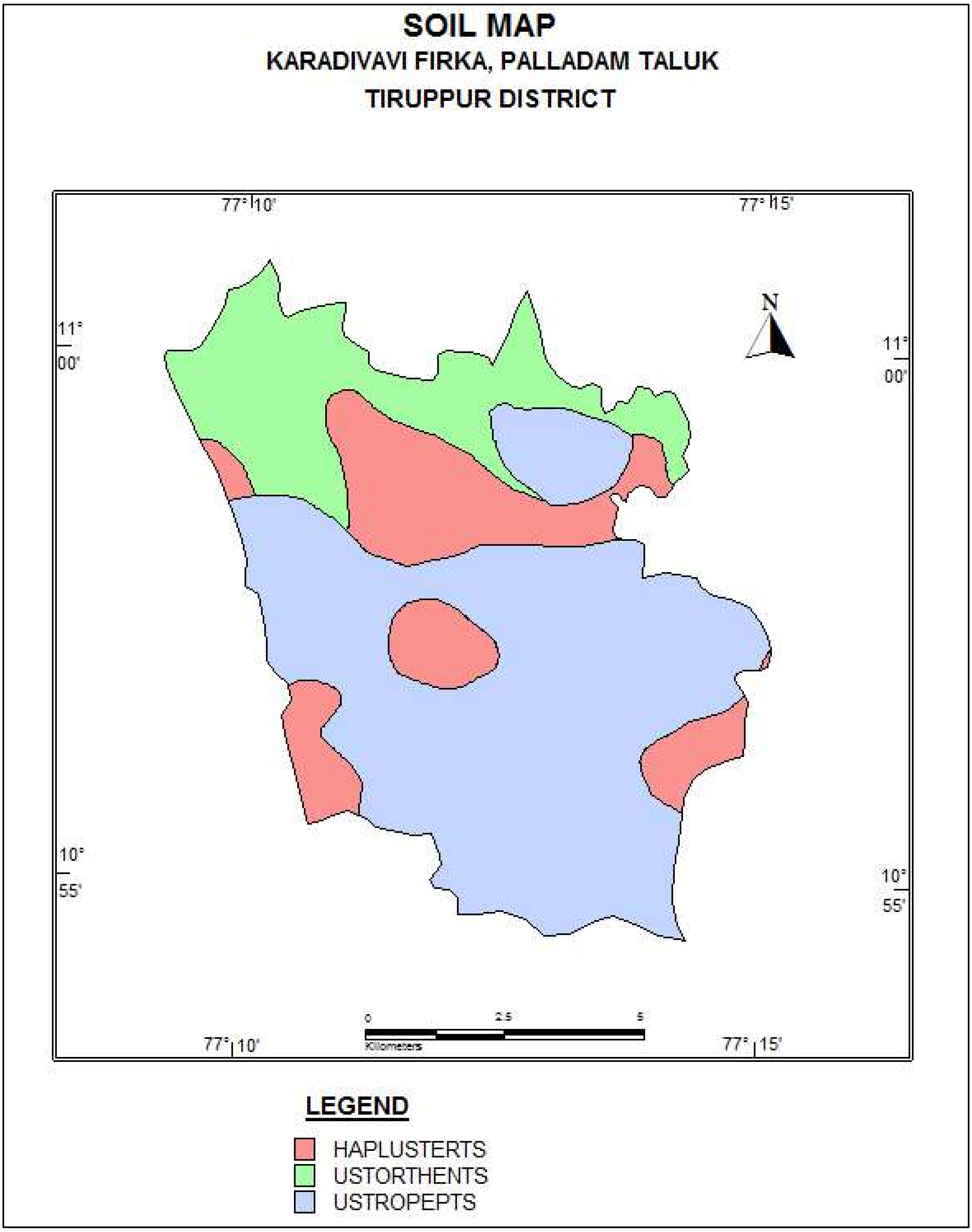


Figure 3 b: soil map of Kradivavi firka

3.4 Drainage

The Karadivavi Firka falls under Noyil, Amaravthi and Ponnani rivers. The major drainage patterns observed is Dendritic to sub -dendritic.Some of the tanks are connected with streams. Only seasonal floods inundate lower parts of the basins. Tanks and surface water bodies are spread over the entire firka. The drainage pattern is the dendritic and sub- dendritic. Drainage is flowing from northwest to south east. The drainage map of Karadivavi firka is given in Fig 4.

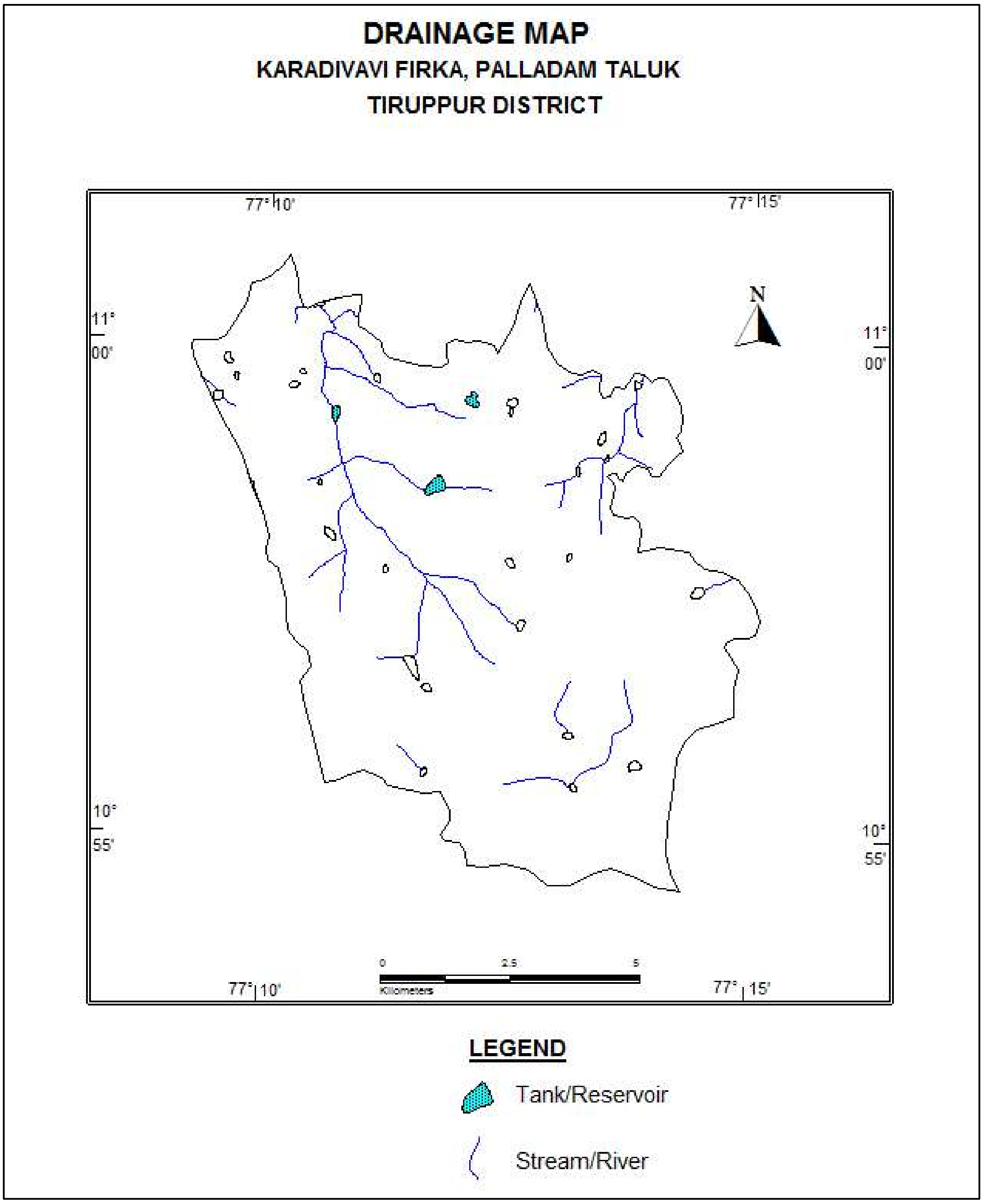


Figure 4 : showing Drainage map of Karadivavi Firka

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 scantyKaradivaviarea 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
Palladam	Karadivavi	72.7505	0.413	0.133	0.546

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 1.96 to 21.62 mbgl during pre- monsoon (May 2015) and from 1.769 to 22.763 m mbgl during post monsoon (January 2016). The hydrogeological map of Karadivavi firka is given in Figure 5. The Average in pre and post monsoon is 8.795 and 7.405 respectively.

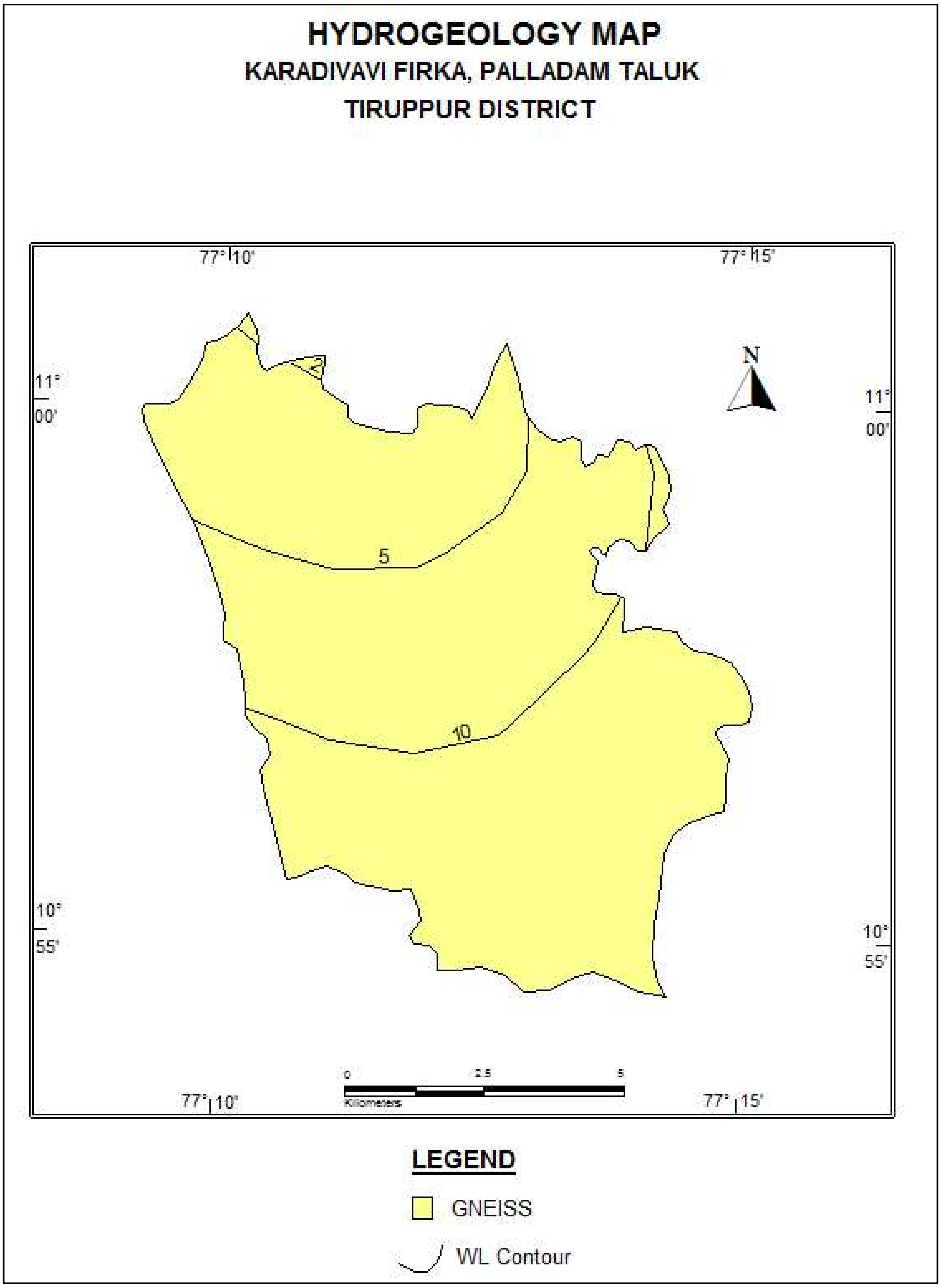


Figure 5: Hydrogeological Map of Karadivavi Firka

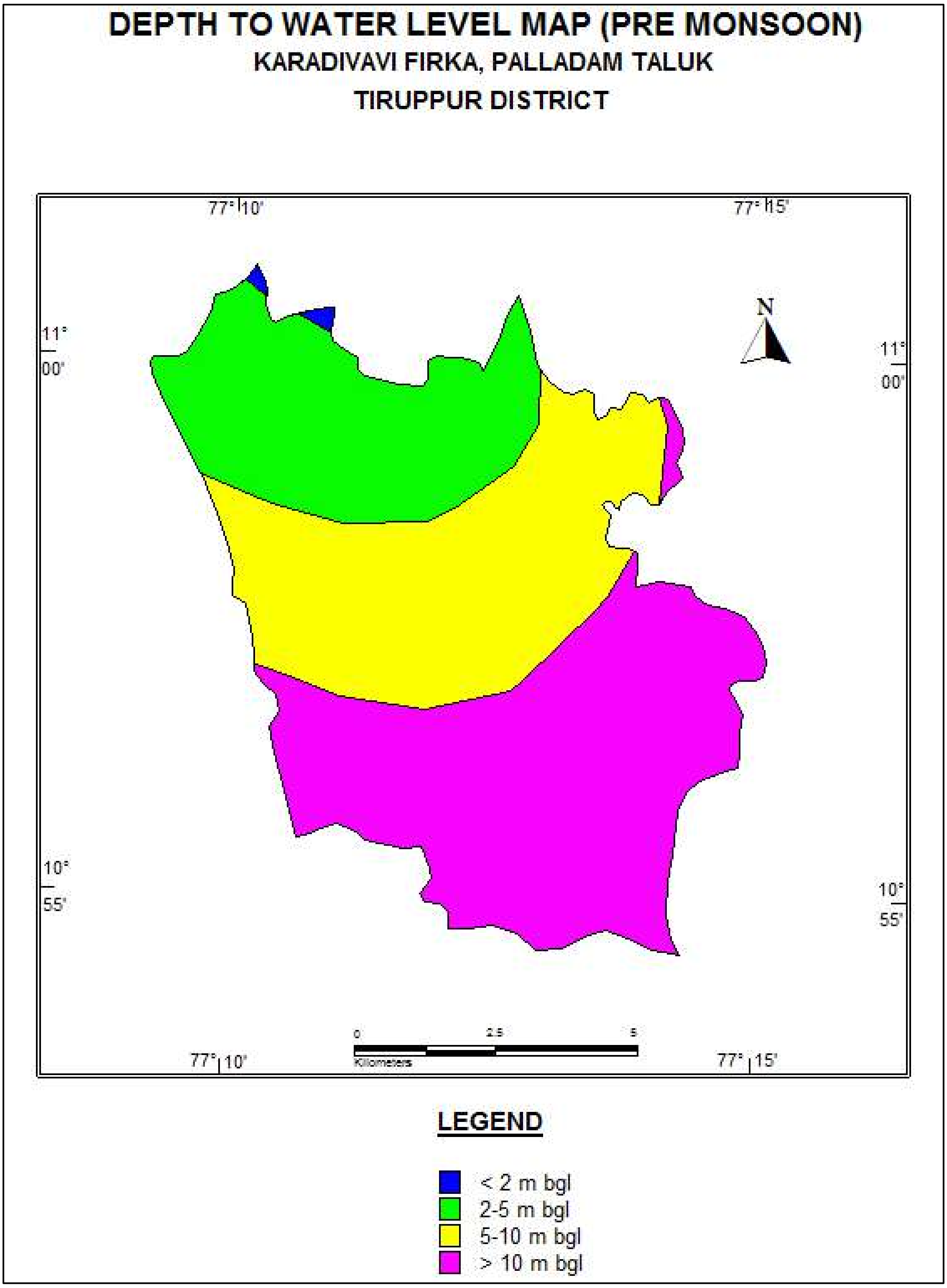


Figure 6a : Pre -monsoon Decadal water level in Karadivavi firka

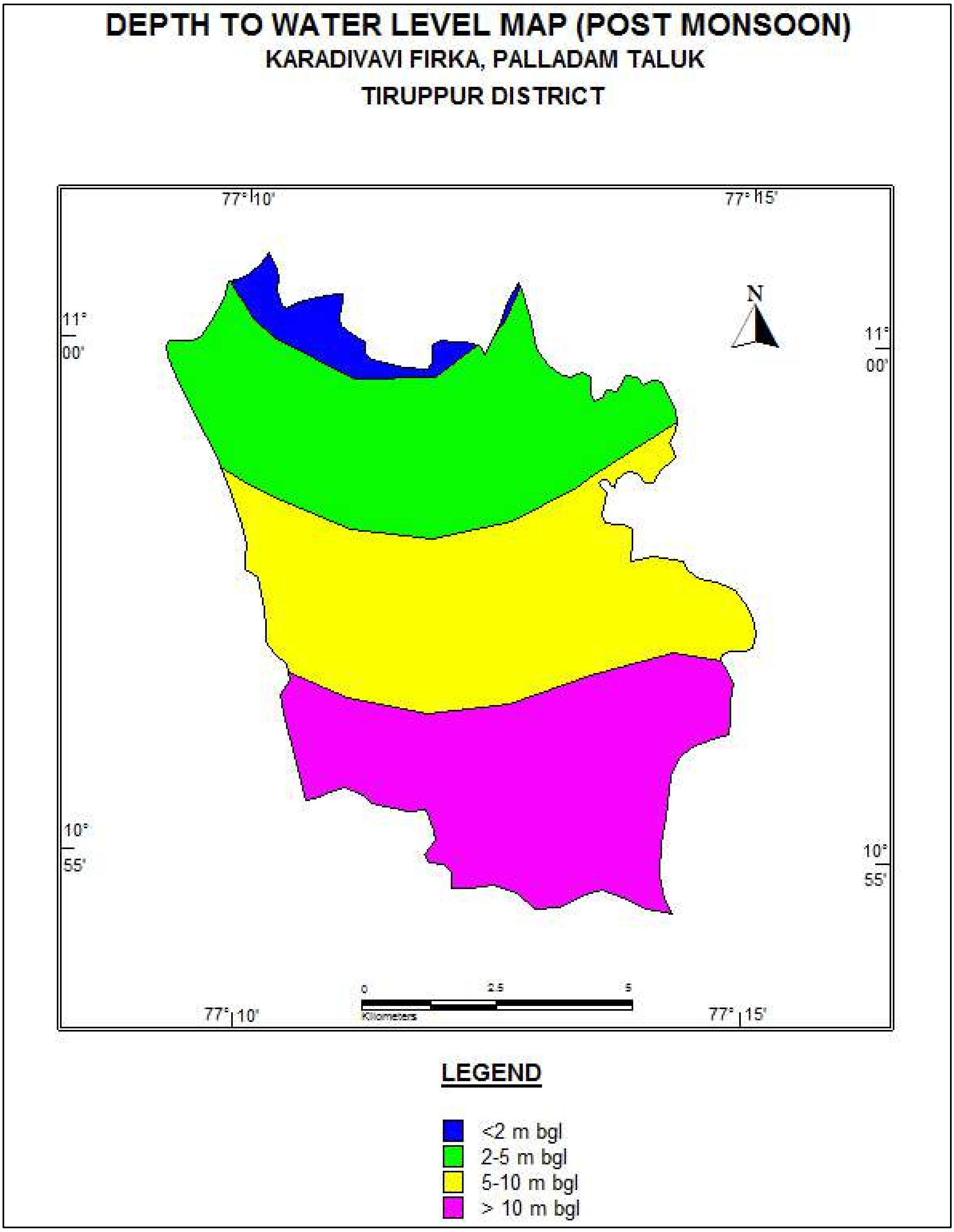


Figure 6 b : Post-monsoon Decadal water level in Karadivavi firka

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 Karadivavi firka

Firka	Ground water 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)					%	
Karadivavi	**72.75**	4.7306	4.2575	6.8922	0.2905	7.1827	168.708	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 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	5	Suitable for all major recharge structures like Percolation pond and stop dam, check dam etc.,
High	10	Suitable for all major recharge structures like stop dam, check dam etc.,
Moderate	50	Suitable for all major recharge structures like earthen check dam, Boulder check dam and Nala bund etc.,
Poor	35	Hilly/Forest /Catchment area

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

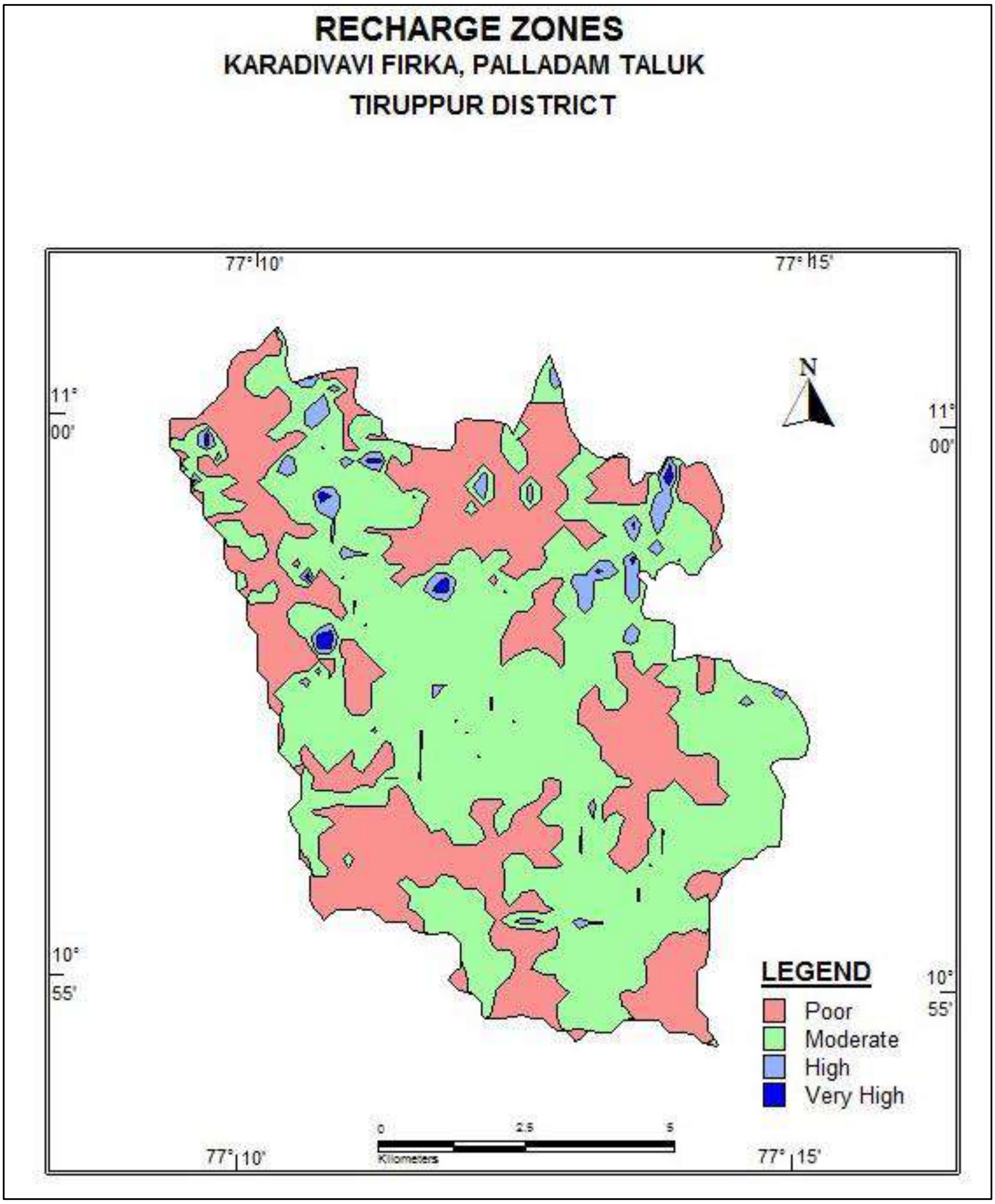


Figure 7showing the recharge worthy area Karadivavi firka

5. Planning for groundwater recharge /conservation

5.1 Justification of the artificial recharge & conservation measures

- The Karadivavi Firka is with high stage of groundwater development i.e, **168** % and with sufficient amount of uncommitted surface runoff/flow of **4.50** MCM.
- The total weathered zone available beneath the ground in the firka is **8.73** MCM. Out of these total volume available for recharge considering 3.5 m depth from 3 m) is **4.80** MCM.

- The Karadivavi Firka consists of **24** 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 Karadivavi areas reveals that more than 65 % of areas are suitable for recharge.
- In Karadivavi firka more than 63 % area is characterised by the agricultural activities, there is sufficient scope for the water conservation measures to 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 Karadivavi 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 Karadivavi Firka is**4.506 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

Karadivavi firka area is covered by the seasonal nallahs/drains which carry heavy discharge during monsoon period . It is proposed that such seasonal nallahs will be identified and the rain water will be harnessed through construction of series of check dams nallahs bund and gabion structures so as to harness this water thereby increasing the resident period of the water in these channels and to increase the soil moisture content. As per the integrated model prediction around 30 % of the firkas areas are suitable for these structures. It is proposed to construct **4** Check dam and **7** Nallah bunds. The tentative location of these **11** 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 4 Check dam in Karadivavi firka

S. NO.	LONGITUDE	LATITUDE	TYPE OF ARS
1	77.19531	10.95936	Check Dam
2	77.17975	10.96744	Check Dam
3	77.22148	10.98056	Check Dam
4	77.17664	10.99638	Check Dam

Tentative location of proposed 7 Nalla bund in Karadivavi Firka

SL.NO	LONGITUDE(DD)	LATITUDE (DD)	TYPE OF ARS
1	77.22386	10.97463	Nala Bund
2	77.19604	10.97499	Nala Bund
3	77.20007	10.95271	Nala Bund
4	77.18030	10.95990	Nala Bund
5	77.24327	10.95972	Nala Bund
6	77.22954	10.98829	Nala Bund
7	77.18835	10.99063	Nala Bund

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 **24** existing ponds/tanks have been identified with latitude and longitude given below and marked on Plate 1.

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

Sl.NO	LONGITUDE	LATITUDE	STRUCTURE	ACTION
1	77.17512	11.00600	TANK / RESERVOIR	DESILTTAION AND RECHARGE SHAFT
2	77.17267	10.99468	TANK / RESERVOIR	DESILTTAION AND RECHARGE SHAFT
3	77.18540	10.99374	TANK / RESERVOIR	DESILTTAION AND RECHARGE SHAFT
4	77.16137	10.99370	TANK / RESERVOIR	DESILTTAION AND RECHARGE SHAFT
5	77.23004	10.99328	TANK / RESERVOIR	DESILTTAION AND RECHARGE SHAFT
6	77.17131	10.99248	TANK / RESERVOIR	DESILTTAION AND RECHARGE SHAFT
7	77.20840	10.98834	TANK / RESERVOIR	DESILTTAION AND RECHARGE SHAFT
8	77.22494	10.98088	TANK / RESERVOIR	DESILTTAION AND RECHARGE SHAFT
9	77.22006	10.97858	TANK / RESERVOIR	DESILTTAION AND RECHARGE SHAFT
10	77.17595	10.97605	TANK / RESERVOIR	DESILTTAION AND RECHARGE SHAFT
11	77.16450	10.97551	TANK / RESERVOIR	DESILTTAION AND RECHARGE SHAFT
12	77.21881	10.96410	TANK / RESERVOIR	DESILTTAION AND RECHARGE SHAFT
13	77.20865	10.96288	TANK / RESERVOIR	DESILTTAION AND RECHARGE SHAFT
14	77.18753	10.96156	TANK / RESERVOIR	DESILTTAION AND RECHARGE SHAFT
15	77.21918	10.93401	TANK / RESERVOIR	DESILTTAION AND RECHARGE SHAFT
16	77.19463	10.92745	TANK / RESERVOIR	DESILTTAION AND RECHARGE SHAFT
17	77.22023	10.92515	TANK / RESERVOIR	DESILTTAION AND RECHARGE SHAFT
18	77.18547	10.99356	TANK / RESERVOIR	DESILTTAION AND RECHARGE SHAFT
19	77.23013	10.99337	TANK / RESERVOIR	DESILTTAION AND RECHARGE SHAFT
20	77.17133	10.99245	TANK / RESERVOIR	DESILTTAION AND RECHARGE SHAFT
21	77.20883	10.96266	TANK / RESERVOIR	DESILTTAION AND RECHARGE SHAFT
22	77.21920	10.93380	TANK / RESERVOIR	DESILTTAION AND RECHARGE SHAFT
23	77.21995	10.92492	TANK / RESERVOIR	DESILTTAION AND RECHARGE SHAFT
24	77.19432	10.92714	TANK / RESERVOIR	DESILTTAION AND RECHARGE SHAFT

5.3.2 Water conservation measure

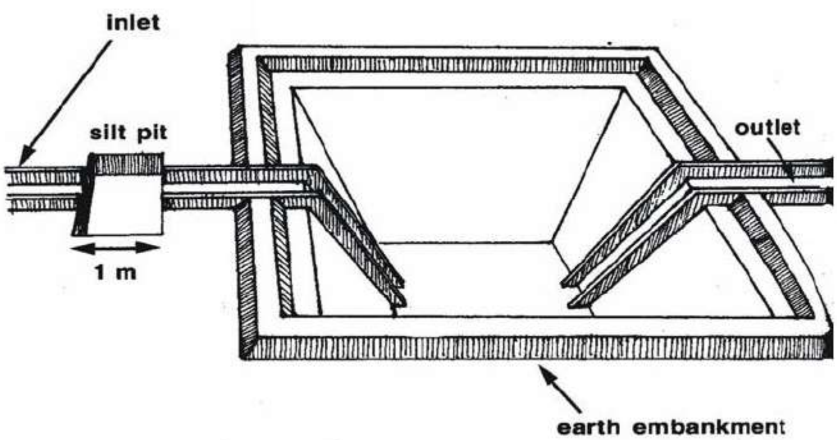
5.3.2.1 Farm Pond

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 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.

It is proposed to take up micro irrigation system in **50** ha. The cost estimation for this component has been taken from SOR of Agricultural Engineering Department (AED), Govt. of Tamil Nadu. Tentative locations of proposed micro irrigation are shown in Plate 1.

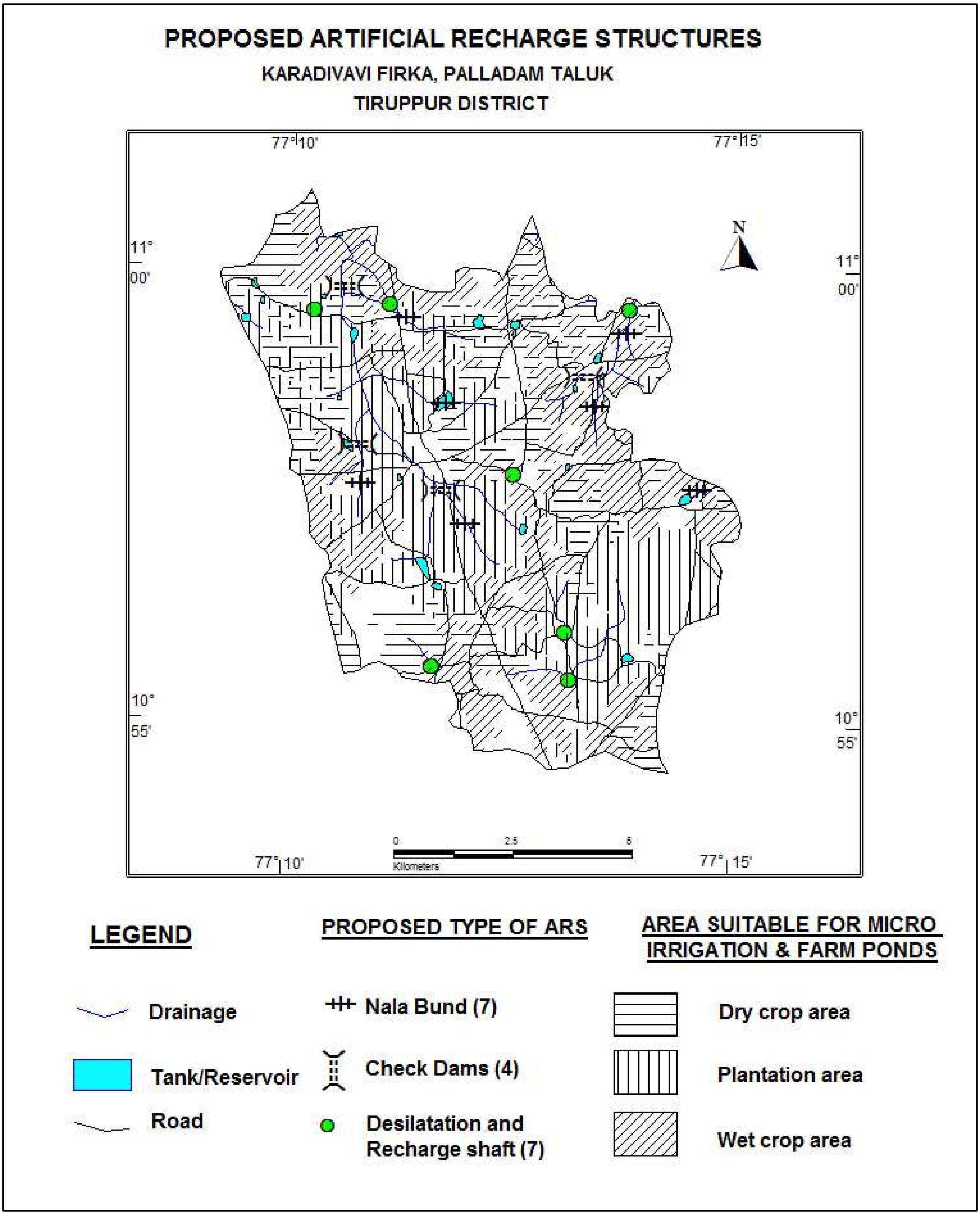


Plate 1. Location map showing the proposed AR Structures in Karadivavi firka

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	4	3400 (80%)	9.0	36	54400
Nala bunds/ Gabion (4 Fillings)	Width: 5 to 15 m	7	750 (80%)	2.0	14	16800
Revival, repair of water bodies (3 fillings)	(~150 m x150 m x1.5m)	24	33750 (80%)	25.0	600	1944000
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)	24		2.0	48	
Farm Pond (in ha) (5 filling)	(30 m x 30m x 1.5 m)	50 unit	1200(85%)	1	50	300000
			Sub Total		**748**	**2315200**
Water Conservation Activities						
Sprinkler/ drip/ HDPE pipes	For 1 ha with 5 m interval HDPE pipe	50 ha		0.6 /ha	30	350000
			Total		**778**	**2665200**
Impact assessment and O & M						
Piezometers Up to 50 mbgl – 2 nos. @ 0.6 lakh (Impact assessment to be carried out by the implementing agencies)					**1.2**	
Total cost of the Project					**779.2**	
Add 5% for O & M on total cost of the scheme					**38.96**	
Impact assessment to be carried out by the implementing agencies @ 5% of Total cost					**38.96**	
				TOTAL	**857.12**	

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 made between National Rural 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 impact assessment at rate of 5 % of the total cost of the project for 5 years from the completion of artificial recharge structures.