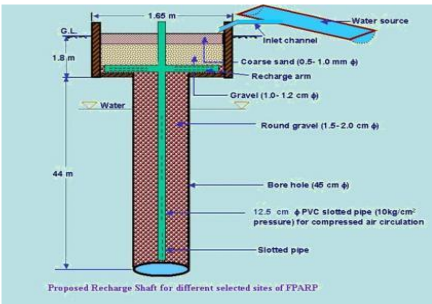
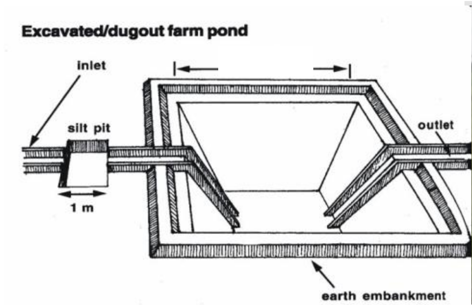
Plan on Artificial Recharge to Groundwater and Water Conservation in Silvathur Firka, Dindigul Taluk, Dindigul District, Tamil Nadu





By

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

Content

AT GLANCE	
Name of Firka	Silvathur
Taluk	Dindigul
District	Dindigul
State	Tamil Nadu
Total area	57.14 Sq.km
Total suitable area	34.86
Lat. & Lon.	10° 17’48“ to 10° 23’ 25” & 78° 01’ 21”to 78° 07’ 47”.
Rainfall	913.38 mm
Monsoon	744.3 mm
Non- Mon soon	169.08 mm
Geology	Crystalline metamorphic gneisses
WATER LEVEL	
Pre – Monsoon	5 to 10 m bgl.
Post - Monsoon	2 to 5 m bgl.
GROUND WATER RESOURCES ESTIMATION	
Replenish able ground water resources	7.61 MCM
Net ground water available	6.85 MCM
Ground water draft for irrigation	8.65 MCM
Groundwater draft for domestic & industrial water supply	0.42 MCM
Total ground water draft	9.07 MCM
Stage of ground water development (%)	133 %
Uncommitted surface runoff available for the Firka	6.38 MCM
Total volume of weathered zone	686 MCM
Total volume available for recharge (considering 3 m depth from 3 m bgl	286 MCM
ARTIFICIAL RECHARGE /CONSERVATION MEASURES	
Structures Proposed (tentative) Nalla Bund Revival, repair of pond, tanks with recharge shaft	 1 19
Improving Water Efficiency /saving Micro irrigation system for 100 ha	0.7 MCM
Excepted groundwater recharge	1.65 MCM
Total expected groundwater recharge/ saving	2.35 MCM
Tentative total cost of the project	Rs. 4.72 Cr
Expected rise in water level by recharging /saving	4.44 m

Plan on Artificial Recharge to Groundwater and Water Conservation in Silvathur Firka, Dindigul Taluk, Dindigul district, Tamil Nadu

1. Introduction

India is the largest user of groundwater in the world. Food grain security of the country is mainly dependent on water resources and groundwater play major role in irrigation sector. Imprints of Over-Exploitation on groundwater resources are being observed as steep deepening of water levels, drying up 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.

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 firkas as Over Exploited, Critical, Semi Critical and Safe.

Out of 1129 firkas (assessment units) of Tamil Nadu the category of groundwater development is over-exploited in 374 firkas, critical in 48 firkas, semi-critical in 235 firkas, safe in 437 firkas. And the rest 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 governments which need replication at larger scale in close coordination with State government agencies and stakeholders, so that capacity building of state implementing agencies and awareness among stakeholders towards artificial recharge and rainwater harvesting can be made.

2. Objectives of the scheme

Objectives of the proposed scheme are

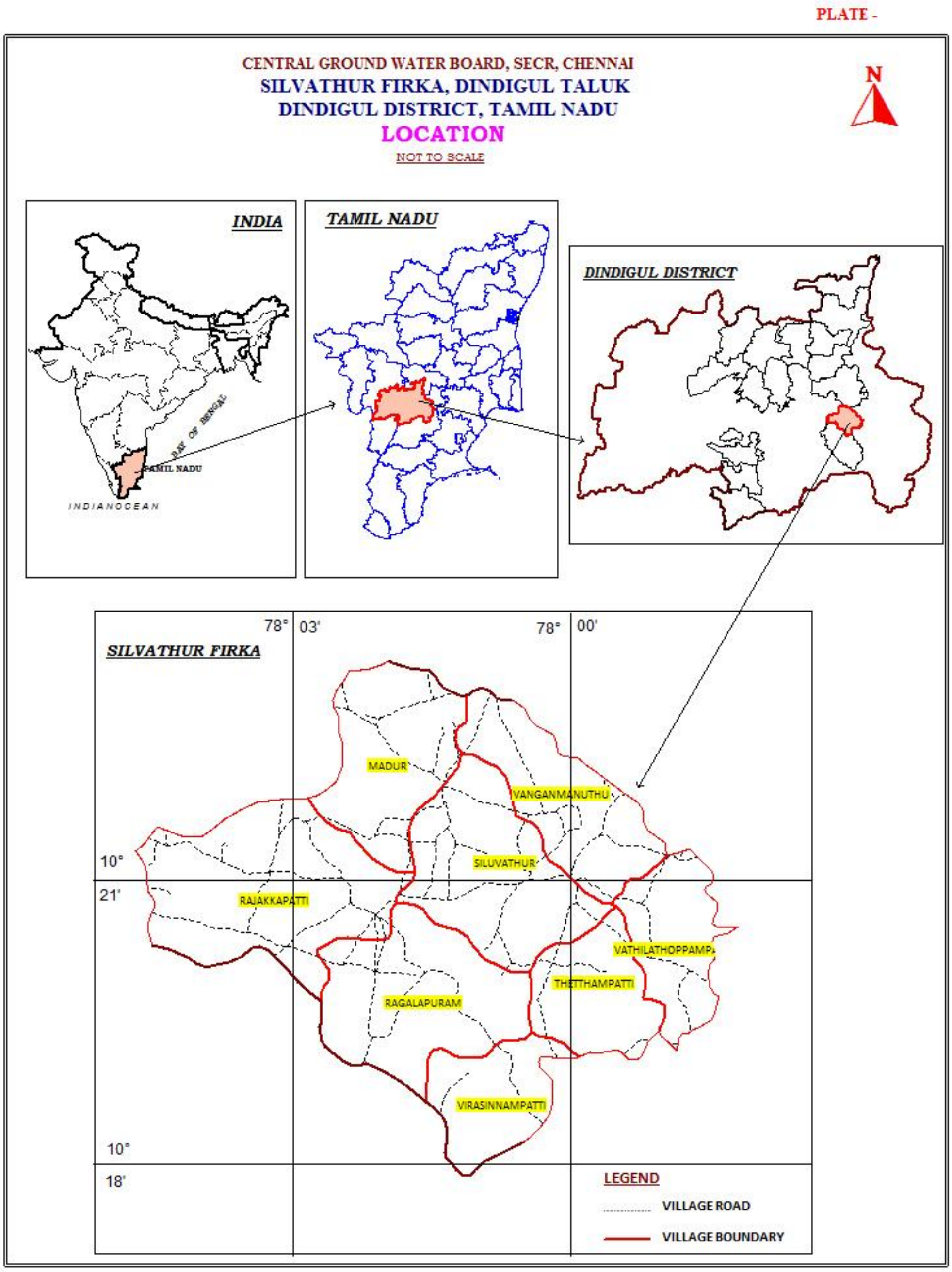
- To upscale recharge activities, supplement additional groundwater resources by harvesting surplus runoff, sustainability of groundwater resources at shallow depths
- Recovery of over-exploited groundwater areas by implementing artificial recharge measures in groundwater stress areas.
- Conservation, development and sustainable management of natural resources including their usage.

3. Study area details

3.1 Location

The total area of Silvathur firka is 57.14 sq.km and Silvathur firka lies between North latitudes 10°17’48“ to 10°23’25” and east longitudes 78°01’21” to 78°07’47” and falls in Survey of India toposheet number 58J/3. Location map of Silvathur firka is given in Figure 1.

Figure 1



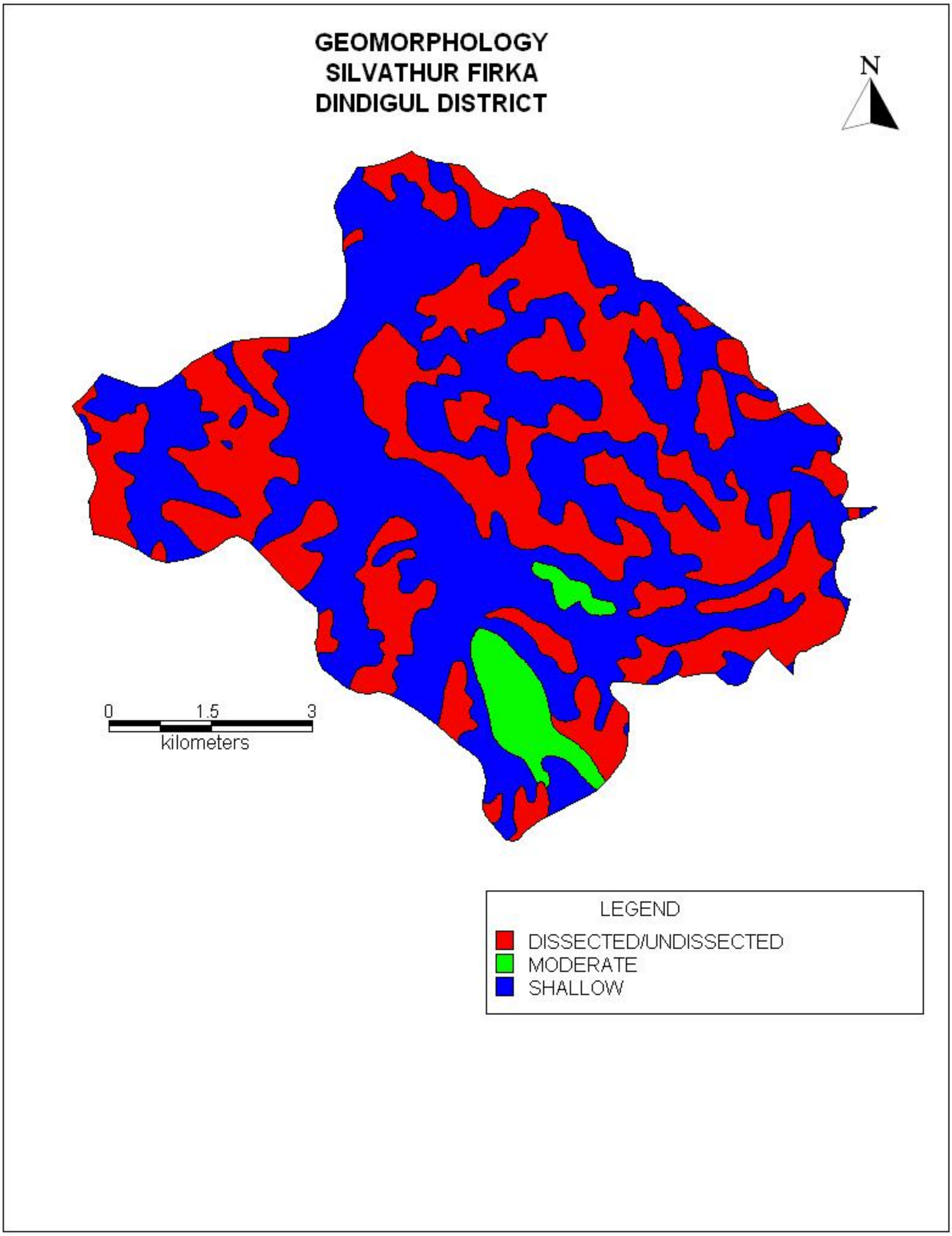
3.2 Geomorphological Set up

Geomorphologically, the area consists of hills and plain landforms. In plain landforms, Pediplain `weathered moderate and shallow are occupied major part of the firka. These landforms are influencing the ground water recharge. Hill landforms like residual hills, denudation hill and structural hills 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 Silvathur firka

LANDFORMS	% of Area
PEDIPLAIN (WEATHERED) SHALLOW	56
DISSECTED/UNDISSECTED	41
PEDIPLAIN (WEATHERED) MODERATE	3

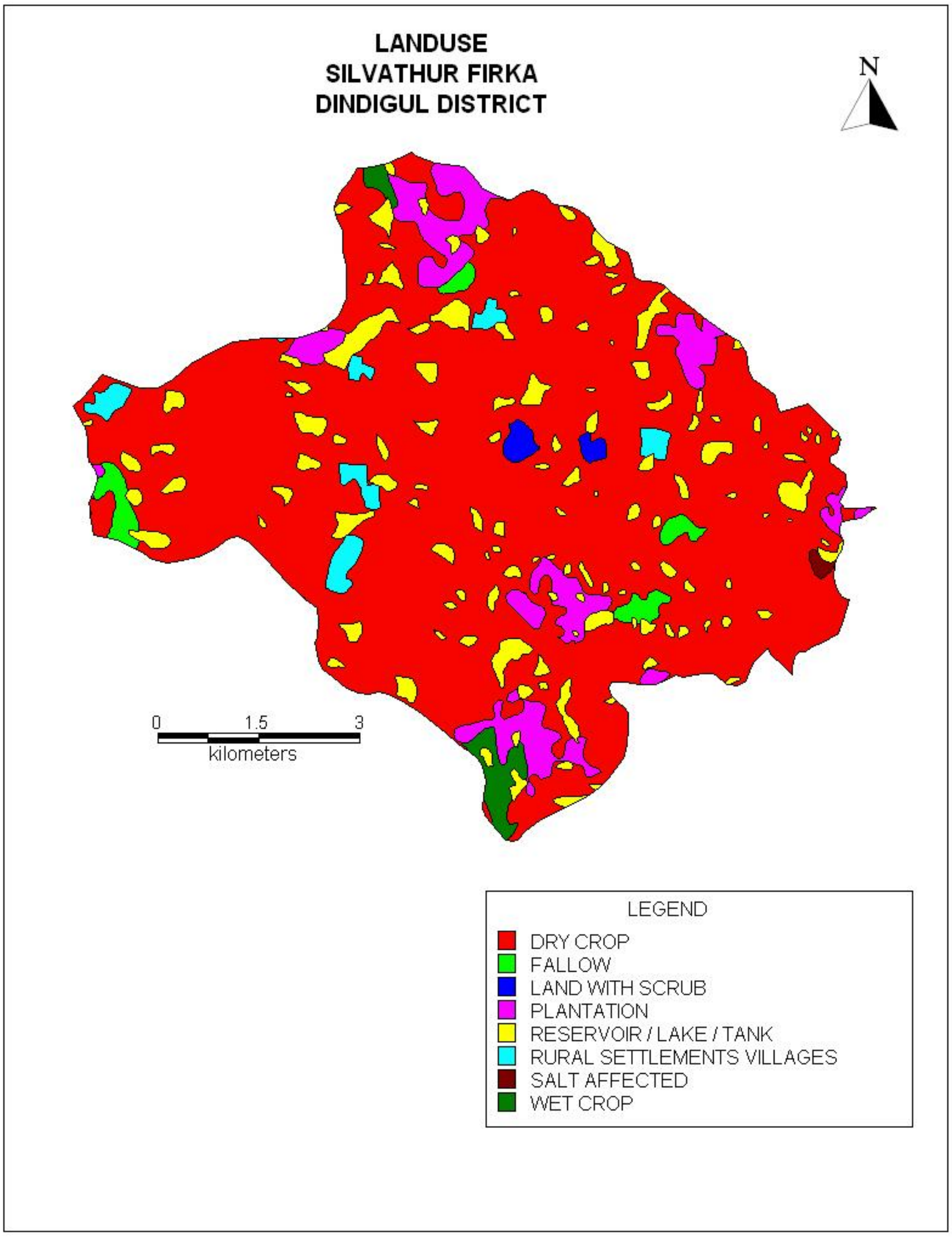
Figure-2


GEOMORPHOLOGY
SILVATHUR FIRKA
DINDIGUL DISTRICT
N
0 1.5 3
kilometers
LEGEND
DISSECTED/UNDISSECTED
MODERATE
SHALLOW

3.3 Land use and soil

The land use pattern of the Silvathur Firka is given in figure 3. Predominantly the most of the area is characterised by dry crops (80%) and plantation(6.5%). (i.,e agricultural fields) and considerable area is covered with Tanks (8%) of the total area of the firka (Source: IRS, Anna university, Chennai Tamil Nadu). This area is highly suitable for water conservation and recharge.

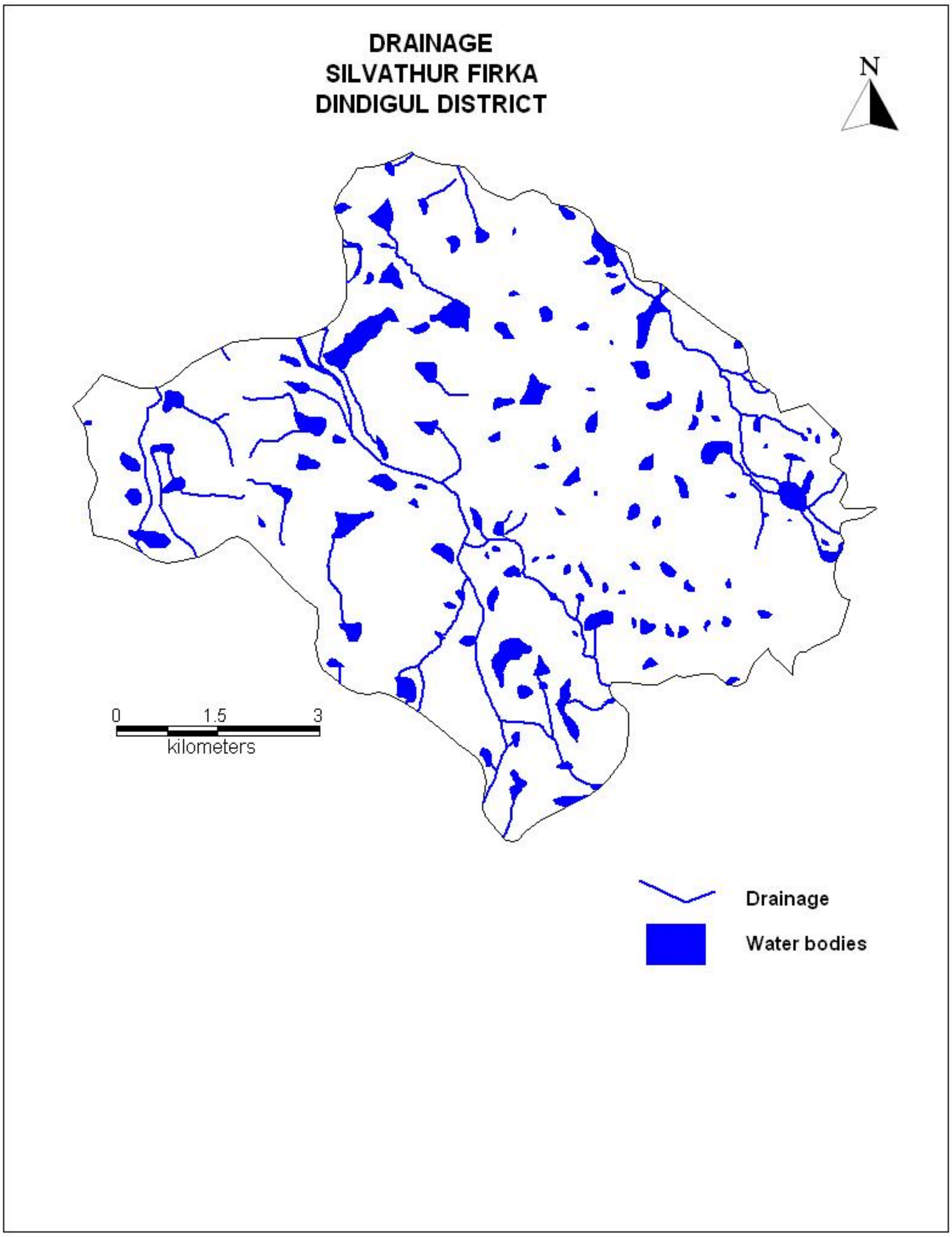
Figure – 3



3.4 Drainage

The entire Firka area is within the Kodavanar river basin, which is a tributary of Cauvery River Basin and the entire area is drained by Mangarai Ari which flows from west to east to join Kodavanar river at Agaram, near Tadidombu. Basin sub soil water is used to irrigate the lands. Tanks and surface water bodies are spread over the entire firka. The drainage is dendritic and sub- dendritic. The gradient of surface flow ranges from 10m/km in the hilly tracks of western part of the firka to 2m/km in the plains of the firka. The drainage map of Silvathur firka is given in Fig 4.

Figure – 4



3.5 Rainfall

Silvathur area falls under tropical climate. The period from April to June is generally hot and dry. The average temperature varies from 26 to 41° C. The humidity is relatively high in the mornings and varies between 65 and 85%. While in the afternoons it varies between 40 and 70%. Silvathur Firkas receives rainfall from southwest monsoon (June – September), northeast monsoon (October – December) and non-monsoon periods (January – May). The area receives the major rainfall from northeast monsoon and the normal annual rainfall is 913.38mm.

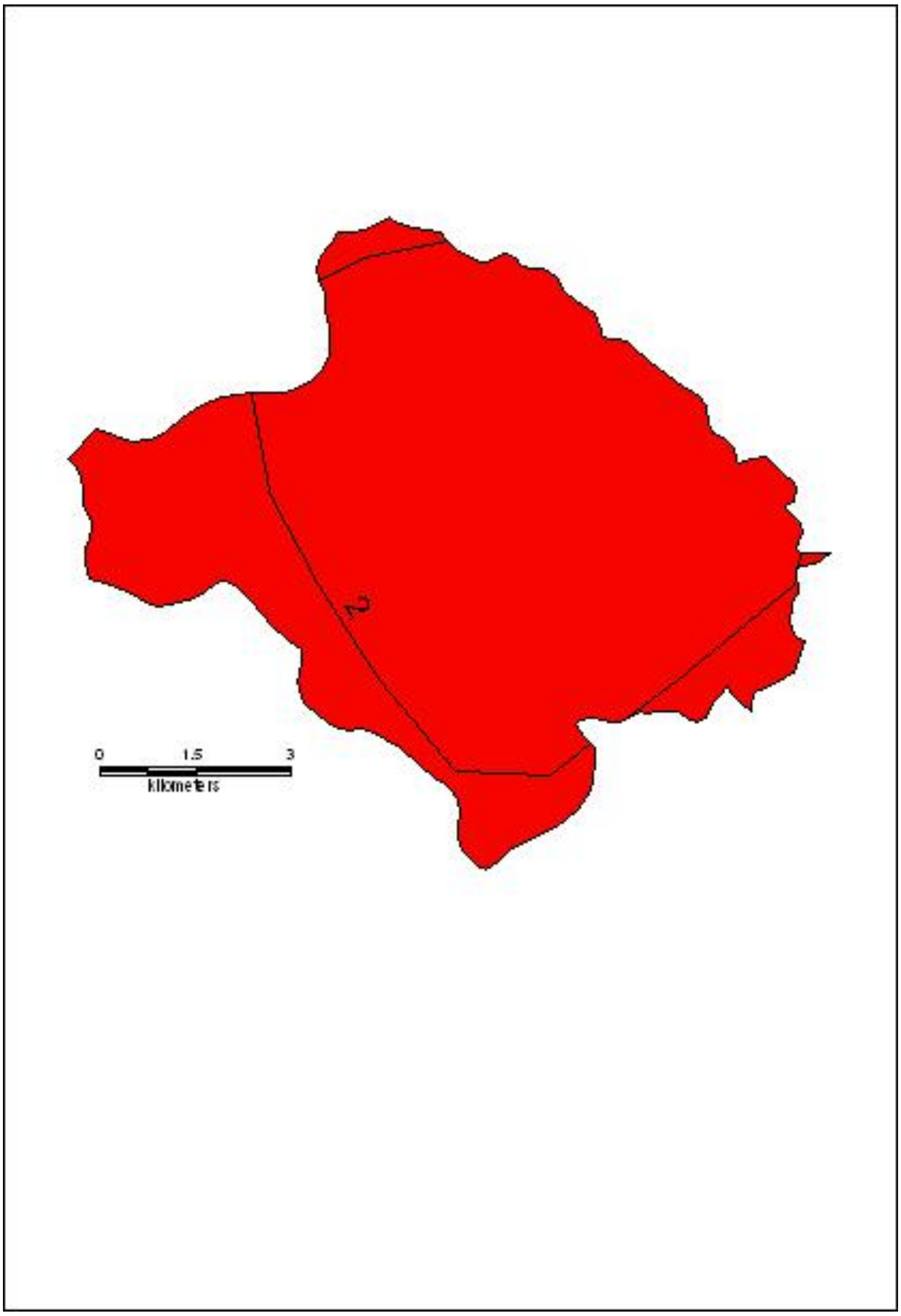
Taluk	Name of Firkas	Area in sq.km	Monsoon rainfall (Jun to Dec) In mm	Non monsoon rainfall (Jan – May) In mm	Total Rainfall In mm
Dindigul	Silvathur	57.14	744.3	169.08	913.38

3.6 Hydrogeology

The entire firka is underlain by the crystalline rocks consisting of Honrblede –Biotite gneiss, Epidote-Hornblede gneiss. Ground water occurs in pheratic condition in weathered and fractured gneiss rock formations. The weathering is highly erratic and the depth of abstraction structures is controlled by the degree of weathering and fracturing. Large diameter dug wells are more common ground water abstraction structures in the area. The diameter of the dug well is in the range of 5 to 10 m and depth of dug wells range from 10 to 18 m bgl. The dug wells yield up to 30-100 cu.m in summer months and few wells remains dry. The yield is adequate for irrigation for one or two crops in monsoon period. In summer it is inadequate as the groundwater storage reduces.

The hydrogeological map of Silvathur firka is given in Figure – 5. Decadal mean water level of pre-monsoon and post monsoon are given as fig 6a & 6b. The present water level in the firka is in the range of 5.00 to 10 m bgl.

Figure – 5: HYDROGEOLOGY OF SILVATHUR FIRKA, DINDIGUL DISTRICT



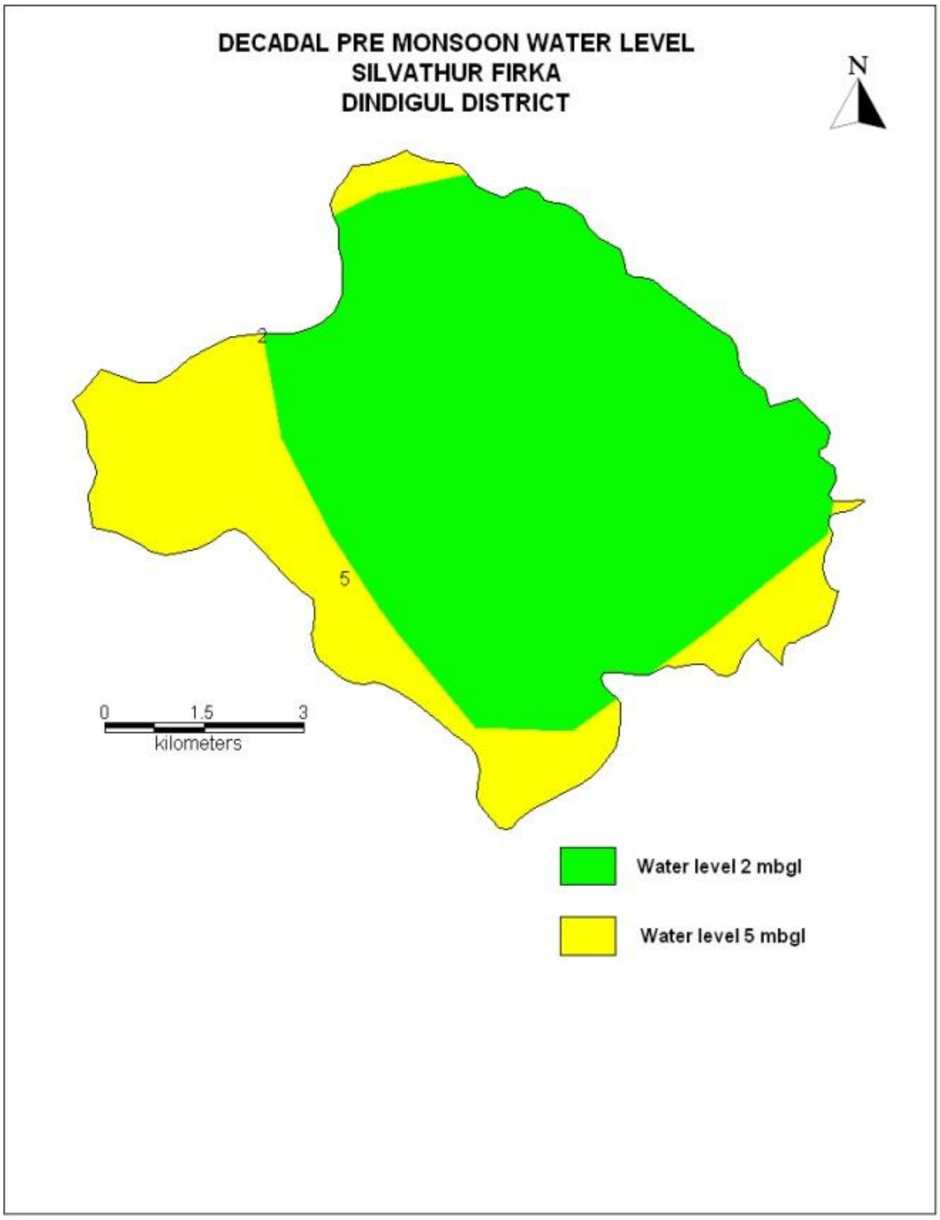


Figure 6a. **Pre-monsoon water level in Silvathur firka (Decadal)**

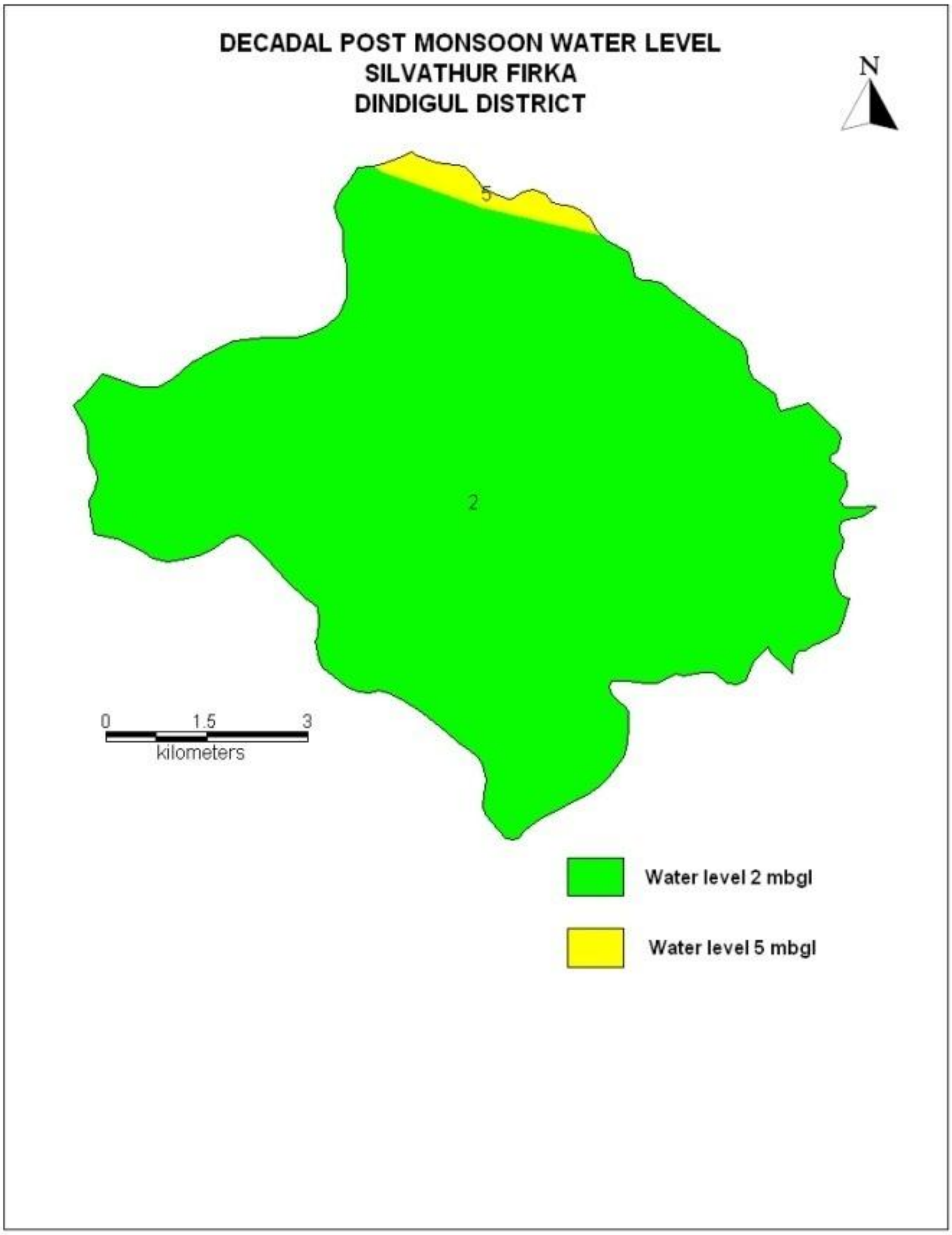


Figure 6b. **Post-monsoon water level in Silvathur firka (Decadal)**

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 Silvathur firka

Firka	GW WORTHY AREA	REPLENISH ABLE GROUND WATER RESOURCES	NET GROUND WATER AVAILABLE	GROUND WATER DRAFT FOR IRRIGATION	GROUNDWA TER DRAFT FOR DOMESTIC & INDUSTRIAL WATER SUPPLY	TOTAL GROUN D WATER DRAFT	STAGE OF GROUND WATER DEVELOP MENT (%)	CATEGORY
	(Sq.Km)	(In MCM)					%	
Silvathur	57.14	7.61	6.85	8.65	0.42	9.07	133	OVER EXPLOITED

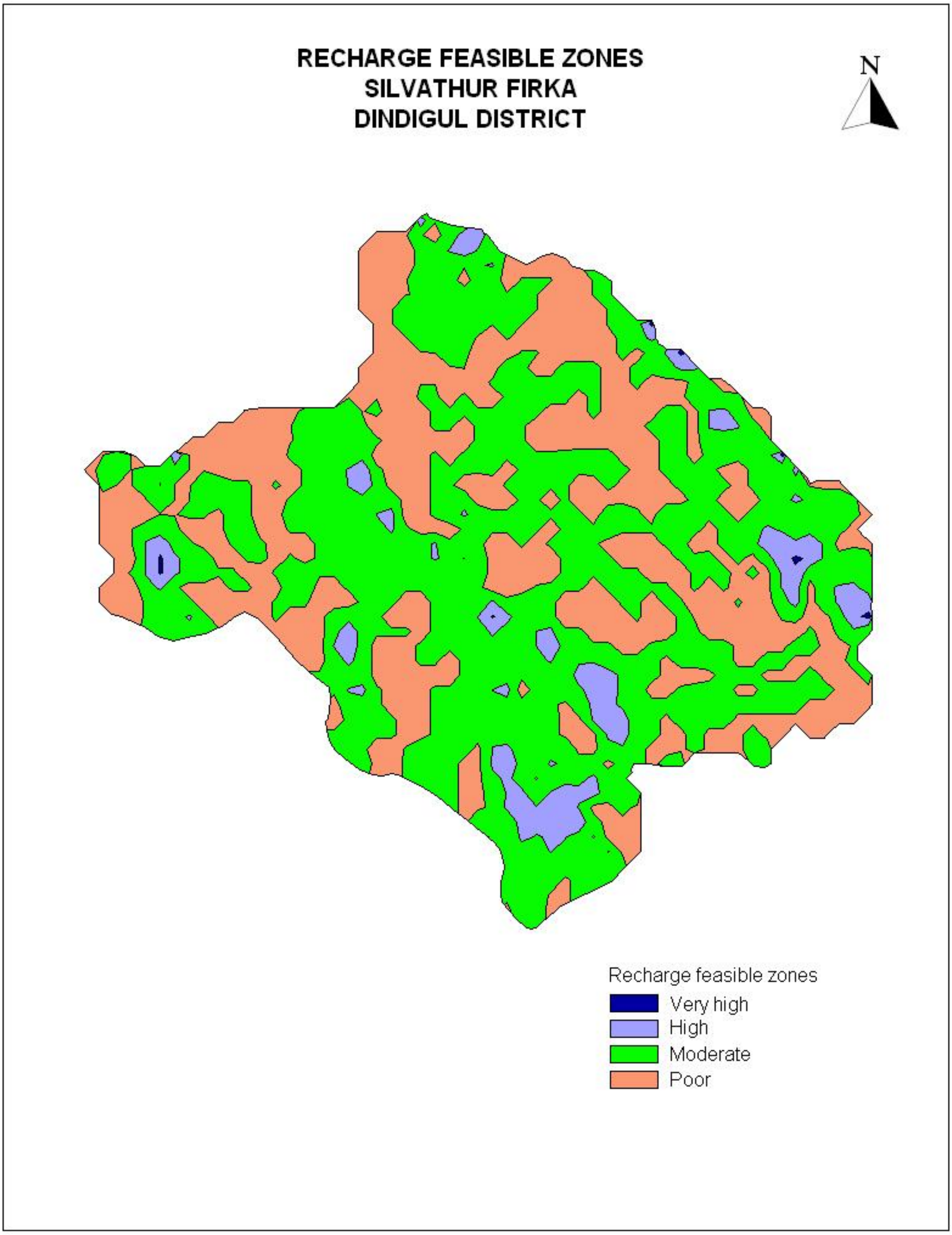
4. Spatial Data Integration

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 has been attempted using index overlay model in GIS environ. In this model, above seven layers have been integrated by assigning weightage to each layer either 20 or 10 and cumulative weight for all layers as 100. Geomorphology, weathered thickness and surface water bodies are assigned weightage of 20 each and the rest 4 layers viz., geology, land use, drainage and fractured depth have been assigned 10 each out of the total 100 scale, so as the total score would be 100 for all seven layers. Sub-classes of each theme has been assigned scores of 1-10 scale and then all the seven layers have been integrated and a map with feasible recharge zones has been generated. The resultant map has been reclassified into four classes (Very 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	0	Suitable for all major recharge structures like Percolation pond and stop dam, check dam etc.,
High	6	Suitable for all major recharge structures like stop dam, check dam etc.,
Moderate	55	Suitable for all major recharge structures like earthen check dam, Boulder check dam and Nala bund etc.,
Poor	39	Hilly/Forest /Catchment area

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

Figure - 7



RECHARGE FEASIBLE ZONES
SILVATHUR FIRKA
DINDIGUL DISTRICT
N
Recharge feasible zones
Very high
High
Moderate
Poor

5. Planning for groundwater recharge /conservation

5.1 Justification of the artificial recharge & conservation measures

- The Silvathur Firkas is with high stage of groundwater development i.e, 133 % and with sufficient amount of uncommitted surface runoff/flow of 6.38 MCM.
- The total weathered zone available beneath the ground in the firka is 686 MCM. Out of these total volume availa ble for recharge considering 5 m depth from 3 m) is 286 MCM.
- The Silvathur Firka consists of MORE THAN 100 surface water bodies /lakes (cover more than 8% of the total area of 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 Silvathur areas reveals that more than 60 % of areas are suitable for good to moderate recharge.
- In Silvathur firka more than 85 % 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 Silvathur 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 Silvathur Firka is 6.38 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 structures proposed along with justification are given below.

5.3.1.1 Check dam/Nala bund

Silvathur firka area is covered by the seasonal nallahs/drains which carry heavy discharge during monsoon period is debauched into the water bodies within a short duration. It is proposed that such seasonal nala 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. As per the integrated model prediction, it is proposed to construct only one Nala bund. The tentative location this AR are given below and shown in Plate 1. The size and location of these structures are tentative and details field survey is essential to ascertain the exact size and location.

Tentative location of proposed Nalla bund in Silvathur firka

SL.NO	LATITUDE (DD)	LONGITUDE(DD)	TYPE OF ARS
1	10.3598	78.112	NALLA BUND

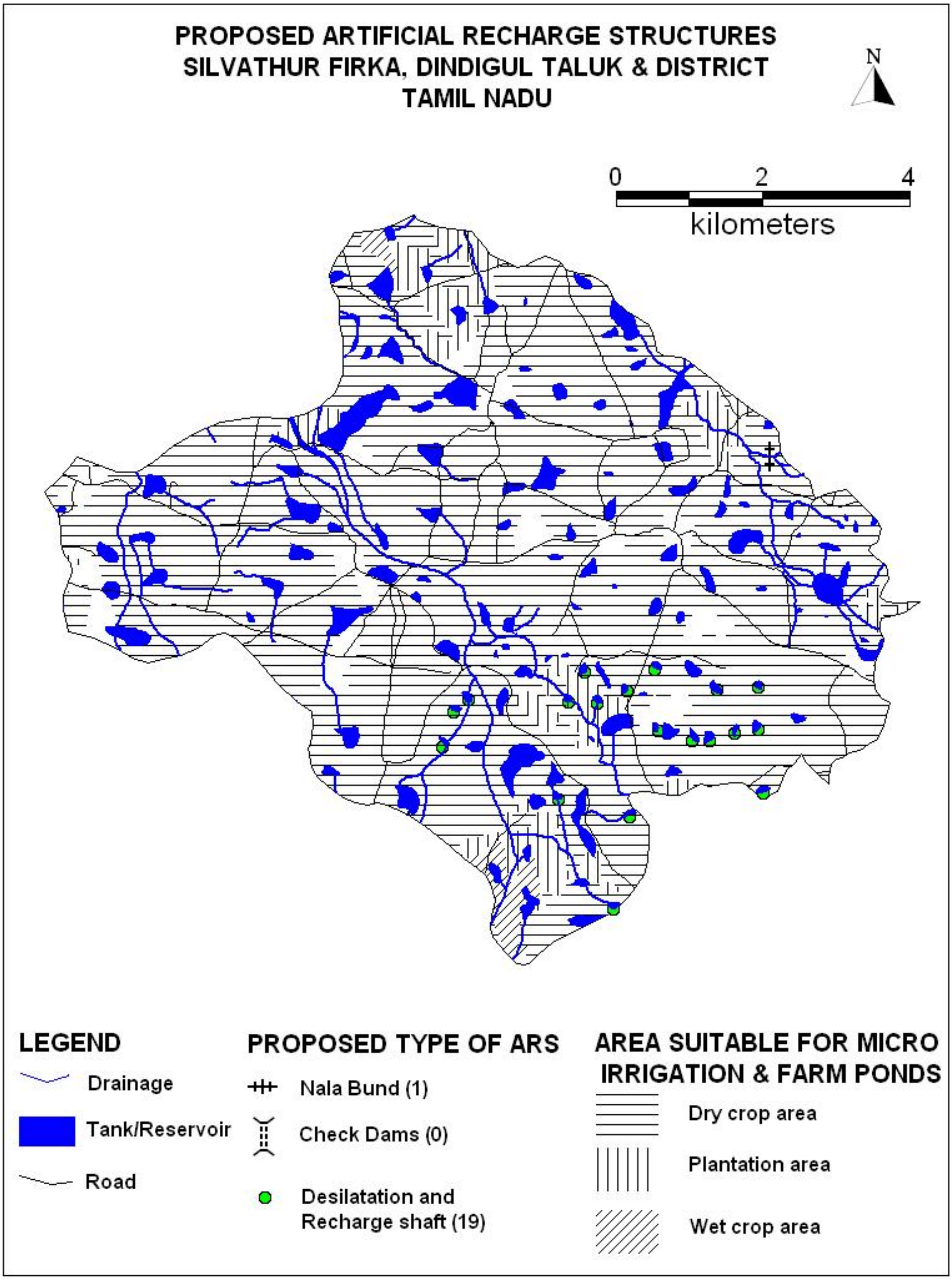
5.3.1.2. Revival, repair of water bodies

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 19 existing ponds/tanks have been identified with latitude and longitude given below and marked on Plate 1. The above 19 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 Silvathur firka.

Sl. No.	LATITUDE	LONGITUDE	STRUCTURE	ACTION
1	10.3343	78.0974	TANK/ RESERVOIR	DESILTTAION AND RECHARGE
2	10.3339	78.0887	TANK/ RESERVOIR	DESILTTAION AND RECHARGE
3	10.3321	78.1103	TANK/ RESERVOIR	DESILTTAION AND RECHARGE
4	10.3317	78.1051	TANK/ RESERVOIR	DESILTTAION AND RECHARGE
5	10.3316	78.094	TANK/ RESERVOIR	DESILTTAION AND RECHARGE
6	10.3306	78.0743	TANK/ RESERVOIR	DESILTTAION AND RECHARGE
7	10.3303	78.0867	TANK/ RESERVOIR	DESILTTAION AND RECHARGE
8	10.3301	78.0903	TANK/ RESERVOIR	DESILTTAION AND RECHARGE
9	10.329	78.0724	TANK/ RESERVOIR	DESILTTAION AND RECHARGE
10	10.3269	78.1103	TANK/ RESERVOIR	DESILTTAION AND RECHARGE
11	10.3267	78.0978	TANK/ RESERVOIR	DESILTTAION AND RECHARGE
12	10.3265	78.1073	TANK/ RESERVOIR	DESILTTAION AND RECHARGE
13	10.3256	78.102	TANK/ RESERVOIR	DESILTTAION AND RECHARGE
14	10.3255	78.1042	TANK/ RESERVOIR	DESILTTAION AND RECHARGE
15	10.3248	78.071	TANK/ RESERVOIR	DESILTTAION AND RECHARGE
16	10.3192	78.111	TANK/ RESERVOIR	DESILTTAION AND RECHARGE
17	10.3183	78.0854	TANK/ RESERVOIR	DESILTTAION AND RECHARGE
18	10.3162	78.0943	TANK/ RESERVOIR	DESILTTAION AND RECHARGE
19	10.305	78.0923	TANK/ RESERVOIR	DESILTTAION AND RECHARGE

PLATE – 1


PROPOSED ARTIFICIAL RECHARGE STRUCTURES
SILVATHUR FIRKA, DINDIGUL TALUK & DISTRICT
TAMIL NADU
N
0
2
4
kilometers
LEGEND
Drainage
Tank/Reservoir
Road
PROPOSED TYPE OF ARS
Nala Bund (1)
Check Dams (0)
Desilatation and
Recharge shaft (19)
AREA SUITABLE FOR MICRO
IRRIGATION & FARM PONDS
Dry crop area
Plantation area
Wet crop area

5.3.2 Water conservation measure

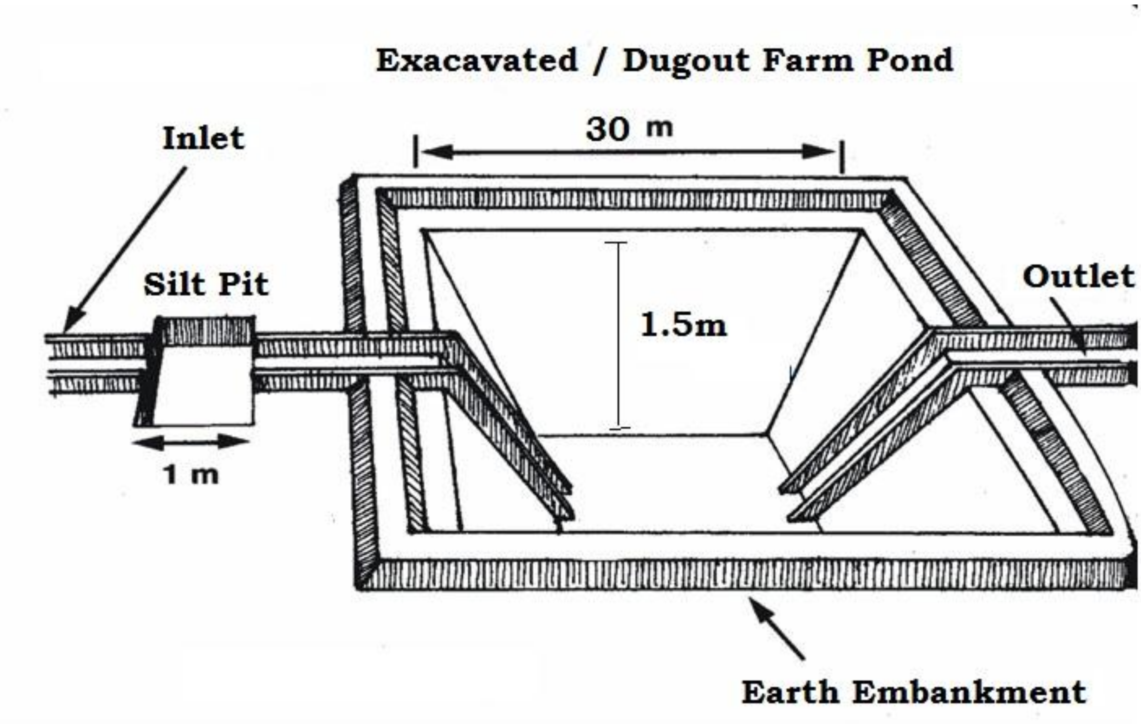
5.3.2.1 Farm Pond

A farm pond is a large dug out in the earth, usually square or rectangular in shape, which harvests rainwater and stores it for future use. It has an inlet to regulate inflow and an outlet to discharge excess water. The pond is surrounded by a small bund, which prevents erosion on the banks of the pond. The size and depth depend on the amount of land available, the type of soil, the farmer's water requirements, the cost of excavation, and the possible uses of the excavated earth. Water from the farm pond is conveyed to the fields manually, by pumping, or by both methods.

Advantages of Farm Ponds

- They provide water to start growing crops, without waiting for rain to fall.
- They provide irrigation water during dry spells between rainfalls. This increases the yield, the number of crops in one year, and the diversity of crops that can be grown.
- Bunds can be used to raise vegetables and fruit trees,thus supplying the farm household with an additional source of income and of nutritious food.
- Farmers are able to apply adequate farm inputs and perform farming operations at the appropriate time, thus increasing their productivity and their confidence in farming.
- They check soil erosion and minimize siltation of waterways and reservoirs.
- They supplies water for domestic purposes and livestock
- They promote fish rearing.
- They recharge the ground water.
- They improve drainage.
- The excavated earth has a very high value and can be used to enrich soil in the fields, levelling land, and constructing farm roads

As per the Landuse classification of the firka, majority of the area is covered by the agricultural field. Hence it is proposed to construct 100 farm ponds as per the specification of AED, Govt. of Tamil Nadu (30 x 30 x 1.5 m).



5.3.2.2. Micro Irrigation System (Sprinkler/ drip/ HDPE pipes)

Micro irrigation is defined as the frequent application of small quantities of water directly above and below the soil surface; usually as discrete drops, continuous drops or tiny streams through emitters placed along a water delivery line.

In flood/furrow irrigation method more than 50% of applied water is wasted through seepage to deeper level, localized inundation causes loss through evaporation and it leaches out the nutrients from the plant. While through drip & sprinkler irrigation wastage of irrigational water could be minimized. The studies on different crops, has revealed that irrigation water is saved drastically. The conveyance losses (mainly seepage & evaporation) can be saved up to 25 to 40% through utilization of HDPE pipes. Initially the scheme is proposed to be implemented in worst affected areas showing deepest water levels and significant declining trends. So with micro irrigation system the irrigation draft can be minimised by 50% and an amount of 325000 cum water can be saved for 100 ha of dry crop area.

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.

6. Tentative Cost Estimation

A 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 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						
Nala bunds/ Gabion (4 Fillings)	Width: 5 to 15 m	1	3000	2.0	2	2400
Revival, repair of water bodies (3 fillings)	(~100mx100mx2.5m)	19	1425000	12	228	1140000
Recharge shaft with the pond /tanks	Recharge shaft of 1.5m dia with 2m depth with filter media in lower 1m, Bore dia 10” Casing 6” Depth 30m	19		2	38	
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	**428**	**2352400**
Impact assessment and O & M						
PiezometersUp to 50 m bgl – 1 no. @ 0.6 lakh (Impact assessment to be carried out by the implementing agencies)					**0.6**	
Total cost of the project					**428.6**	
O & M - 5 % of total cost of the scheme					**21.43**	
Impact assessment to be carried out by the implementing agencies @5% of total cost					**21.43**	
				GRAND TOTAL	**471.46**	

Note: The type, number and cost of structure may vary according to site, after the ground truth verification

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 National Rural Employment Guarantee Act (NREGA) (Ministry of Rural Development) & Programmes of Water Resources (MoWR , RD & GR). The district Dindigul 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			■	■	■	■	■	■

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 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.

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CONSERVE WATER FOR SUSTENANCE, PROSPERITY AND HAPPINESS

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