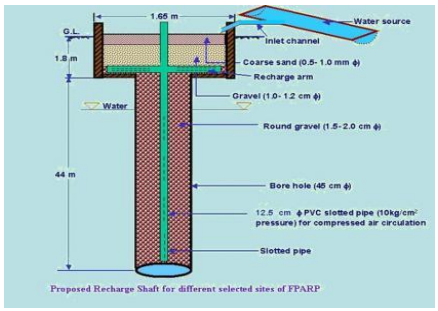
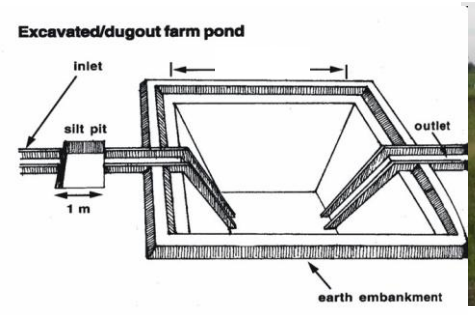
Plan on Artificial Recharge to Groundwater and Water Conservation in Oddanchatram Firka, Oddanchatram Taluk, Dindigul District, Tamil Nadu





By

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

Content

AT GLANCE	
Name of Firka	Oddanchatram
Taluk	Oddanchatram
District	Dindigul
State	Tamil Nadu
Total area	191.12 Sq.km
Total suitable area	168.18
Lat. & Lon.	10° 25’ 17“ to 10° 33’ 01” & 77° 35’ 59”to 77° 47’ 22”.
Rainfall	794.96 mm
Monsoon	663.13 mm
Non- Mon soon	131.83 mm
Geology	Crystalline metamorphic gneisses, Charnockiote and Anorthosite.
WATER LEVEL	
Pre - Monsoon	5 to 10 m bgl.
Post - Monsoon	2 to 10 m bgl.
GROUND WATER RESOURCES ESTIMATION	
Replenish able ground water resources	16.81 MCM
Net ground water available	15.13 MCM
Ground water draft for irrigation	29.21 MCM
Groundwater draft for domestic & industrial water supply	1.01 MCM
Total ground water draft	30.22 MCM
Stage of ground water development (%)	200 %
Uncommitted surface runoff available for the Firka	19.01 MCM
Total volume of weathered zone	2293 MCM
Total volume available for recharge (considering 3 m depth from 3 m bgl	956 MCM
ARTIFICIAL RECHARGE /CONSERVATION MEASURES	
Structures Proposed (tentative) Masonry Check dam Nalla Bund Revival, repair of pond, tanks with recharge shaft	 2 20 3
Improving Water Efficiency/saving Micro irrigation system for 100 ha	0.7 MCM
Excepted groundwater recharge	0.765 MCM
Total expected groundwater recharge/ saving	1.46 MCM
Tentative total cost of the project	Rs. 2.91 Cr
Expected rise in water level by recharging /saving	0.57 m

Plan on Artificial Recharge to Groundwater and Water Conservation in Oddanchatram Firka, Oddanchatram 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

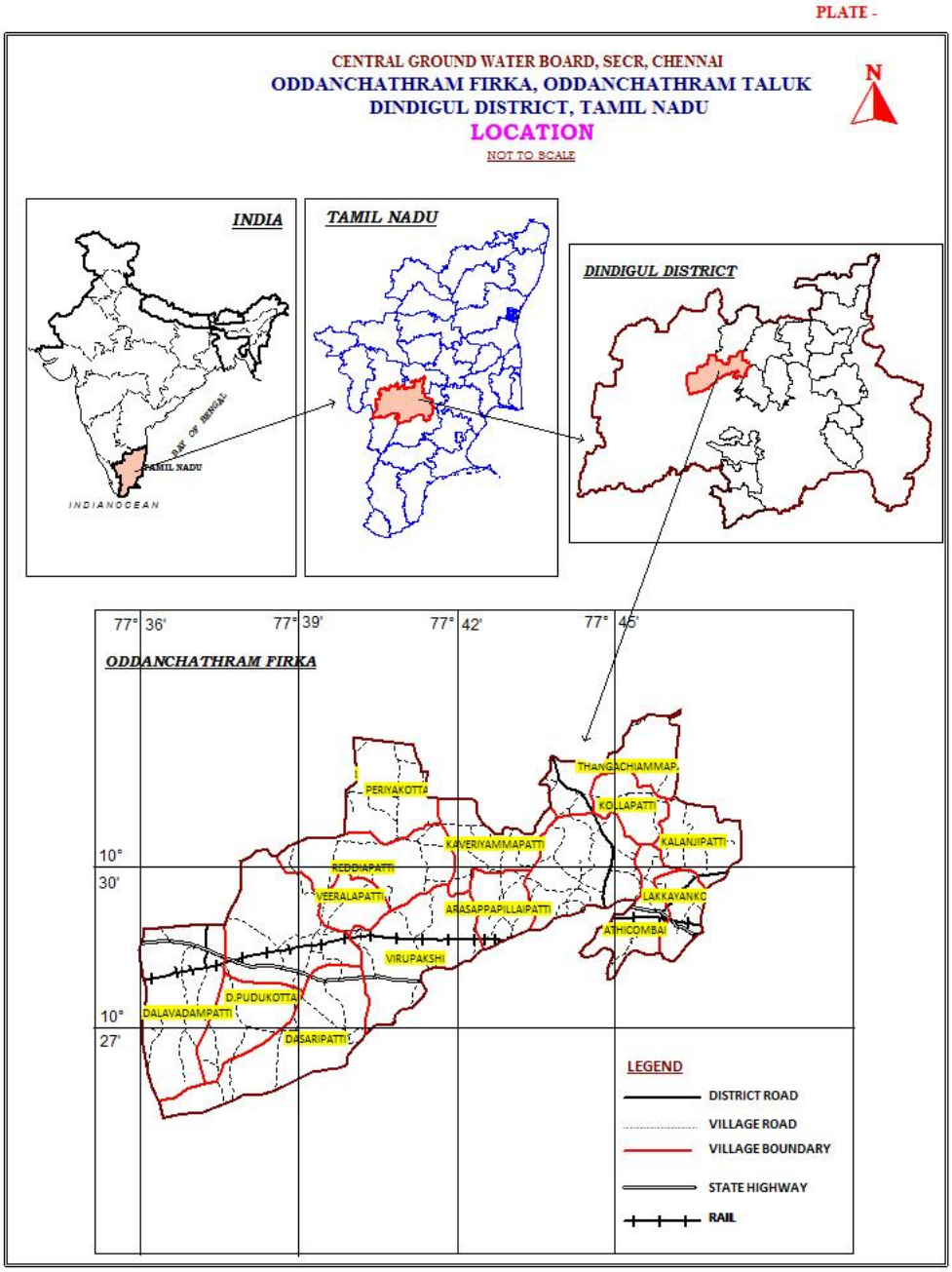
- To upscale recharge activities, supplement additional groundwater resources by harvesting surplus runoff, sustainability of groundwater resources at shallow depths
- Recovery of over-exploited groundwater areas by implementing artificial recharge measures in groundwater stress areas.
- Conservation,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

3. Study area details

3.1 Location

The total area of Oddanchatram firka is 93.69 sq.km and Oddanchatram firka lies between North latitudes 10°25'17" to 10°33'01" and east longitudes 77°35'59" to 77°47'22" and falls in Survey of India toposheet numbers 58F/10,11,14&15. Location map of Oddanchatram firka is given in Figure 1.

Figure – 1



3.2 Geomorphological Set up

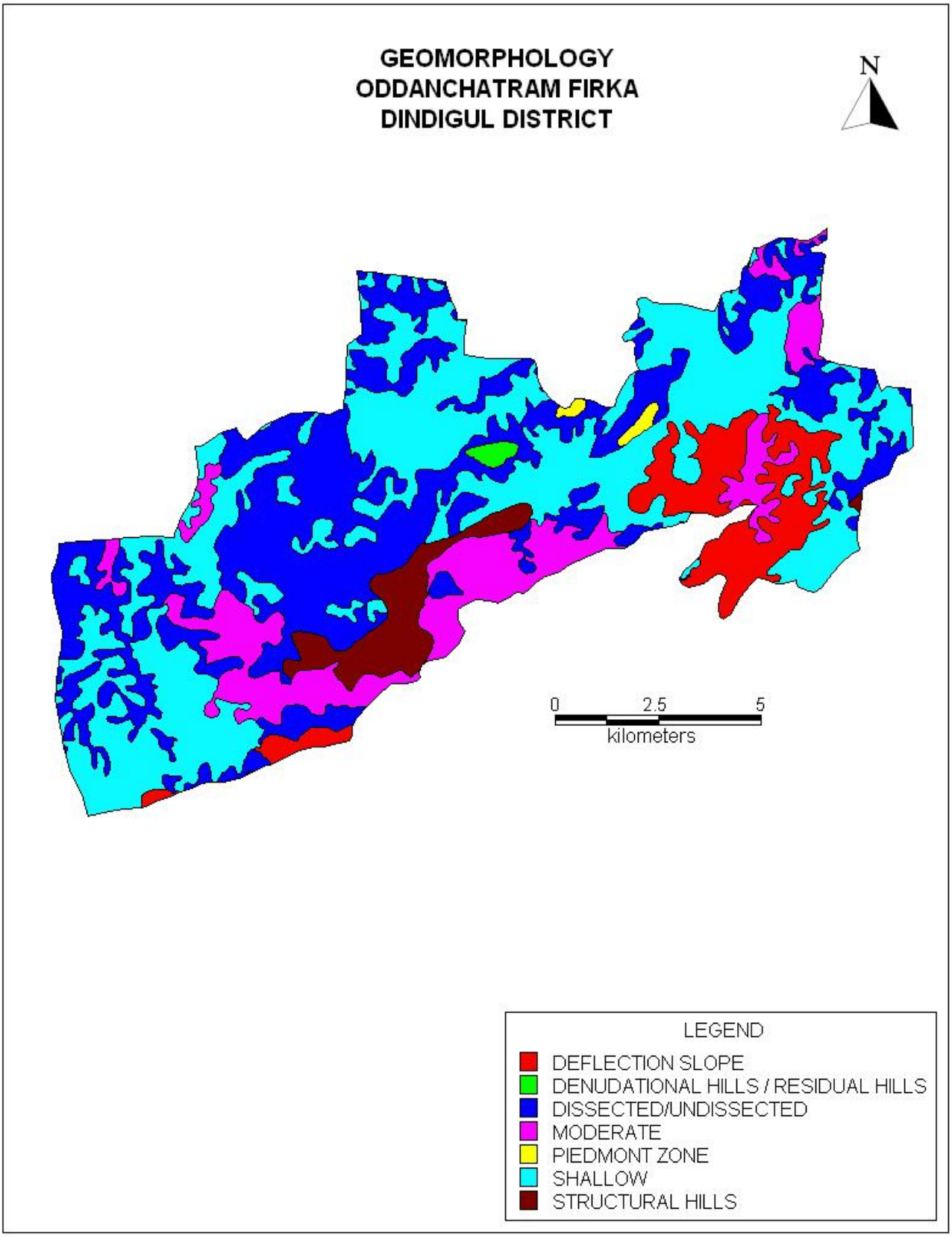
Geomorphologically, the area consists of plain landforms with little hills. In plain landforms, Pediplain `weathered moderate and shallow and dissected/ undissected are occupied 80% of the firka. These landforms are influencing the ground water recharge. Hill landforms like residual hills, denudation 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 Oddanchatram firka

LANDFORMS	% of Area
PEDIPLAIN (WEATHERED) MODERATE	12.6
STRUCTURAL HILLS	4.4
DENUDATIONAL HILLS / RESIDUAL HILLS	0.4
DISSECTED/UNDISSECTED	34
PIEDMONT ZONE	0.4
DEFLECTION SLOPE	8.3
PEDIPLAIN (WEATHERED) SHALLOW	40

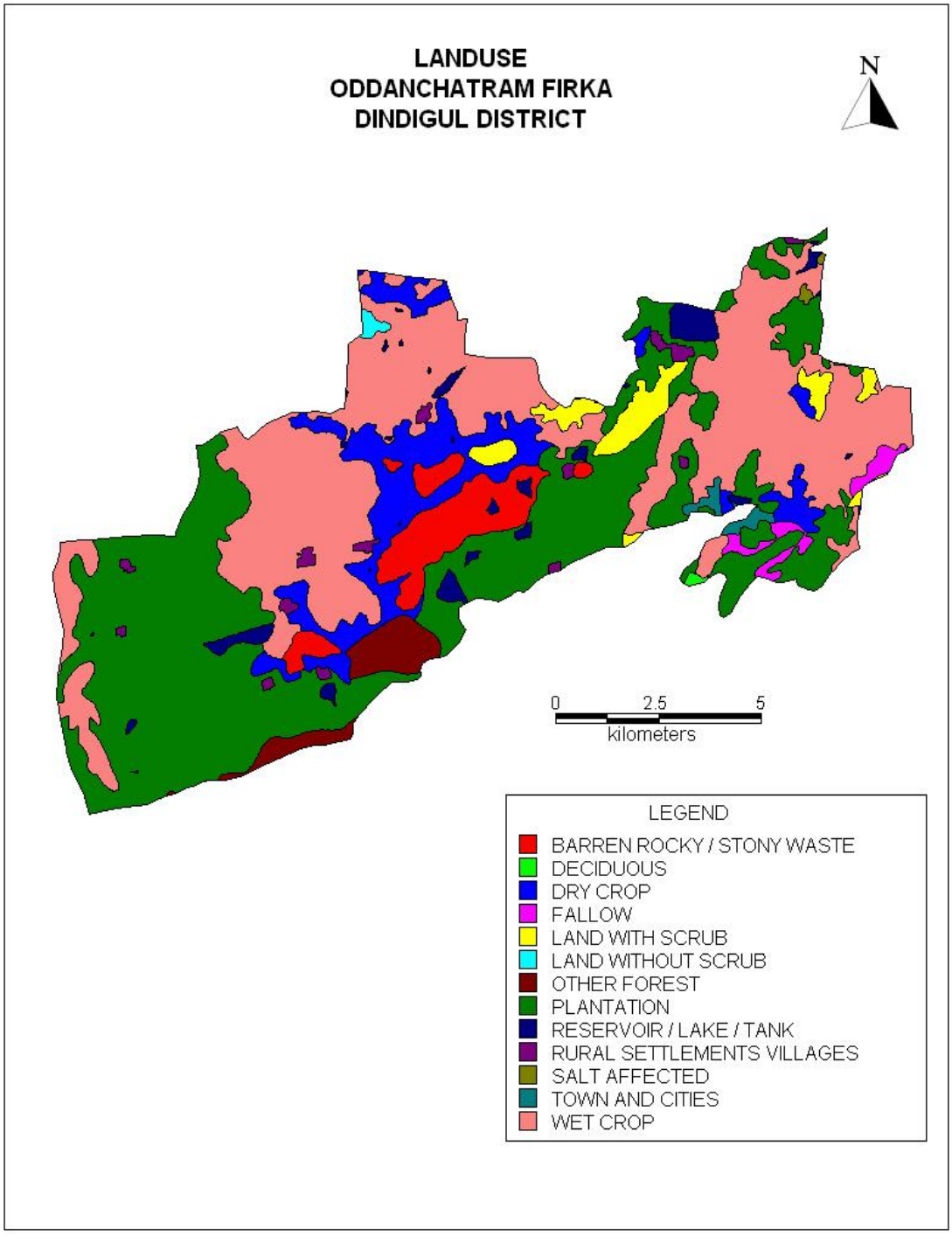
Figure-2


GEOMORPHOLOGY
ODDANCHATRAM FIRKA
DINDIGUL DISTRICT
N
0
2.5
5
kilometers
LEGEND
DEFLECTION SLOPE
DENUDATIONAL HILLS / RESIDUAL HILLS
DISSECTED/UNDISSECTED
MODERATE
PIEDMONT ZONE
SHALLOW
STRUCTURAL HILLS

3.3 Land use and soil

The land use pattern of the Oddanchatram 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 50 % 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 Firkas is occupied by rock outcrops with loamy soil.

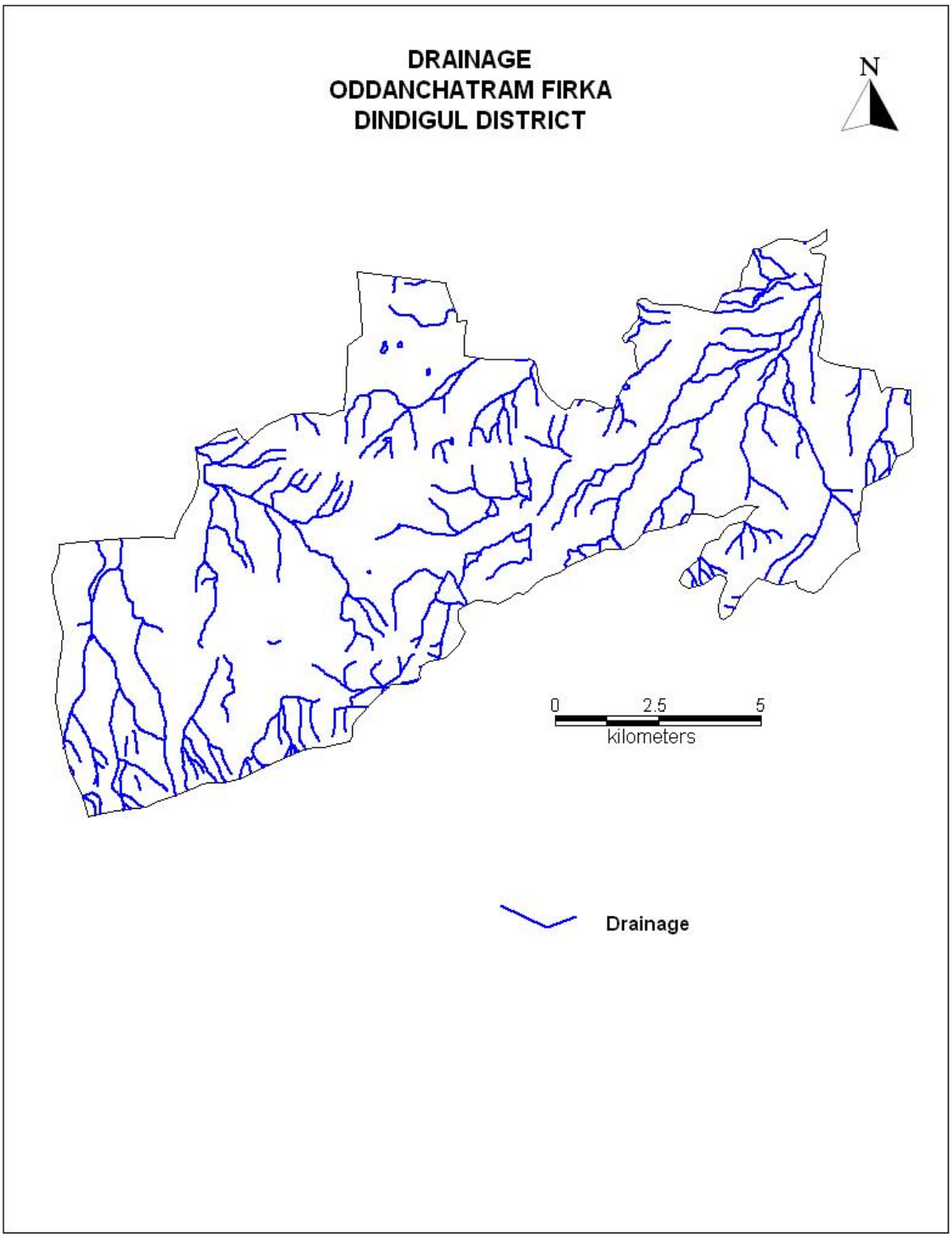
Figure - 3



3.4 Drainage

The entire Firka area is within the Cauvery i river basin. A number of small streams originate from the hills located in the Oddanchatram firka.only and form part of Kodavnar sub basin. 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 Oddanchatram firka is given in Fig 4.

Figure – 4



3.5 Rainfall

Oddanchatram 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%. Oddanchatram 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 795mm.

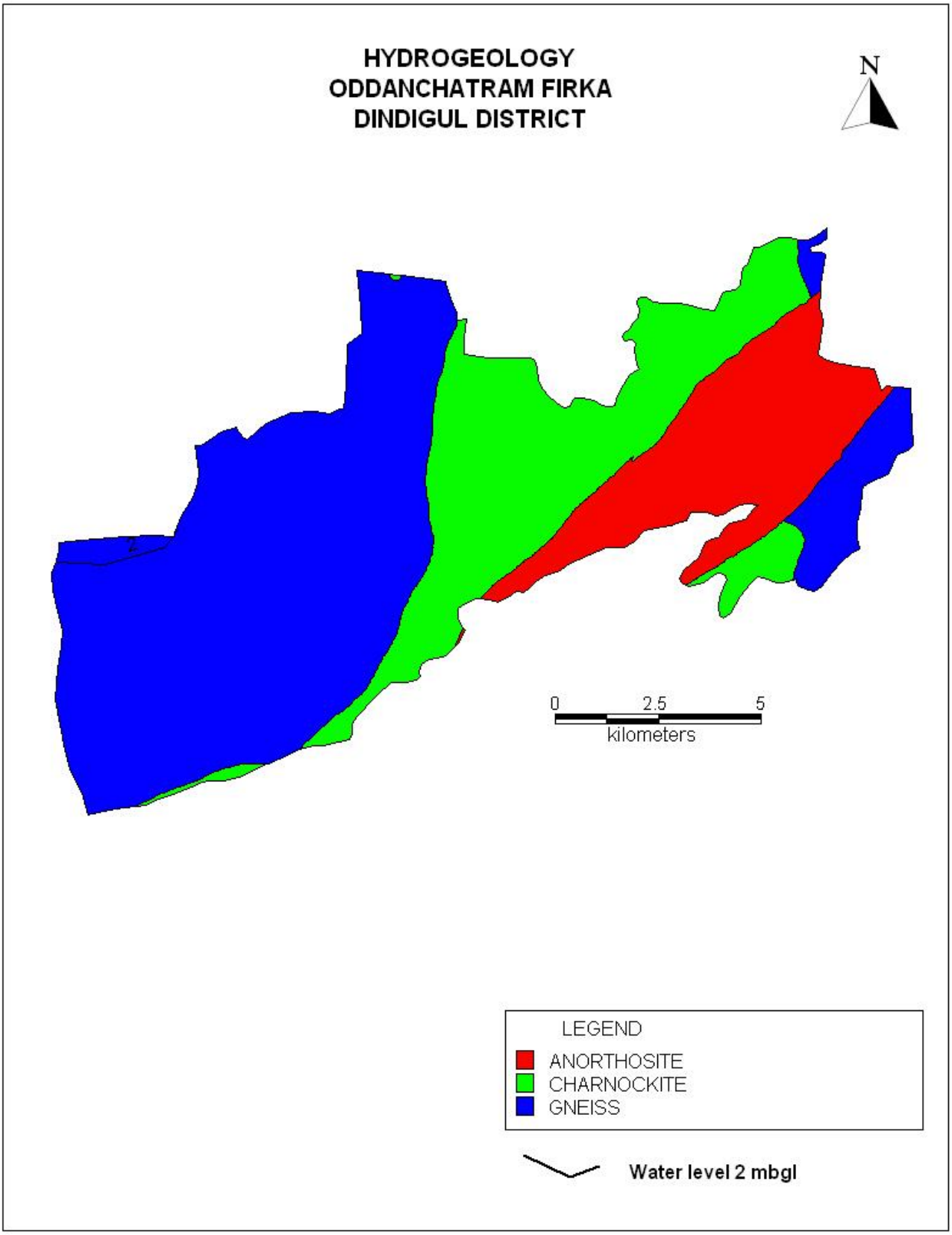
Taluk	Name of Firkas	Area in sq.km	Monsoon rainfall (Jun to Dec) In mm	Non monsoon rainfall (Jan – May) In mm	Total Rainfall In mm
Oddanchatram	Oddanchatram	191.12	663.93	131.83	794.96

3.6 Hydrogeology

The entire firka is underlain by the crystalline rocks consisting of Honrblede –Biotite gneiss, Epidote-Hornblede gneisses, Charnockites and Anorthosites. 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 Oddanchatram 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
ODDANCHATRAM FIRKA
DINDIGUL DISTRICT
N
0
2.5
5
kilometers
LEGEND
ANORTHOSITE
CHARNOCKITE
GNEISS
Water level 2 mbgl

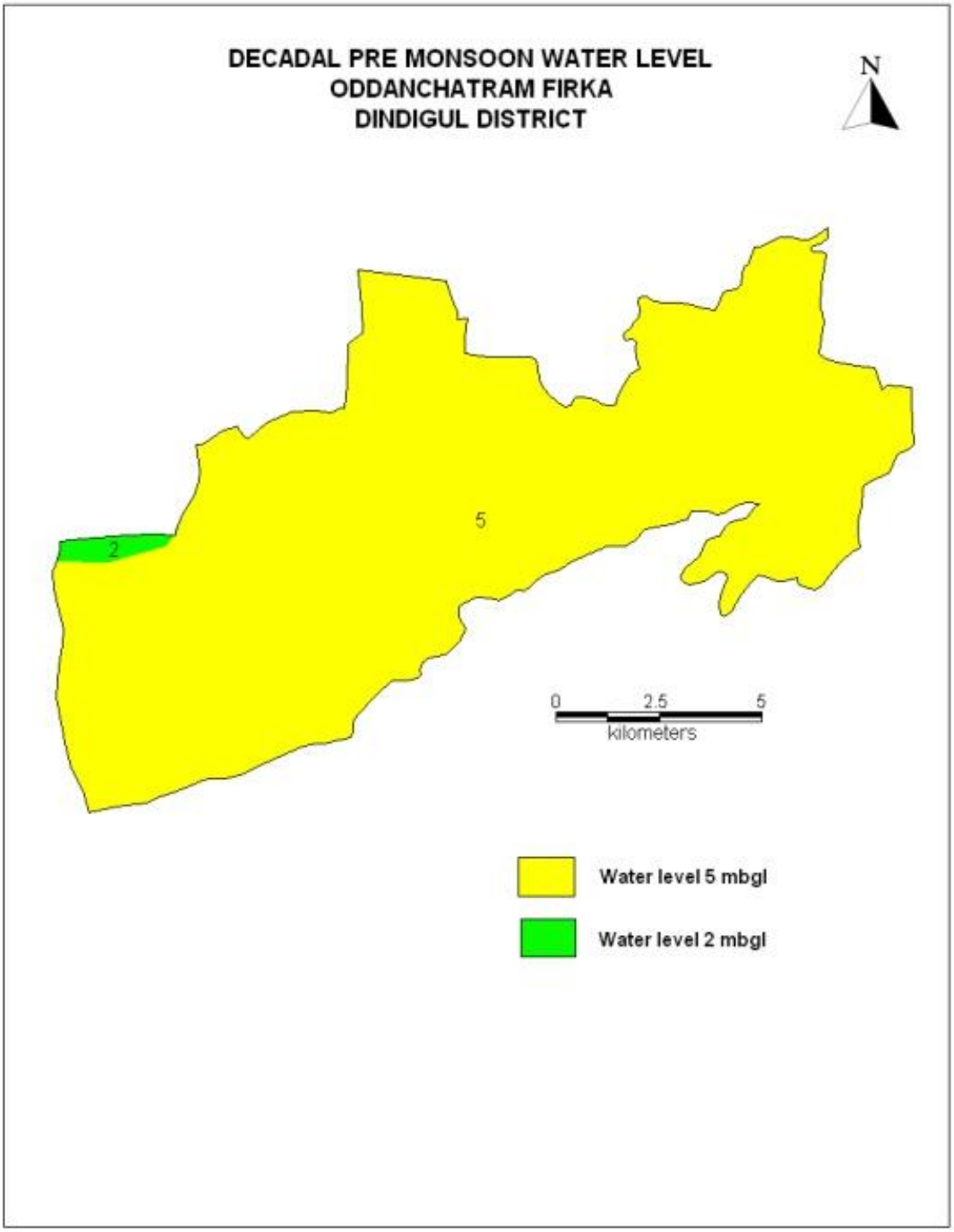


Figure 6a. **Pre-monsoon water level in Oddanchatram firka (Decadal)**

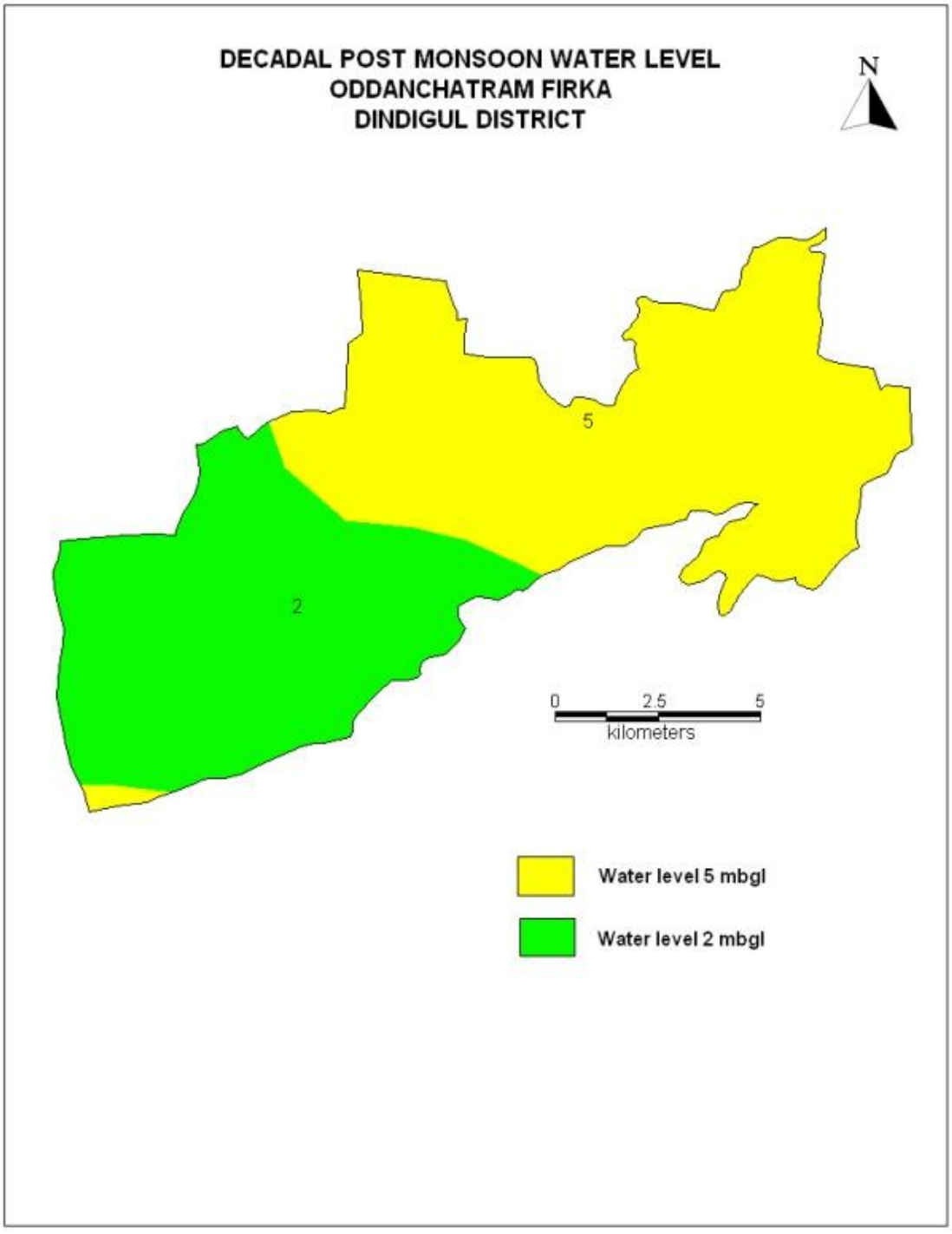


Figure 6b. **Post-monsoon water level in Oddanchatram firka (Decadal)**

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 Oddanchatram 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)					%	
Oddanchatram	154	16.81	15.13	29.21	1.01	30.22	200	OVER EXPLOITED

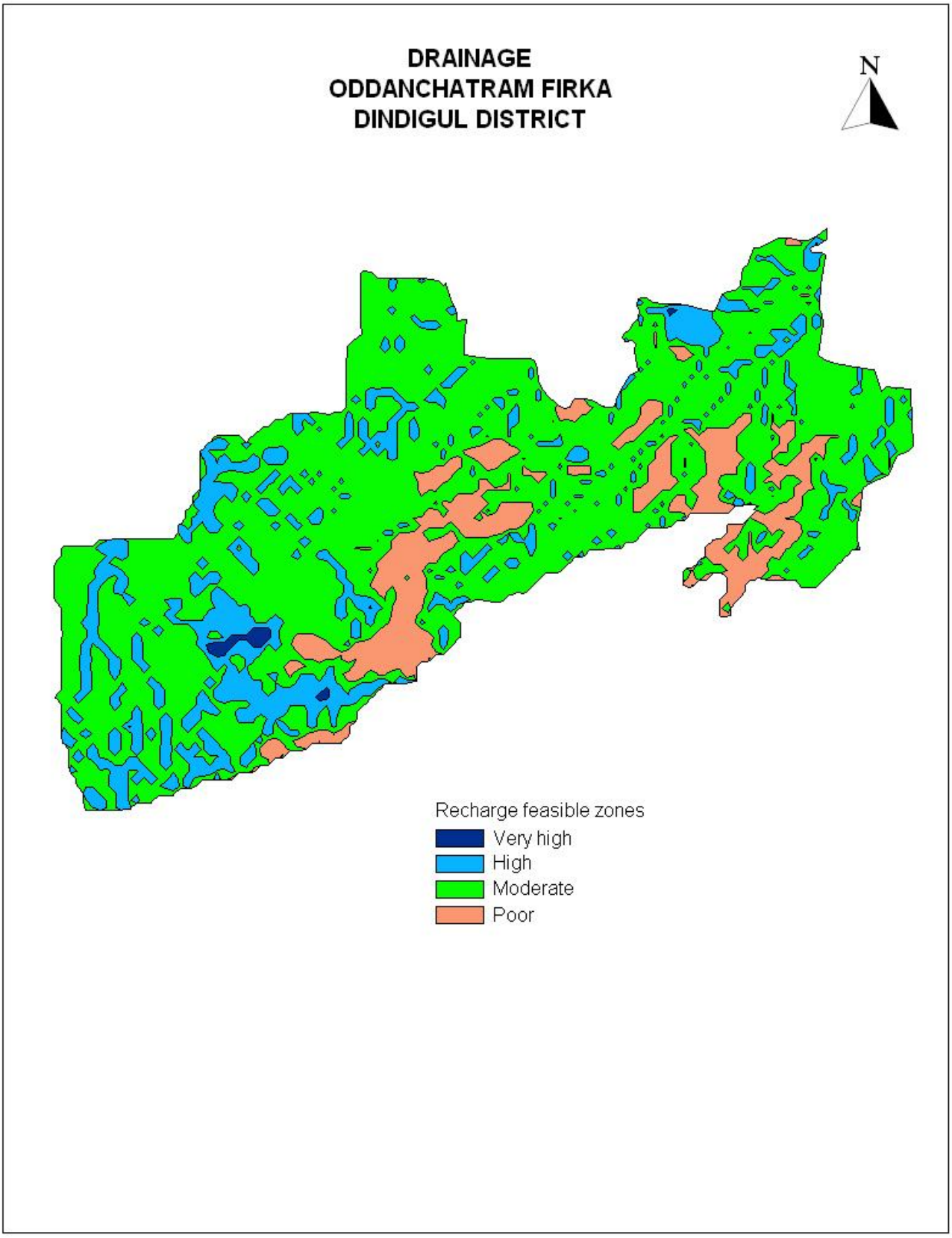
4. Spatial Data Integration

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	1	Suitable for all major recharge structures like Percolation pond and stop dam, check dam etc.,
High	18	Suitable for all major recharge structures like stop dam, check dam etc.,
Moderate	69	Suitable for all major recharge structures like earthen check dam, Boulder check dam and Nala bund etc.,
Poor	12	Hilly/Forest /Catchment area

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

Figure - 7


DRAINAGE
ODDANCHATRAM 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 Oddanchatram Firkas is with high stage of groundwater development i.e, 200 % and with sufficient amount of uncommitted surface runoff/flow of 19.01 MCM.
- The total weathered zone available beneath the ground in the firka is 2293 MCM. Out of these total volume available for recharge considering 5 m depth from 3 m) is 956 MCM.
- The Oddanchatram Firka consists of 14 surface water bodies /lakes (cover almost 2 % 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 Oddanchatram areas reveals that more than 80 % of area is suitable for recharge.
- In Oddanchatram firka more than 50 % 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 Oddanchatram 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 Oddanchatram Firka is 19.01 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

Oddanchatram 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 2 Check dam and 20 Nala bunds. The tentative location of these 30 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 2 Check dam in Oddanchatram firka

S. NO.	LATITUDE(DD)	LONGITUDE(DD)	TYPE OF ARS
1	10.5127	77.7854	Check Dam
2	10.4821	77.6545	Check Dam

Tentative location of proposed 20 Nalla bund in Oddanchatram firka

SL.NO	LATITUDE (DD)	LONGITUDE(DD)	TYPE OF ARS
1	10.5435	77.7556	NALLA BUND
2	10.5097	77.694	NALLA BUND
3	10.5087	77.6982	NALLA BUND
4	10.4641	77.6657	NALLA BUND
5	10.4696	77.6658	NALLA BUND
6	10.439	77.6333	NALLA BUND
7	10.4388	77.6068	NALLA BUND
8	10.449	77.6659	NALLA BUND
9	10.4921	77.7366	NALLA BUND
10	10.502	77.7811	NALLA BUND
11	10.5034	77.7838	NALLA BUND
12	10.4882	77.6467	NALLA BUND
13	10.4932	77.6509	NALLA BUND
14	10.4902	77.6595	NALLA BUND
15	10.4356	77.6289	NALLA BUND
16	10.4323	77.6331	NALLA BUND
17	10.4345	77.6441	NALLA BUND
18	10.4984	77.6397	NALLA BUND
19	10.4877	77.6609	NALLA BUND
20	10.4978	77.7238	NALLA BUND

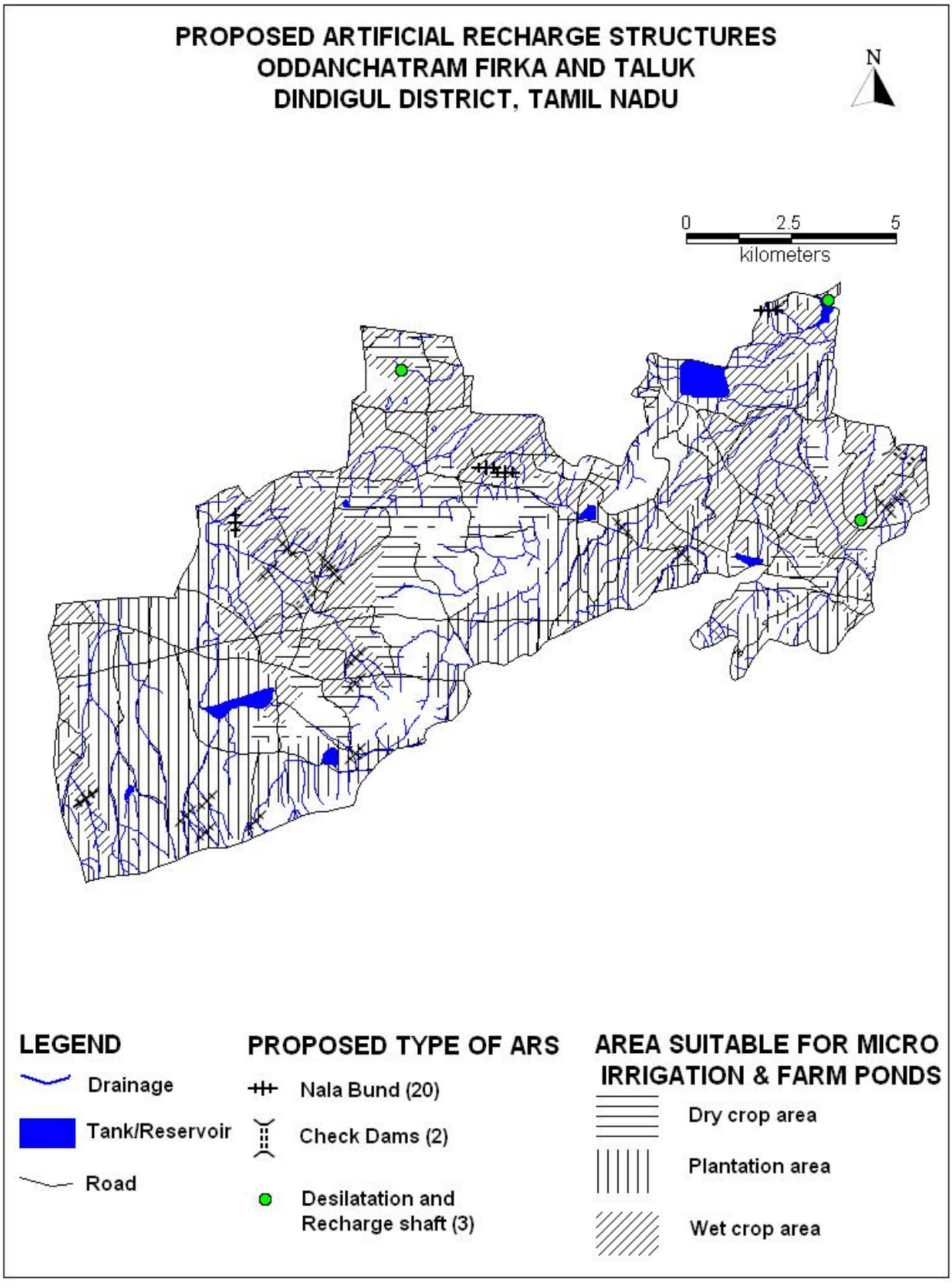
5.3.1.2. Revival, repair of water bodies

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 3 existing ponds/tanks have been identified with latitude and longitude given below and marked on Plate 1. The above 3 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 Oddanchatram firka.

Sl. No.	LATITUDE	LONGITUDE	STRUCTURE	ACTION
1	10.5468	77.7684	TANK/ RESERVOIR	DESILTTAION AND RECHARGE
2	10.4999	77.7756	TANK/ RESERVOIR	DESILTTAION AND RECHARGE
3	10.532	77.6757	TANK/ RESERVOIR	DESILTTAION AND RECHARGE

PLATE – 1


PROPOSED ARTIFICIAL RECHARGE STRUCTURES
ODDANCHATRAM FIRKA AND TALUK
DINDIGUL DISTRICT, TAMIL NADU
N
0
2.5
5
kilometers
LEGEND
Drainage
Tank/Reservoir
Road
PROPOSED TYPE OF ARS
Nala Bund (20)
Check Dams (2)
Desilatation and Recharge shaft (3)
AREA SUITABLE FOR MICRO IRRIGATION & FARM PONDS
Dry crop area
Plantation area
Wet crop area

5.3.2 Water conservation measure

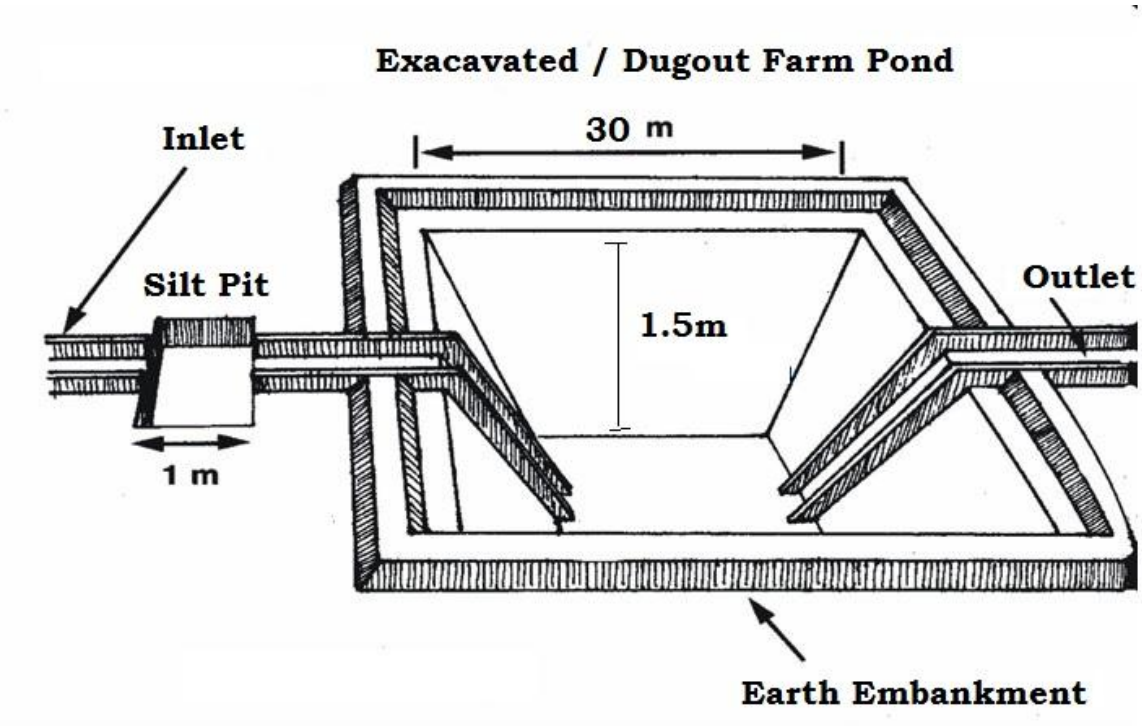
5.3.2.1 Farm Pond

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						
Masonry Check dams (5 Fillings)	Crest- 10 -15 m; Height- 1 m to 1.5 m	2	34000	9	18	27200
Nala bunds/ Gabion (4 Fillings)	Width: 5 to 15 m	20	60000	2.0	40	48000
Revival, repair of water bodies (3 fillings)	(~100mx100mx2.5m)	3	225000	12	36	180000
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	3		2	6	
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	**260**	**1465200**
Impact assessment and O & M						
PiezometersUp to 50 m bgl – 7 nos. @ 0.6 lakh					**4.2**	
Total cost of the project					**264.2**	
O & M - 5 % of total cost of the scheme					**13.21**	
Impact assessment to be carried out by the implementing agencies @ 5% of total cost					**13.21**	
				GRAND TOTAL	**290.62**	

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.

Prepared under Supervision of

Shri. A. Subburaj, Head of Office, CGWB, SECR, Chennai

Nodal Officer

Dr.S.Subramanian, Senior Hydrogeologist, CGWB, SECR, Chennai

Program – Core Working Committee

Shri. A. Ravi, Sr.Hg (Scientist- D, **CGWB, SECR, Chennai**

Dr. S. Subramanian, Sr.Hg (Scientist- D, **CGWB, SECR, Chennai**

Ms. D. Dhayamalar, Sr.Hg (Scientist- D, **CGWB, SECR, Chennai**

Dr.B. Umapathi, Sr.Hg (Scientist- D, **CGWB, SECR, Chennai**

Shri. R. Arumugam , Scientist D, **CGWB, SECR, Chennai**

Compiled by

Dr.S.Subramanian, Senior Hydrogeologist, **CGWB, SECR, Chennai**

जीविका, समृद्धिएवंसुख शहालीकेलिएजलसंचयनकरें

CONSERVE WATER FOR SUSTENANCE, PROSPERITY AND HAPPINESS

विस्तृतजानकारीकेलिएसंपर्ककरें:-

क्षेत्रीयनिदेशक

केन्द्रीयभूमिजलबोर्ड

दक्षिणपूर्वीतटीयक्षेत्र

ई-I,सी-ब्लॉक,राजाजीभवन

बेसंतनगर

Contact for further details

The Regional Director

Central Ground Water Board

South Eastern Coastal Region

E1, C Block, Rajaji Bhawan

Besant Nagar

Chennai –600090