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GOVERNMENT OF INDIA
MINISTRY OF WATER RESOURCES,
RIVER DEVELOPMENT & GANGA REJUVENATION
CENTRAL GROUND WATER BOARD

PLAN ON
ARTIFICIAL RECHARGE TO GROUNDWATER AND
WATER CONSERVATION IN
THAVANAMPALLI MANDAL, CHITTOOR DISTRICT,
ANDHRA PRADESH

SOUTHERN REGION
HYDERABAD
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PLAN ON
ARTIFICIAL RECHARGE TO GROUNDWATER AND
WATER CONSERVATION IN
THAVANAMPALLI MANDAL, CHITTOOR DISTRICT,
ANDHRA PRADESH

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AT A GLANCE

Name of the Mandal	THAVANAMPALLI
District	CHITTOOR
State	ANDHRA PRADESH
Total Area(sq. km)	192
Area suitable for Artificial Recharge (sq.km.)	192
Latitude and Longitude	13.202100 to 13.366050 and 78.816430 to 79.065160.
Average Annual Rainfall (mm)	886
Geology	BGC
Average Depth To Water Level (Decadal) (Pre Monsoon)	8.2
Average Depth To Water Level (Decadal) (Post Monsoon)	3.4
Ground Water Resources (2011)	
Annual Replenishable Ground Water Resources (MCM/yr)	24.70
Net Annual Ground Water Availability(MCM)/yr	22.23
Net Annual Ground Water Draft(MCM)/yr	24.01
Projected Demand for Domestic and Industrial Use(MCM)/yr	2.96
Stage of Ground Water Development (%)	108
Surface Run-off (MCM)/yr	41.45
Total Storage Created in the Mandal by Various Agencies (MCM)/yr	0.84
Artificial Recharge/Conservation Measures	
Recharge Structures Proposed (No.s)	Check Dams: 71 Farm ponds: 600, Recharge Shafts: 59
Improving Water use Efficiency	Micro Irrigation System: 3000 ha
Tentative Total Cost in Lakhs (Rs.)	2484.825
Expected Recharge/Savings (MCM)/yr	11.218

1. INTRODUCTION

Thavanampalli Mandal is one of over-exploited Mandal in Chittoor district, Andhra Pradesh State, which is economically backward and chronically drought affected. The Mandal has 24 inhabited villages and with 30 gram panchayats.

2. LOCATION

The Mandal lies between north latitudes 13.202100 to 13.366050 and between east longitudes 78.816430 to 79.065160. The Mandal occupies the southern part of the Chittoor district and is bounded on the north by Somala Mandal, on the east by Irala Mandal, on the south by Bangarupalem Mandal and west by Bangarupalem Mandal. (Fig.1) The geographical area of the Mandal is 192 sq.km.

3. PHYSIOGRAPHY AND DRAINAGE:

The area is drained by streams which are tributaries of Palar River. The streams are mostly ephemeral in nature. The drainage pattern is dendritic, rectangular to sub rectangular due to the influence of geological structures. (Fig.2)

4. RAINFALL

The average rainfall in the Mandal is 886 mm. The rainfall during the South-west monsoon season i.e., June-September accounts for about 85% of the total rainfall.

5. LAND USE PATTERN

Out of the total geographical area of 192 sq.km, the area covered by forest is 19.23 sq.km and the net area sown is 72.06 sq.km. Barren and uncultivable land is 24.10 sq.km. The land for non agricultural use accounts for 30.90 sq.km.(Fig.3)

6. HYDROGEOLOGY

The area is underlain by granites and granitic gneisses of Archaean age (Fig.4). Ground water occurs in weathered and fractured zones under water table and semi- confined conditions. The weathered zone thickness as per the GEC report is 15 m. The weathered zone has been extensively tapped by dug and dug cum bore wells upto 20 m depth, which are mostly dry now. Ground water occurs in the fractured granites upto 200 m bgl. However, the potential fractures are encountered between 50-100 m bgl. The cumulative yield varies from 2-5 lps.

7. GROUND WATER LEVEL SCENARIO

The depth to water level during the pre-monsoon and post-monsoon varies from 5 to 20 m. The depth to water levels maps for pre and post monsoon period (2014) are shown in Figs 5 & 6 respectively. The decadal mean water level trend during post monsoon is depicted in the Fig.7.

8. DYNAMIC GROUND WATER RESOURCES

The Ground water availability, Utilization and stage of Development in Thavanampalli Mandal Chittoor District are given in Table-1.

Table-1: Ground water resources of Thavanampalli mandal, Chittoor district.

Annual Replenishable Ground water resources (MCM)	24.70
Net Annual Ground Water Availability(MCM)/yr	22.23
Net Annual Ground Water Draft(MCM)/yr	24.01
Projected Demand for Domestic and Industrial use up to 2025. (MCM)	2.96
Stage of Ground water development (%).	108
Whether notified or not with year of notification.	No

9. NEED FOR ARTIFICIAL RECHARGE AND CONSERVATION METHODS

The ground water withdrawal is more than the recharge with a stage of development above hundred percent. The long term water level trend mostly shows a declining trend and the water levels are very deep ranging upto 20 m. The sustainability of bore wells has become questionable as many bore wells are either drying up or have recorded reduced yields. There is no surface water irrigation facility in the area. All these factors indicate that there is an urgent need for artificial recharge and water conservation in the Mandal.

10. JUSTIFICATION OF THE ARTIFICIAL RECHARGE PROJECT

Thavanampalli Mandal falls under high stage of ground water development i.e., 108 % and with sufficient amount of uncommitted surface runoff. The area is completely dependent on ground water for domestic, industrial and irrigation purposes. During the monsoons runoff quickly flows out of the area without natural recharge to ground water. It is necessary to apply artificial recharge techniques to allow more and more recharge through check dams, PTs, MPTs, farm ponds, recharge shafts to cope up with the withdrawal pattern and also to improve ground water situation through various interventions including on farm activities and micro irrigation systems (Sprinkler-Drip-HDPE).

11. AVAILABILITY OF SURPLUS, SURFACE WATER FOR ARTIFICIAL RECAHRGE OR CONSERVATION

The runoff was calculated by taking into account of normal rainfall of the mandal and corresponding runoff yield from Strangers table. The existing storage created by various artificial recharge structures constructed by the State Government, if any, was deducted for calculating the runoff yield to recommend new AR structures.

Total Geographical area (Sq.kms)	192
Hilly Area (Sq.kms)	0
Area suitable for Artificial Recharge (sq.km.)	192
Runoff Yield in MCM/yr	41.45
Existing No. of Check Dams	62
Storage created MCM/yr	0.439
Existing No. of Percolation Tanks	56
Storage created MCM/yr	0.40
Total Existing Storage Created	0.84

12. FEASIBLE ARTIFICIAL RECHARGE STRUCTURES

Since the mandal is categorized as over exploited, there is an immediate need for improving ground water scenario and to ensure sustainability of ground water sources. It is also suggested to create additional storage capacity of surface water bodies which would result in supplementing irrigation thereby reducing the ground water draft. The run off available in the mandal has been assessed as 17.56 MCM/yr, which could be considered for further planning of artificial recharge. However, the number of artificial recharge structures feasible has been recommended in areas, by considering the utilizable yield, number of existing structures, land use, drainage pattern and also where the post monsoon water levels (decadal mean) are more than 5 m bgl., and or decadal trends are either falling or showing insignificant raising trend.

A) Check dams and Percolation Tanks

The area is covered by seasonal nalas – drains, which carry discharge during monsoon period debauched into the water bodies within a short duration. It is proposed to identify such nalas for construction of check dams/Percolation tank with recharge shafts, so as to harness ground water and to increase soil moisture content.

- The site selected for check dam/Percolation Tank should have sufficient thickness of permeable soils or weathered material to facilitate recharge of stored water within a short span of time. The water stored in these structures is mostly confined to the stream course and height is normally less than 2m.
- These are designed based on stream width and excess water is allowed to flow over the crest wall. In order to avoid scouring from excess runoff water cushions are provided on the downstream side. To harness maximum runoff in the stream, a series of such check dams can be constructed to have recharge on a regional scale.
- Considering the annual monsoon rainfall of 886 mm, sufficient rain water can be harnessed. This will improve ground water regime as well as delaying the instant flow into the main river.
- The flow in these seasonal rivers can be sustained up to about 2 to 3 months after monsoon.

- Recharge trenches can also be constructed along upstream side of the check dam/Percolation Tank in the impoundment area for enhancing the ground water recharge rate.

Thus, a total of **71 Check dams** are recommended.

B). Recharge Shafts

The existing check dams and percolation tanks lose their storage capacity as well as recharge capacity due to siltation. Hence, Recharge shafts are recommended in the existing Check dams and Percolation tanks to enhance the ground water recharge. During the heavy downpours, there will be sufficient accumulation of runoff, which can also effectively be utilized for recharge by constructing recharge shafts. Hence, it is proposed to construct 31 and 28 recharge shafts of 165 mm dia with 30 m depth in the existing check dams and percolation tanks respectively.

C). Farm Ponds

A farm pond is a large dug out in the earth, usually square or rectangular in shape, which harvests rain water 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 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 Land use classification, majority of the area is covered by the agricultural field. Hence, it is proposed to construct 600 farm ponds in 30 villages of the Mandal @ 20 farm ponds in each village.

D). 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 wastages 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 3000 ha @ 100 ha per village..

13. TENTATIVE COST ESTIMATES (THAVANAMPALLI MANDAL)

S.No.	Feasible Artificial Recharge & Water Conservation structures/	No. of Structures/ Quantity	Total Volume (MCM)	Tentative unit cost (in Rs lakh)	Total tentative cost (in Rs Lakh)	Expected Annual GW recharge/savings (MCM)
1	Proposed Masonry Check dams Crest Length -10-15 m, Height-1-2 m) (0.007 MCM*4 fillings)	71	1.988	5	355	1.491
2	Recharge shaft in Check dam (50% of the existing Check dams)	31	0.341	0.5	15.5	0.341
3	Proposed Percolation Tanks (100*100*2.5)* 4 fillings)	0	0	15	0	0
4	Renovation Desilting, Repairs and installation of Recharge Shafts in existing PTS (50% of the existing PTS)	28	0.308	1	28	0.308
5	Proposed Farm Pond (6 filling) 5*5*1.5 dimension @ 20 farm ponds per each village	600	0.0864	0.25	150	0.07776
6	Proposed Sprinkler/drip/HDPE pipes for 100 ha in each village	3000	18	0.6	1800	9
7	Proposed Piezometers up to 50 mbgl @ one PZ per Village	30	0	0.6	18	0
8 (i)	Total (No. of AR Structures)	760	2.72		566.5	2.218
8 (ii)	Total (ha)	3000			1800	9
	Total (8(i) + 8 (ii))				2366.5	11.218
9	Impact Assessment & O & M -5 % of Total cost of the Scheme				118.325	
	Grand Total				2484.825	

*(Expected annual GW Recharge/Savings MCM - CDS& PTS: 75%, Farm ponds - 90%, Sprinklers-50%, Recharge shafts in existing CDS and PTS-100%)

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

14. TIME SCHEDULE

Steps	Quarters							
	1st	2 nd	3 rd	4 th	5 th	6 th	7 th	8 th
Identification of line department/implementing agency and preparation of DPR								
Approval of Scheme and releases of sanction of funds								
Implementation of ARS								

Phase = one quarter or 3 months or equivalent to financial quarter

A). Operation and Maintenance

In all projects impact assessment has to be carried out to ensure that project 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 as well as operation & Maintenance at the rate of 5% of the total cost of the project for 5 years from the completion of artificial recharge project.

B). Expected Benefits

The benefits of the project are:

1. The implementation of the project would result in additional recharge/Ground water savings to the tune of 11.218 MCM.
2. Ground water recharge will help in arresting the rapid decline in ground water resources and will also ensure improvement in quality of ground water by dilution.
3. Proposed structures and measures will also enhance the ground water potential and would ensure sustainability of ground water resources. It is estimated that the stage of ground water development may likely to be reduced from the present 108% to 72% (36%)
4. It will also help in controlling soil erosion.

Acknowledgements

The data received from the Director Ground Water Department Andhra Pradesh in respect of the basic inputs is duly acknowledged. The information on existing Artificial Recharge Structures have been taken from the EMUSTER, Department of Rural Development, Government of AP.

EXISTING ARTIFICIAL RECHARGE STRUCTURES
THAVANAMPALLI MANDAL, CHITTOOR DISTRICT, AP.

S.no	Gram Panchayat	Habitation	Structure Type	Longitude	Latitude	Scheme
1	Aragondagollapalle	A.Gollapalli	Check Dam	78.9382	13.2684	NREGS
2	Thavanampalleputtur	ThavanampallePuttur	Check Dam	79.0095	13.2389	NREGS
3	Thavanampalleputtur	ThavanampallePuttur	Check Dam	79.0133	13.2487	NREGS
4	Thodalthora	Kurapallekandriga	Check Dam	78.9378	13.3081	NREGS
5	Thodalthora	Thodathora H.W.	Check Dam	78.9488	13.3032	NREGS
6	Sarakallu	Sarakallu	Check Dam	78.9246	13.3478	NREGS
7	Sarakallu	Sarakallu A.W.	Check Dam	78.9288	13.3357	NREGS
8	Sarakallu	Sarakallu A.W.	Check Dam	78.9284	13.3342	NREGS
9	Eguvathadakara	BapinaiduPalle	Check Dam	78.9741	13.2667	NREGS
10	E.maredupalle	E.MareduPalli	Check Dam	79.0189	13.2480	NREGS
11	Eachaneri	Eachaneri	Check Dam	78.9792	13.3018	NREGS
12	Eachaneri	Kamalavarivooru	Check Dam	78.9667	13.3086	NREGS
13	Eachaneri	Kamalavarivooru	Check Dam	78.9687	13.3053	NREGS
14	Eachaneri	Kamalavarivooru	Check Dam	78.9701	13.3059	NREGS
15	Jonnagurukula	Jonnagurukula	Check Dam	78.9574	13.2556	NREGS
16	Jonnagurukula	Neelampalle H.W.	Check Dam	78.9576	13.2564	NREGS
17	Karakampalle	E.Karakampalle	Check Dam	78.9988	13.2829	NREGS
18	Karakampalle	E.Karakampalle H.W.	Check Dam	79.0009	13.2782	NREGS
19	Karakampalle	E.Karakampalle H.W.	Check Dam	78.9993	13.2800	NREGS
20	Kattakindapalle	KummaraKuntaPalle	Check Dam	78.9172	13.3157	NREGS
21	Govindareddipalle	Govindareddipalle	Check Dam	78.9267	13.3096	NREGS
22	Govindareddipalle	Govindareddipalle	Check Dam	78.9216	13.3119	NREGS
23	Muthukur	M.Gollapalle	Check Dam	78.9427	13.2390	NREGS
24	Muthukur	M.Gollapalle	Check Dam	78.9422	13.2384	NREGS
25	Vengampalle	Vengampalle	Check Dam	78.9673	13.3468	NREGS
26	Vengampalle	Vengampalle	Check Dam	78.9543	13.3287	NREGS
27	Mynogundlapalle	Mutharapalle	Check Dam	79.0647	13.2556	NREGS
28	Gurukavaripalle-g.palle	G.Gollapalle	Check Dam	78.9192	13.3214	NREGS
29	Gurukavaripalle-g.palle	Patrapalle H.W.	Check Dam	78.9241	13.3294	NREGS
30	Mallakunta	Krishnapuram	Check Dam	78.8897	13.3091	NREGS
31	Mallakunta	Krishnapuram	Check Dam	78.8773	13.3049	NREGS
32	Mallakunta	Yadamalavaripalle	Check Dam	78.9084	13.3155	NREGS
33	Mallakunta	Yadamalavaripalle	Check Dam	78.9063	13.3145	NREGS
34	Kondrajukulva	Modavaneri	Check Dam	78.9878	13.2951	NREGS
35	Kondrajukulva	Modavaneri	Check Dam	78.9790	13.2965	NREGS
36	Kondrajukulva	Modavaneri	Check Dam	78.9913	13.3074	NREGS
37	Kondrajukulva	Modavaneri	Check Dam	78.9902	13.3088	NREGS
38	Kondrajukulva	Oddipalle	Check Dam	78.9869	13.2923	NREGS
39	Madhavaram	Boyapalle	Check Dam	78.8459	13.2977	NREGS
40	Madhavaram	Madhavaram	Check Dam	78.8320	13.2966	NREGS
41	Madhavaram	Madhavaram	Check Dam	78.8353	13.2977	NREGS
42	Madhavaram	Madhavaram	Check Dam	78.8394	13.2976	NREGS
43	Madhavaram	Vijayapuram	Check Dam	78.8529	13.3029	NREGS

44	Diguvamagham	DiguvaMagham	Check Dam	78.9680	13.2691	NREGS
45	Diguvamagham	DiguvaMagham	Check Dam	78.9600	13.2723	NREGS
46	Diguvamodulapalle	D.Modulapalle	Check Dam	79.0203	13.2316	NREGS
47	Eguvathavanampalle	E.Thavanampalle	Check Dam	78.9923	13.2694	NREGS
48	Patnam	Patnam	Check Dam	79.0634	13.2657	NREGS
49	Patnam	Patnam	Check Dam	79.0553	13.2516	NREGS
50	Punyasamudram	Peddapalem	Check Dam	79.0440	13.2437	NREGS
51	Mathyam	DiguvaMathyam	Check Dam	78.9504	13.2493	NREGS
52	Mathyam	Mathyam	Check Dam	78.9500	13.2470	NREGS
53	Mathyam	Mathyam	Check Dam	78.9493	13.2438	NREGS
54	Mathyam	Mathyam	Check Dam	78.9250	13.2497	NREGS
55	Mathyam	Mathyam	Check Dam	78.9260	13.2519	NREGS
56	Mathyam	Mathyam H.W.	Check Dam	78.9454	13.2419	NREGS
57	Mathyam	Paipalle	Check Dam	78.9425	13.2398	NREGS
58	Mathyam	Paipalle	Check Dam	78.9415	13.2396	NREGS
59	Aragonda	Aragonda	Check Dam	78.9538	13.2812	NREGS
60	Karakampalle	E.Karakampalle H.W.	Check Wall	79.0007	13.2800	NREGS
61	Karakampalle	E.Karakampalle H.W.	Check Wall	79.0000	13.2806	NREGS
62	Patnam	Patnam	Check Wall	79.0642	13.2663	NREGS
63	Thavanampalleputtur	ThavanampallePuttur	MPT	79.0104	13.2505	NREGS
64	Thodalthora	Thodathora H.W.	MPT	78.9549	13.3025	NREGS
65	Sarakallu	Sarakallu	MPT	78.9217	13.3514	NREGS
66	Sarakallu	Sarakallu	MPT	78.9344	13.3486	NREGS
67	E.maredupalle	E.MareduPalli	MPT	79.0215	13.2407	NREGS
68	Eachaneri	Eachaneri	MPT	78.9628	13.2989	NREGS
69	Eachaneri	Eachaneri	MPT	78.9715	13.3107	NREGS
70	Eachaneri	Eachaneri	MPT	78.9717	13.3101	NREGS
71	Eachaneri	Eachaneri	MPT	78.9683	13.3110	NREGS
72	Eachaneri	Kamalavarivooru	MPT	78.9592	13.3112	NREGS
73	Eachaneri	Kamalavarivooru	MPT	78.9586	13.3115	NREGS
74	Eachaneri	Kamalavarivooru	MPT	78.9647	13.3111	NREGS
75	Eachaneri	Kamalavarivooru	MPT	78.9647	13.3119	NREGS
76	Cherlopalle	Voddivanicheruvu	MPT	78.9533	13.3171	NREGS
77	Cherlopalle	Voddivanicheruvu	MPT	78.9539	13.3170	NREGS
78	Kattakindapalle	Uppoddipalle	MPT	78.9038	13.3253	NREGS
79	Muthukur	M.Gollapalle	MPT	78.9524	13.2323	NREGS
80	Pallecheruvu	Jettipalle	MPT	78.9942	13.2811	NREGS
81	Pallecheruvu	Mylavaripalle	MPT	78.9911	13.2783	NREGS
82	Gurukavaripalle-g.palle	G.Gollapalle H.W.	MPT	78.9169	13.3266	NREGS
83	Kondrajukalva	KondrajuKalva	MPT	78.9705	13.2900	NREGS
84	Kondrajukalva	KondrajuKalva	MPT	78.9648	13.2820	NREGS
85	Kondrajukalva	KondrajuKalva	MPT	78.9615	13.2936	NREGS
86	Kondrajukalva	Modavaneri	MPT	78.9836	13.3097	NREGS
87	Kondrajukalva	Oddipalle	MPT	78.9892	13.2920	NREGS
88	Madhavaram	Swastik Nagar	MPT	78.8655	13.3107	NREGS
89	Diguvamodulapalle	D.Modulapalle	MPT	79.0040	13.2330	NREGS
90	Diguvamodulapalle	Mittamadigapalle	MPT	79.0069	13.2251	NREGS

91	Diguvamodulapalle	Oddupalle	MPT	79.0031	13.2327	NREGS
92	Diguvamodulapalle	Ponnedupalle	MPT	78.9972	13.2307	NREGS
93	Eguvathavanampalle	E.Thavanampalle	MPT	79.0030	13.2625	NREGS
94	Eguvathavanampalle	Kothagonepalle	MPT	79.0037	13.2538	NREGS
95	Eguvathavanampalle	Mittapalle	MPT	78.9954	13.2545	NREGS
96	Eguvathavanampalle	Mittapalle	MPT	79.0000	13.2621	NREGS
97	Patnam	Patnam	MPT	79.0595	13.2626	NREGS
98	Patnam	Patnam	MPT	79.0570	13.2530	NREGS
99	Patnam	Siddampalle	MPT	79.0443	13.2597	NREGS
100	Punyasamudram	Dwarakapuram	MPT	79.0373	13.2549	NREGS
101	Punyasamudram	Dwarakapuram	MPT	79.0390	13.2549	NREGS
102	Punyasamudram	Kurapalle	MPT	79.0338	13.2572	NREGS
103	Punyasamudram	Santhapalle H.W.	MPT	79.0446	13.2536	NREGS
104	Thodalthora	Thodathora H.W.	PT	78.9478	13.3049	NREGS
105	Sarakallu	Krishnapuram	PT	78.9190	13.3442	NREGS
106	Sarakallu	Sarakallu A.W.	PT	78.9259	13.3355	NREGS
107	Cherlopalle	Voddivanicheruvu	PT	78.9481	13.3161	NREGS
108	Kattakindapalle	Kattakindapalle	PT	78.9210	13.3089	NREGS
109	Kattakindapalle	KummaraKuntaPalle	PT	78.9217	13.3066	NREGS
110	Kattakindapalle	Uppoddipalle	PT	78.9037	13.3221	NREGS
111	Kattakindapalle	Uppoddipalle	PT	78.9073	13.3170	NREGS
112	Mynogundlapalle	Mynogundlapalle	PT	79.0746	13.2708	NREGS
113	Mynogundlapalle	Mynogundlapalle H.W.	PT	79.0717	13.2813	NREGS
114	Gurukavaripalle-g.palle	G.Gollapalle	PT	78.9178	13.3305	NREGS
115	Gurukavaripalle-g.palle	G.Gollapalle	PT	78.9169	13.3261	NREGS
116	Madhavaram	Swastik Nagar H.W.	PT	78.8632	13.3098	NREGS
117	Madhavaram	Swastik Nagar H.W.	PT	78.8571	13.3079	NREGS
118	Patnam	Patnam	PT	79.0573	13.2656	NREGS

PROPOSED ARTIFICIAL RECHARGE STRUCTURES
THAVANAMPALLI MANDAL, CHITTOOR DISTRICT, AP.

S.No.	Mandal	Lattitude	Longitude	Structure_Type
1	Thavanamapalli	13.2339	79.0363	Check Dam
2	Thavanamapalli	13.2332	79.0425	Check Dam
3	Thavanamapalli	13.2319	79.0466	Check Dam
4	Thavanamapalli	13.2355	79.0566	Check Dam
5	Thavanamapalli	13.2367	79.0480	Check Dam
6	Thavanamapalli	13.2432	79.0487	Check Dam
7	Thavanamapalli	13.2418	79.0550	Check Dam
8	Thavanamapalli	13.2404	79.0618	Check Dam
9	Thavanamapalli	13.2482	79.0695	Check Dam
10	Thavanamapalli	13.2685	79.0720	Check Dam
11	Thavanamapalli	13.2427	79.0362	Check Dam
12	Thavanamapalli	13.2318	79.0288	Check Dam
13	Thavanamapalli	13.2298	79.0158	Check Dam
14	Thavanamapalli	13.2224	79.0269	Check Dam
15	Thavanamapalli	13.2200	79.0387	Check Dam
16	Thavanamapalli	13.2415	79.0124	Check Dam
17	Thavanamapalli	13.2428	79.0147	Check Dam
18	Thavanamapalli	13.2610	79.0315	Check Dam
19	Thavanamapalli	13.2530	79.0302	Check Dam
20	Thavanamapalli	13.2501	79.0363	Check Dam
21	Thavanamapalli	13.2601	78.9817	Check Dam
22	Thavanamapalli	13.2553	78.9789	Check Dam
23	Thavanamapalli	13.2591	78.9970	Check Dam
24	Thavanamapalli	13.2587	79.0056	Check Dam
25	Thavanamapalli	13.2493	79.0054	Check Dam
26	Thavanamapalli	13.2421	79.0101	Check Dam
27	Thavanamapalli	13.2221	79.0217	Check Dam
28	Thavanamapalli	13.2387	78.9494	Check Dam
29	Thavanamapalli	13.2309	78.9535	Check Dam
30	Thavanamapalli	13.2296	78.9304	Check Dam
31	Thavanamapalli	13.2852	78.9407	Check Dam
32	Thavanamapalli	13.2978	78.9388	Check Dam
33	Thavanamapalli	13.2974	78.8566	Check Dam
34	Thavanamapalli	13.3100	78.9131	Check Dam
35	Thavanamapalli	13.3106	78.8842	Check Dam
36	Thavanamapalli	13.3098	78.8673	Check Dam
37	Thavanamapalli	13.3095	78.8427	Check Dam
38	Thavanamapalli	13.3043	78.8480	Check Dam
39	Thavanamapalli	13.3100	78.8329	Check Dam
40	Thavanamapalli	13.3098	78.8280	Check Dam
41	Thavanamapalli	13.3017	78.8384	Check Dam
42	Thavanamapalli	13.2989	78.8498	Check Dam

43	Thavanamapalli	13.3015	78.8627	Check Dam
44	Thavanamapalli	13.3266	78.9022	Check Dam
45	Thavanamapalli	13.3247	78.9251	Check Dam
46	Thavanamapalli	13.3484	78.9263	Check Dam
47	Thavanamapalli	13.3519	78.9254	Check Dam
48	Thavanamapalli	13.3387	78.9306	Check Dam
49	Thavanamapalli	13.3361	78.9311	Check Dam
50	Thavanamapalli	13.3358	78.9383	Check Dam
51	Thavanamapalli	13.3404	78.9451	Check Dam
52	Thavanamapalli	13.3246	78.9281	Check Dam
53	Thavanamapalli	13.3330	78.9639	Check Dam
54	Thavanamapalli	13.3407	78.9663	Check Dam
55	Thavanamapalli	13.3505	78.9506	Check Dam
56	Thavanamapalli	13.3538	78.9470	Check Dam
57	Thavanamapalli	13.3438	78.9331	Check Dam
58	Thavanamapalli	13.3253	78.9486	Check Dam
59	Thavanamapalli	13.3046	78.9743	Check Dam
60	Thavanamapalli	13.2945	78.9825	Check Dam
61	Thavanamapalli	13.2831	78.9907	Check Dam
62	Thavanamapalli	13.2722	78.9854	Check Dam
63	Thavanamapalli	13.3003	78.9612	Check Dam
64	Thavanamapalli	13.2733	79.0098	Check Dam
65	Thavanamapalli	13.3227	78.9396	Check Dam
66	Thavanamapalli	13.3249	78.9634	Check Dam
67	Thavanamapalli	13.3492	78.9704	Check Dam
68	Thavanamapalli	13.2272	79.0348	Check Dam
69	Thavanamapalli	13.2671	79.0161	Check Dam
70	Thavanamapalli	13.2592	78.9682	Check Dam
71	Thavanamapalli	13.2607	78.9899	Check Dam

Fig.1

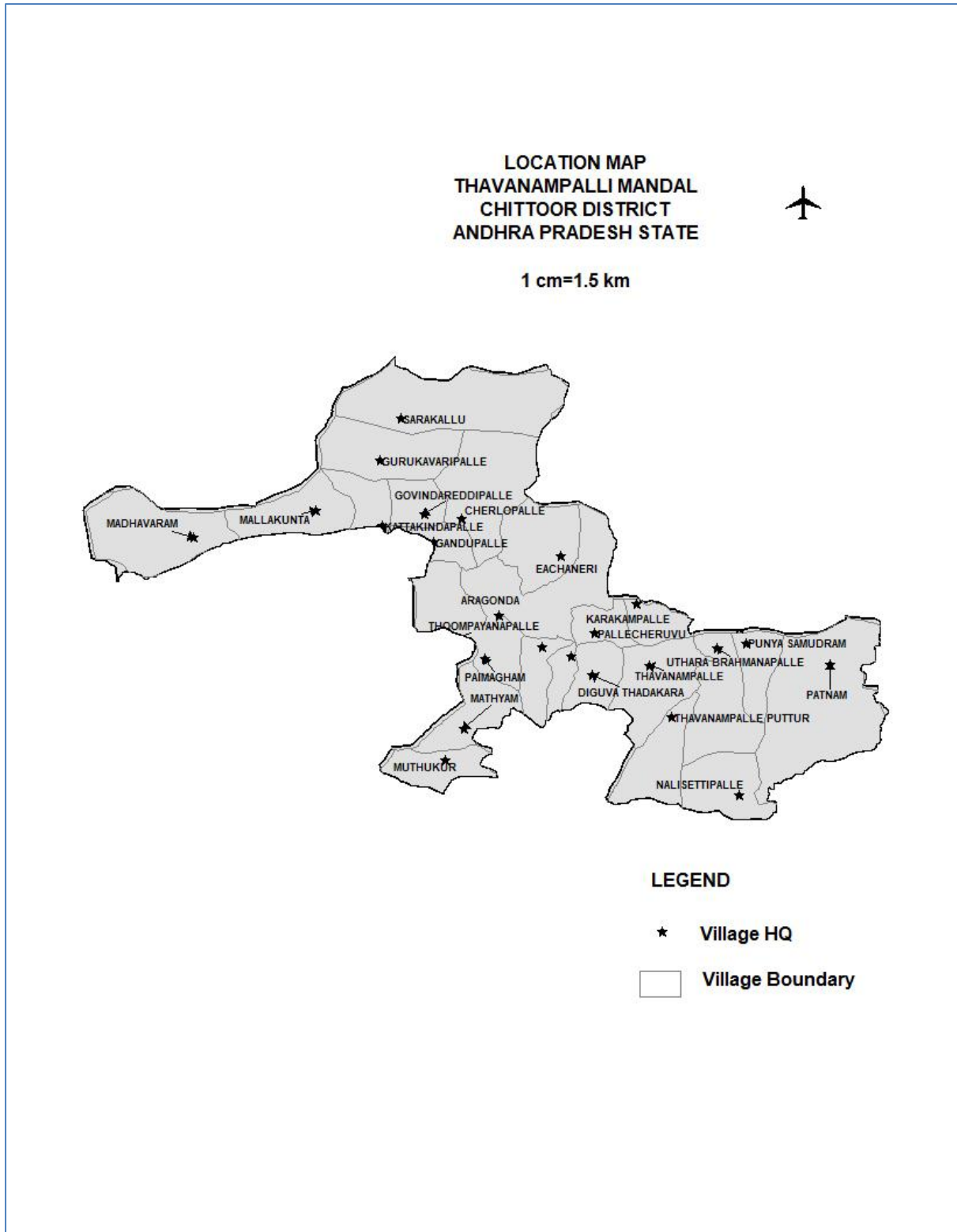


Fig.2

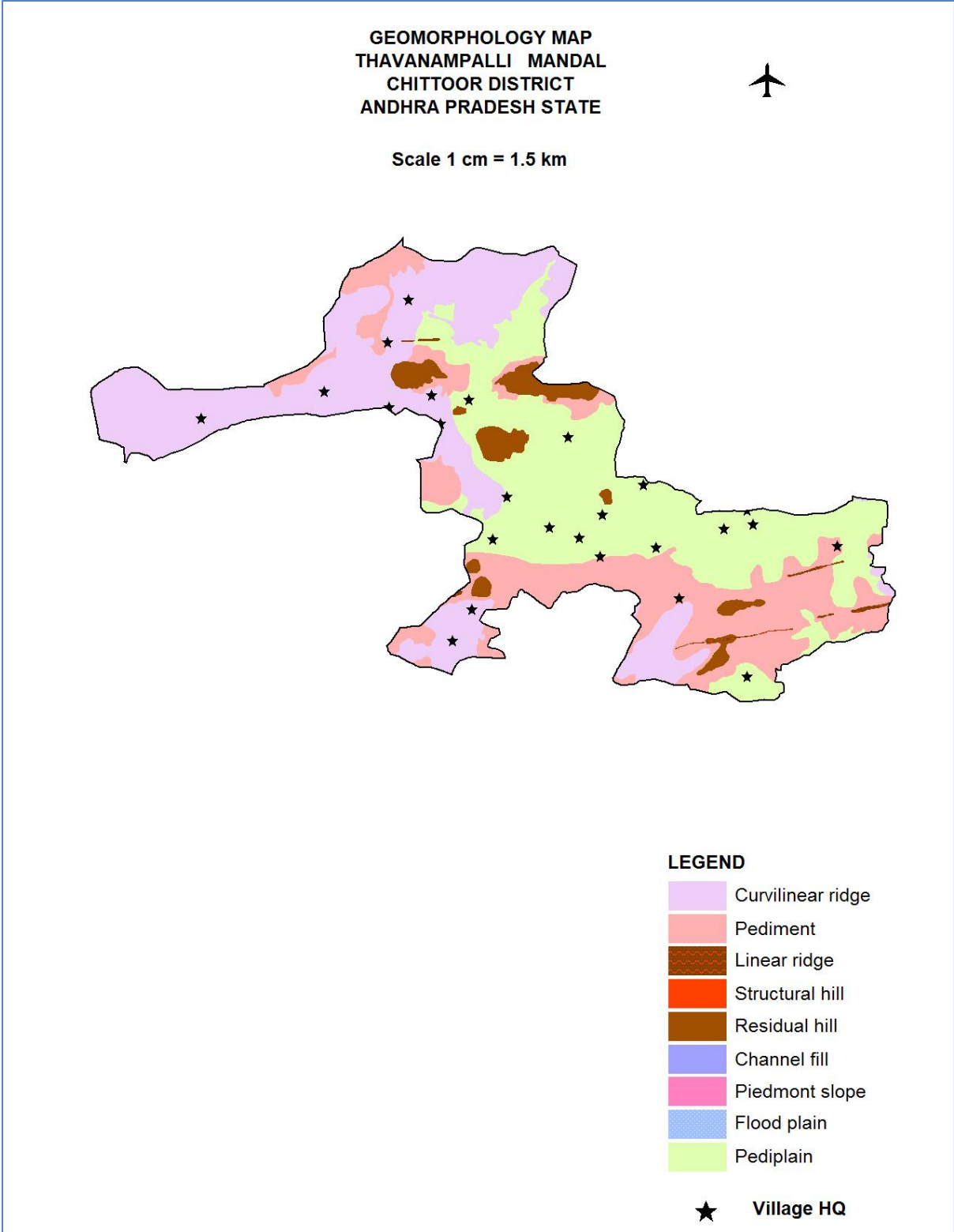


Fig.3

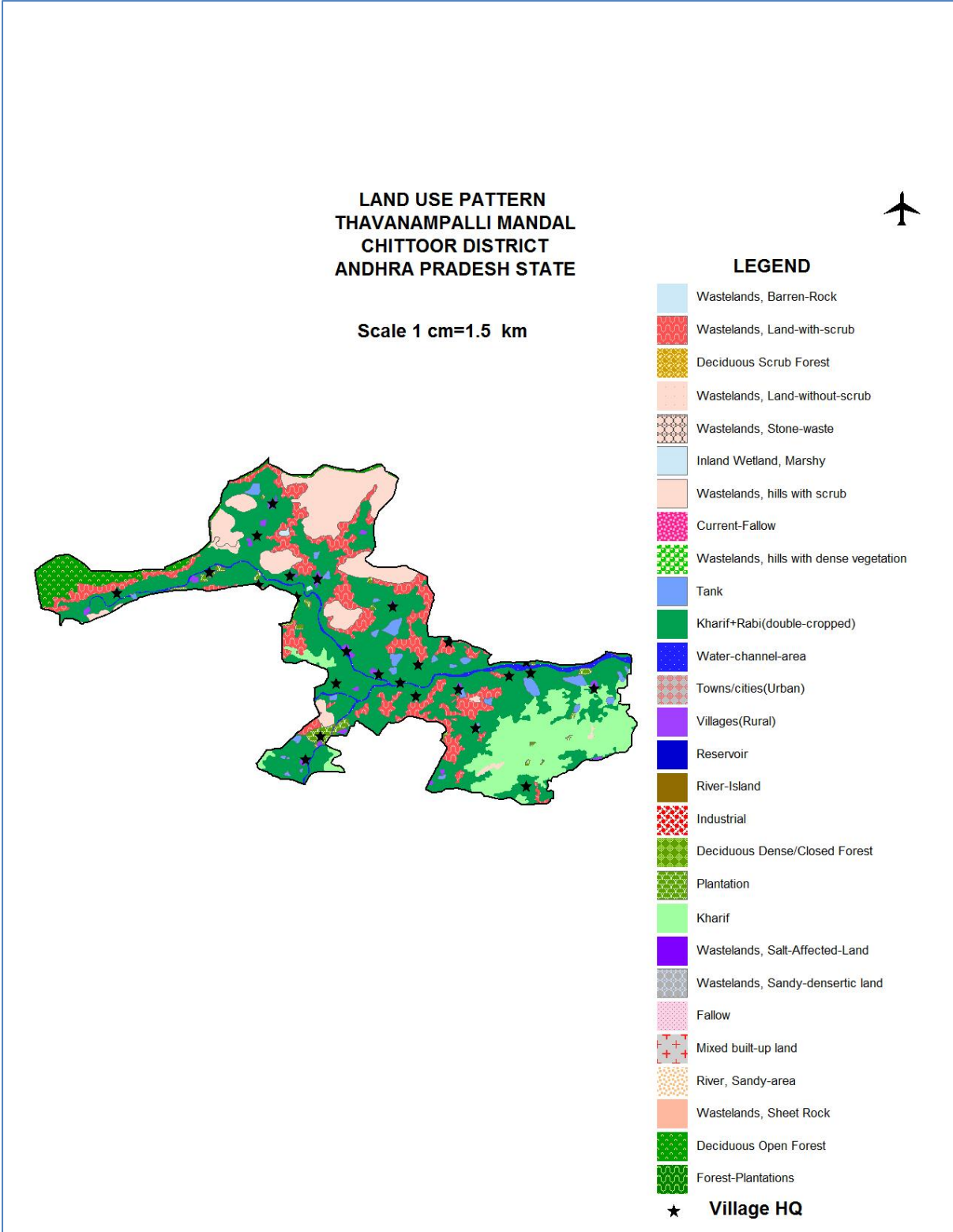


Fig.4

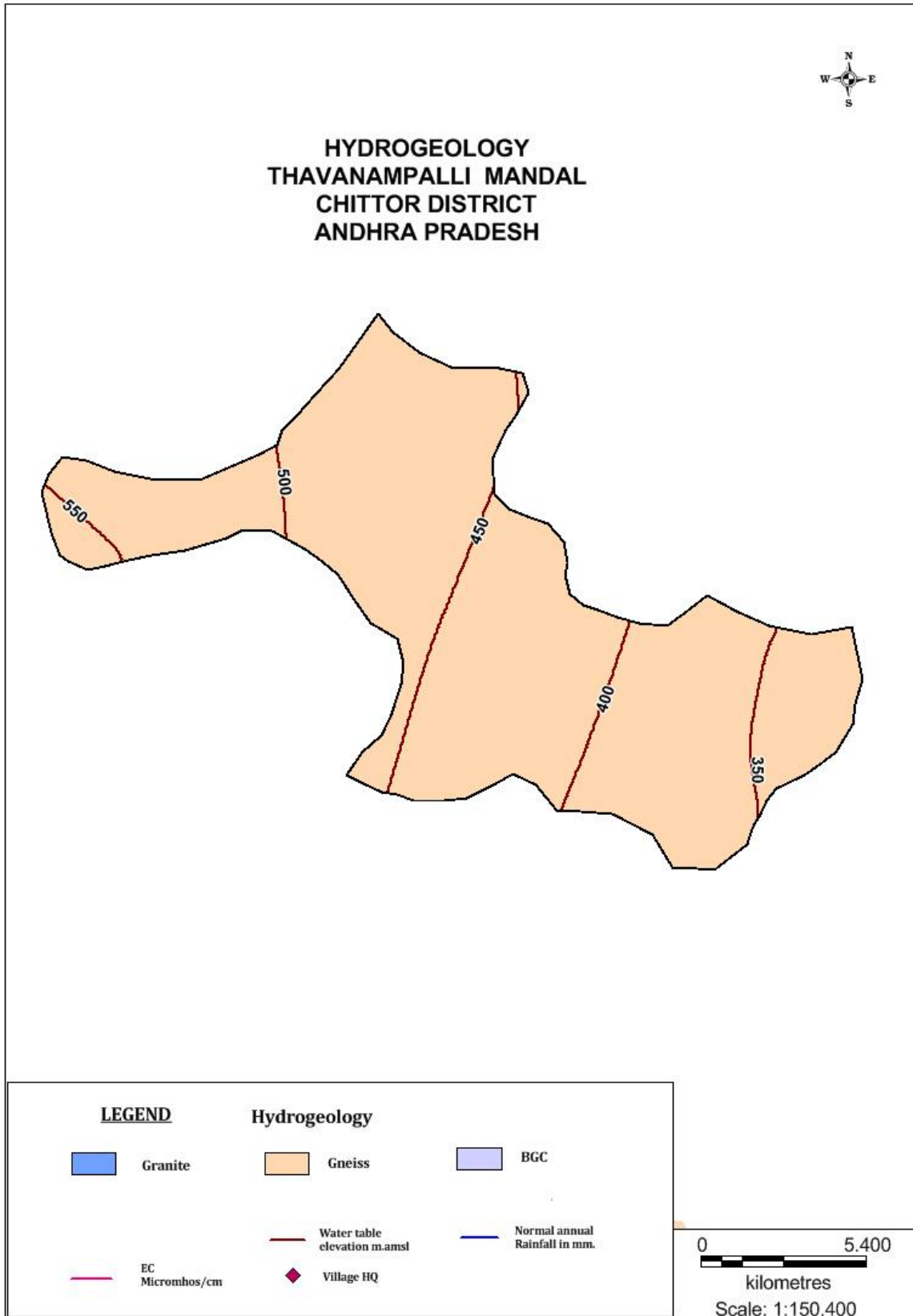


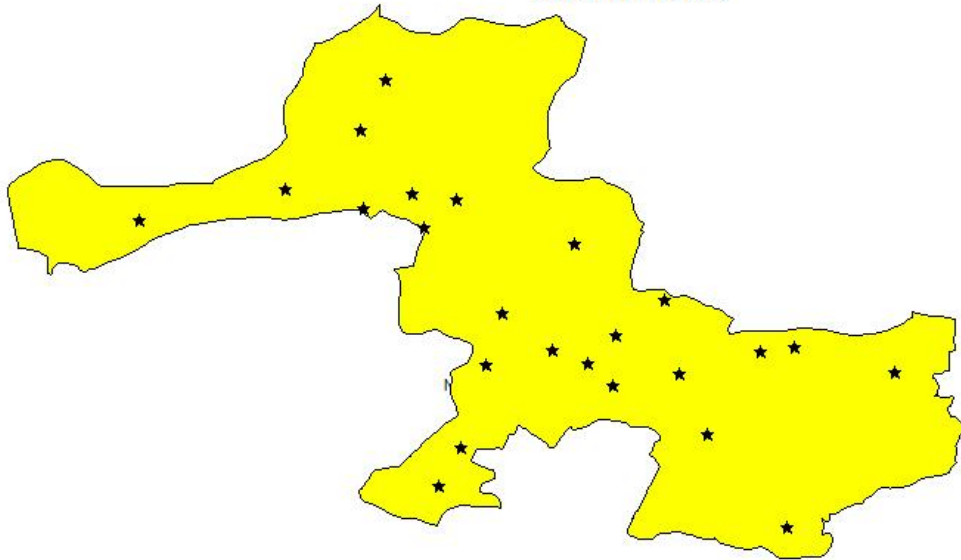
Fig.5

DEPTH TO WATER LEVEL
PRE-MONSOON
THAVANAMPALLI MANDAL
CHITTOOR DISTRICT
ANDHRA PRADESH STATE


0 1.5 3



kilometres



LEGEND (DTWL)

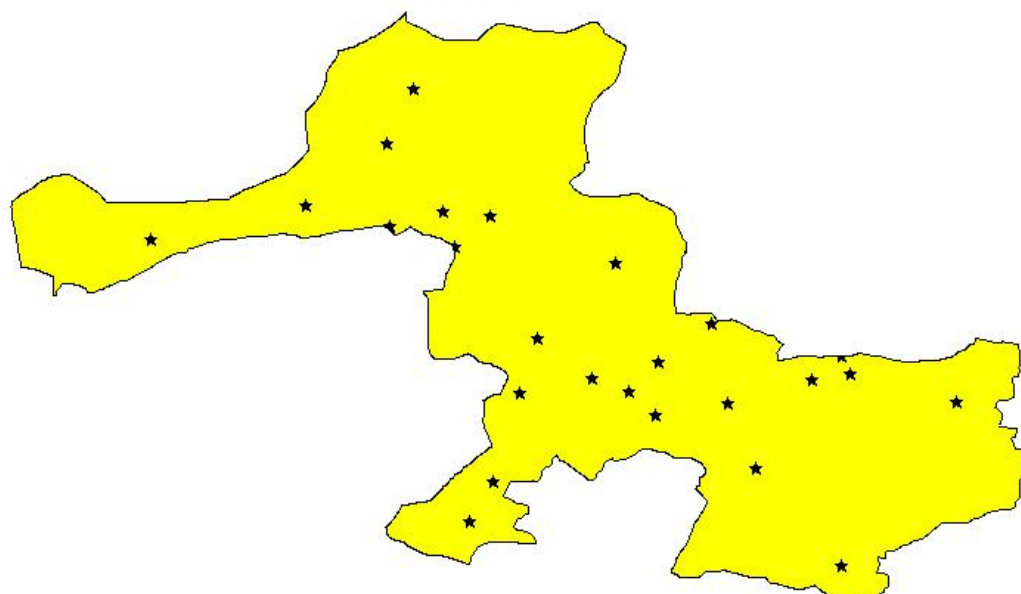
 5 - 10 m bgl

 village HQ

Fig.6

DEPTH TO WATER LEVEL
NOVEMBER 2014
THAVANAMPALLI MANDAL
CHITTOOR DISTRICT
ANDHRA PRADESH STATE

1 cm=1.5 km



LEGEND

-  10 - 20 m bgl
-  Village HQ

Fig.7

