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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
RAMASAMUDRAM MANDAL, CHITTOOR DISTRICT,
ANDHRA PRADESH

SOUTHERN REGION
HYDERABAD
AUGUST-2016

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

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AT A GLANCE

Name of the Mandal	RAMASAMUDRAM
District	CHITTOOR
State	ANDHRA PRADESH
Total Area(sq. km)	168
Area suitable for Artificial Recharge (sq.km.)	134
Latitude and Longitude	13.308260 to 13.461030 and 78.365390 to 78.555360.
Average Annual Rainfall (mm)	736
Geology	BGC
Average Depth To Water Level (Decadal) (Pre Monsoon)	15.50
Average Depth To Water Level (Decadal) (Post Monsoon)	7.50
Ground Water Resources (2011)	
Annual Replenishable Ground Water Resources (MCM/yr)	18.57
Net Annual Ground Water Availability(MCM)/yr	16.71
Net Annual Ground Water Draft(MCM)/yr	29.15
Projected Demand for Domestic and Industrial Use(MCM)/yr	2.51
Stage of Ground Water Development (%)	174
Surface runoff available (MCM)/yr	18.86
Total Storage Created in the Mandal by Various Agencies (MCM)/yr	1.30
Artificial Recharge/Conservation Measures	
Recharge Structures Proposed (No.s)	Percolation Tanks: 20, Check Dams: 0 Farm ponds: 360, Recharge Shafts: 92
Improving Water use Efficiency	Micro Irrigation System: 1800 ha
Tentative Total Cost in Lakhs (Rs.)	1633
Expected Recharge/Savings (MCM)/yr	7.959

1. INTRODUCTION

Ramasamudram Mandal is one of over-exploited Mandal in Chittoor district, Andhra Pradesh State, which is economically backward and chronically drought affected. The Mandal has 15 inhabited villages and with 18 gram panchayats.

2. LOCATION

The Mandal lies between north latitudes 13.308260 to 13.461030 and between east longitudes 78.365390 to 78.555360. The Mandal occupies the Western part of the Chittoor district and is bounded on the north by Madanapalle Mandal, on the east by Nanganur Mandal, on the south by Tamilnadu State and west by Tamilnadu Mandal. (Fig.1)The geographical area of the Mandal is 168 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 736 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 168 sq.km, the area covered by forest is 19.29 sq.km and the net area sown is 55.35 sq.km. Barren and uncultivable land is 28.73 sq.km. The land for non agricultural use accounts for 30.66 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 11 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 mbgl. 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 15 to 20m. The depth to water levels maps for pre and post monsoon period (2014) are shown in Fig 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 Ramasamudram Mandal Chittoor District is given in Table-1.

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

Annual Replenishable Ground water resources (MCM)	18.57
Net Annual Ground Water Availability(MCM)/yr	16.71
Net Annual Ground Water Draft(MCM)/yr	29.15
Projected Demand for Domestic and Industrial use up to 2025. (MCM)	2.51
Stage of Ground water development (%).	174
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

Ramasamudram Mandal falls under high stage of ground water development i.e., 174 % 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)	168
Hilly Area (Sq.kms)	34
Area suitable for Artificial Recharge (sq.km.)	134
Runoff Yield in MCM/yr.	18.86
Existing No. of Check Dams	70
Storage created MCM/yr.	0.496
Existing No. of Percolation Tanks	114
Storage created MCM/yr.	0.81
Total Existing Storage Created	1.30

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 736 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 20 **Percolation tanks** 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 35 and 57 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 360 farm ponds in 18 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 1800 ha @ 100 ha per village.

13. TENTATIVE COST ESTIMATES (RAMASAMUDRAM 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)	0	0	5	0	0
2	Recharge shaft in Check dam (50% of the existing Check dams)	35	0.385	0.5	17.5	0.385
3	Proposed Percolation Tanks (100*100*2.5)* 4 fillings)	20	2	15	300	1.5
4	Renovation Desilting, Repairs and installation of Recharge Shafts in existing PTS (50% of the existing PTS)	57	0.627	1	57	0.627
5	Proposed Farm Pond (6 filling) 5*5*1.5 dimension @ 20 farm ponds per each village	360	0.05184	0.25	90	0.046656
6	Proposed Sprinkler/drip/HDPE pipes for 100 ha in each village	1800	10.8	0.6	1080	5.4
7	Proposed Piezometers up to 50 mbgl @ one PZ per Village	18	0	0.6	10.8	0
8 (i)	Total (No. of AR Structures)	490	3.06		475.3	2.559
8 (ii)	Total (ha)	1800			1080	5.4
	Total (8(i) + 8 (ii))				1555.3	7.959
9	Impact Assessment & O & M -5 % of Total cost of the Scheme				77.765	
	Grand Total				1633.065	

*(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 7.95 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 174% to 118% (56%)
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
RAMASAMUDRAM MANDAL, CHITTOOR DISTRICT, AP

S.no	Gram Panchayat	Habitation	Structure Type	Longitude	Latitude	Scheme
1	Miniki	Miniki	Check Dam	78.4739	13.3634	NREGS
2	Chokkandlapalle	Purandlapalle	Check Dam	78.4568	13.3378	NREGS
3	Malentham	Chemperapalle	Check Dam	78.4986	13.4032	NREGS
4	Malentham	Malenatham	Check Dam	78.5040	13.3675	NREGS
5	Malentham	Malenatham	Check Dam	78.5080	13.3706	NREGS
6	Malentham	Malenatham	Check Dam	78.5103	13.3740	NREGS
7	Malentham	Malenatham	Check Dam	78.5152	13.3757	NREGS
8	Malentham	Singamavaripalle	Check Dam	78.5156	13.3940	NREGS
9	Moogavadi	Errapalle	Check Dam	78.4721	13.3343	NREGS
10	Ramasumudram	Guntalapeta	Check Dam	78.4327	13.3745	NREGS
11	Elavanelloru	Anapalle	Check Dam	78.3708	13.3711	NREGS
12	Elavanelloru	Anapalle	Check Dam	78.3810	13.3753	NREGS
13	Elavanelloru	Dasarlapalle	Check Dam	78.4070	13.3593	NREGS
14	Elavanelloru	Dasarlapalle	Check Dam	78.4087	13.3612	NREGS
15	Elavanelloru	Dasarlapalle	Check Dam	78.4096	13.3637	NREGS
16	Elavanelloru	Dasarlapalle	Check Dam	78.4100	13.3654	NREGS
17	Elavanelloru	Dasarlapalle	Check Dam	78.4114	13.3681	NREGS
18	Elavanelloru	Elavanelloru	Check Dam	78.3900	13.3726	NREGS
19	Elavanelloru	Gajjiganipalle	Check Dam	78.3995	13.3643	NREGS
20	Elavanelloru	Gajjiganipalle	Check Dam	78.3960	13.3540	NREGS
21	Elavanelloru	Paigadda	Check Dam	78.3949	13.3724	NREGS
22	Elavanelloru	Paigadda	Check Dam	78.3971	13.3722	NREGS
23	Kaplle	Ajjamreddipalle	Check Dam	78.4416	13.4422	NREGS
24	Kaplle	Kaplle	Check Dam	78.4177	13.4158	NREGS
25	Kaplle	Nallachennapalle	Check Dam	78.4651	13.4430	NREGS
26	Peddakurapalle	Matlavaripalle	Check Dam	78.4315	13.3917	NREGS
27	Peddakurapalle	Matlavaripalle	Check Dam	78.4286	13.3902	NREGS
28	Peddakurapalle	Matlavaripalle	Check Dam	78.4270	13.3928	NREGS
29	Peddakurapalle	Matlavaripalle	Check Dam	78.4303	13.3874	NREGS
30	Peddakurapalle	Matlavaripalle	Check Dam	78.4301	13.3892	NREGS
31	Peddakurapalle	Narevaaripalle	Check Dam	78.4278	13.4108	NREGS
32	R.nadimpalle	Kondavarikothaindu	Check Dam	78.3939	13.3977	NREGS
33	R.nadimpalle	R.Nadimpalle	Check Dam	78.4039	13.3794	NREGS
34	Arikala	Arikala	Check Dam	78.4990	13.4034	NREGS
35	Arikala	Goduvaripalle	Check Dam	78.4821	13.4117	NREGS
36	Chokkandlapalle	Purandlapalle	Check Dam	78.4568	13.3378	IWMP
37	Moogavadi	Errapalle	Check Dam	78.4721	13.3343	IWMP
38	Elavanelloru	Anapalle	Check Dam	78.3708	13.3711	IWMP
39	Elavanelloru	Anapalle	Check Dam	78.3810	13.3753	IWMP
40	Elavanelloru	Dasarlapalle	Check Dam	78.4070	13.3593	IWMP

41	Elavanelloru	Dasarlapalle	Check Dam	78.4087	13.3612	IWMP
42	Elavanelloru	Dasarlapalle	Check Dam	78.4096	13.3637	IWMP
43	Elavanelloru	Dasarlapalle	Check Dam	78.4100	13.3654	IWMP
44	Elavanelloru	Dasarlapalle	Check Dam	78.4114	13.3681	IWMP
45	Elavanelloru	Elavanelloru	Check Dam	78.3900	13.3726	IWMP
46	Elavanelloru	Gajjiganipalle	Check Dam	78.3995	13.3643	IWMP
47	Elavanelloru	Gajjiganipalle	Check Dam	78.3960	13.3540	IWMP
48	Elavanelloru	Paigadda	Check Dam	78.3949	13.3724	IWMP
49	Elavanelloru	Paigadda	Check Dam	78.3971	13.3722	IWMP
50	Kaplle	Kaplle	Check Dam	78.4177	13.4158	IWMP
51	Kaplle	Nallachennapalle	Check Dam	78.4651	13.4430	IWMP
52	Peddakurapalle	Matlavaripalle	Check Dam	78.4315	13.3917	IWMP
53	Peddakurapalle	Matlavaripalle	Check Dam	78.4286	13.3902	IWMP
54	Peddakurapalle	Matlavaripalle	Check Dam	78.4270	13.3928	IWMP
55	Peddakurapalle	Matlavaripalle	Check Dam	78.4303	13.3874	IWMP
56	Peddakurapalle	Matlavaripalle	Check Dam	78.4301	13.3892	IWMP
57	Peddakurapalle	Narevaaripalle	Check Dam	78.4278	13.4108	IWMP
58	R.nadimpalle	Kondavarikothaindu	Check Dam	78.3939	13.3977	IWMP
59	R.nadimpalle	R.Nadimpalle	Check Dam	78.4039	13.3794	IWMP
60	Moogavadi	Errapalle	Check Wall	78.4720	13.3373	NREGS
61	Ramasumudram	Guntalapeta	Check Wall	78.4264	13.3785	NREGS
62	Chembakur	Tekupalle	Check Wall	78.4049	13.4444	NREGS
63	Arikala	Arikala	Check Wall	78.4856	13.4043	NREGS
64	Arikala	Goduvaripalle	Check Wall	78.4702	13.4070	NREGS
65	Arikala	Goduvaripalle	Check Wall	78.4732	13.4102	NREGS
66	Arikala	Goduvaripalle	Check Wall	78.4738	13.4093	NREGS
67	Arikala	Gollapalle	Check Wall	78.4899	13.4350	NREGS
68	Arikala	Gownivaripalle	Check Wall	78.4771	13.4133	NREGS
69	Moogavadi	Errapalle	Check Wall	78.4720	13.3373	IWMP
70	Chembakur	Tekupalle	Check Wall	78.4049	13.4444	IWMP
71	Kudurucheemanapalle	Kurapalle	MPT	78.5064	13.3467	NREGS
72	Chokkandlapalle	Bikkimvaripalle	MPT	78.4684	13.3198	NREGS
73	Malenthamb	Chemperapalle	MPT	78.5102	13.4014	NREGS
74	Malenthamb	Errapasetipalle	MPT	78.4861	13.3945	NREGS
75	Malenthamb	Errapasetipalle	MPT	78.4846	13.3929	NREGS
76	Malenthamb	Konduru	MPT	78.5203	13.3877	NREGS
77	Malenthamb	Malenatham	MPT	78.5044	13.3673	NREGS
78	Moogavadi	Errapalle	MPT	78.4739	13.3346	NREGS
79	Ramasumudram	Guntalapeta	MPT	78.4335	13.3730	NREGS
80	Ramasumudram	Ramasamudram	MPT	78.4081	13.3512	NREGS
81	Ramasumudram	Ramasamudram	MPT	78.4094	13.3522	NREGS
82	Kaplle	Ajjamreddipalle	MPT	78.4350	13.4410	NREGS
83	R.nadimpalle	R.Nadimpalle H.W	MPT	78.4041	13.3834	NREGS
84	Chembakur	Balejapalle	MPT	78.4109	13.4416	NREGS

85	Chembakur	Chembakur	MPT	78.4033	13.4359	NREGS
86	Chembakur	Cherlapalle	MPT	78.4218	13.4503	NREGS
87	Chembakur	Dandavaripalle	MPT	78.4172	13.4542	NREGS
88	Chembakur	Dandavaripalle	MPT	78.4160	13.4535	NREGS
89	Chembakur	Dandavaripalle	MPT	78.4138	13.4484	NREGS
90	Chembakur	Diguvapalle	MPT	78.4256	13.4379	NREGS
91	Chembakur	Diguvapalle	MPT	78.4260	13.4433	NREGS
92	Chembakur	Mallaiahgaripalli	MPT	78.4055	13.4486	NREGS
93	Chembakur	Tekupalle	MPT	78.3959	13.4427	NREGS
94	Chembakur	Tekupalle	MPT	78.4006	13.4409	NREGS
95	Chembakur	Tekupalle	MPT	78.4051	13.4425	NREGS
96	Chembakur	Vodduvaripalle	MPT	78.4116	13.4536	NREGS
97	Arikala	Arikala	MPT	78.4881	13.4068	NREGS
98	Arikala	Arikala	MPT	78.4849	13.4048	NREGS
99	Arikala	Arikala	MPT	78.4825	13.4049	NREGS
100	Arikala	Gownvaripalle	MPT	78.4776	13.4138	NREGS
101	Kudurucheemanapalle	Kurapalle	MPT	78.5064	13.3467	IWMP
102	Chokkandlapalle	Bikkimvaripalle	MPT	78.4684	13.3198	IWMP
103	Moogavadi	Errapalle	MPT	78.4739	13.3346	IWMP
104	Ramasumudram	Ramasamudram	MPT	78.4081	13.3512	IWMP
105	Ramasumudram	Ramasamudram	MPT	78.4094	13.3522	IWMP
106	R.nadimpalle	R.Nadimpalle H.W	MPT	78.4041	13.3834	IWMP
107	Chembakur	Balejapalle	MPT	78.4109	13.4416	IWMP
108	Chembakur	Chembakur	MPT	78.4033	13.4359	IWMP
109	Chembakur	Cherlapalle	MPT	78.4218	13.4503	IWMP
110	Chembakur	Dandavaripalle	MPT	78.4172	13.4542	IWMP
111	Chembakur	Dandavaripalle	MPT	78.4160	13.4535	IWMP
112	Chembakur	Dandavaripalle	MPT	78.4138	13.4484	IWMP
113	Chembakur	Diguvapalle	MPT	78.4256	13.4379	IWMP
114	Chembakur	Diguvapalle	MPT	78.4260	13.4433	IWMP
115	Chembakur	Mallaiahgaripalli	MPT	78.4055	13.4486	IWMP
116	Chembakur	Tekupalle	MPT	78.3959	13.4427	IWMP
117	Chembakur	Tekupalle	MPT	78.4006	13.4409	IWMP
118	Chembakur	Tekupalle	MPT	78.4051	13.4425	IWMP
119	Chembakur	Vodduvaripalle	MPT	78.4116	13.4536	IWMP
120	Miniki	Budidapalle	PT	78.4810	13.3628	NREGS
121	Miniki	Budidapalle	PT	78.4844	13.3644	NREGS
122	Miniki	Miniki	PT	78.4776	13.3723	NREGS
123	Miniki	Panamareddipalle	PT	78.4768	13.3728	NREGS
124	Ragimakulapalle	Pedarajupalle	PT	78.4738	13.4023	NREGS
125	Ragimakulapalle	Ragimakulapalle	PT	78.4654	13.3927	NREGS
126	Ragimakulapalle	Ragimakulapalle	PT	78.4705	13.3872	NREGS
127	Ragimakulapalle	Sannipalle	PT	78.4819	13.3997	NREGS
128	Ragimakulapalle	Sannipalle	PT	78.4780	13.4007	NREGS

129	Kudurucheemanapalle	Kurapalle	PT	78.5112	13.3475	NREGS
130	Malentham	Chemperapalle	PT	78.5087	13.4063	NREGS
131	Malentham	Chemperapalle	PT	78.5085	13.4085	NREGS
132	Malentham	Errapasetipalle	PT	78.4856	13.3910	NREGS
133	Malentham	Errapasetipalle	PT	78.4983	13.3912	NREGS
134	Malentham	Malenatham	PT	78.5171	13.3929	NREGS
135	Malentham	Singamavaripalle	PT	78.5138	13.3929	NREGS
136	Malentham	Singamavaripalle	PT	78.5138	13.3929	NREGS
137	Malentham	Singamavaripalle	PT	78.5137	13.3925	NREGS
138	Moogavadi	Errapalle	PT	78.4726	13.3388	NREGS
139	Ramasumudram	Guntalapeta	PT	78.4334	13.3737	NREGS
140	Ramasumudram	Guntalapeta	PT	78.4309	13.3748	NREGS
141	Kaplle	Ajjamreddipalle	PT	78.4340	13.4428	NREGS
142	Kaplle	Ajjamreddipalle	PT	78.4385	13.4396	NREGS
143	Kaplle	Bapanavaripalle	PT	78.4240	13.4148	NREGS
144	Kaplle	Bapanavaripalle	PT	78.4241	13.4180	NREGS
145	Kaplle	Buragamaakulapalle	PT	78.4504	13.4440	NREGS
146	Kaplle	Buragamaakulapalle	PT	78.4502	13.4457	NREGS
147	Kaplle	Buragamaakulapalle	PT	78.4564	13.4431	NREGS
148	Kaplle	Byrajupalle	PT	78.4222	13.4239	NREGS
149	Kaplle	Pothurajupalle	PT	78.4304	13.4393	NREGS
150	Peddakurapalle	Manevaripalle	PT	78.4242	13.4053	NREGS
151	Peddakurapalle	Tallaripeddapalle	PT	78.4327	13.3877	NREGS
152	Peddakurapalle	Thirumalareddipalle	PT	78.4391	13.3848	NREGS
153	Peddakurapalle	Thirumalareddipalle	PT	78.4396	13.3837	NREGS
154	R.nadimpalle	Kondavarikothaindu	PT	78.3931	13.4007	NREGS
155	R.nadimpalle	R.Nadimpalle	PT	78.3956	13.3830	NREGS
156	Arikala	Goduvaripalle	PT	78.4663	13.4087	NREGS
157	Arikala	Goduvaripalle	PT	78.4686	13.4097	NREGS
158	Arikala	Goduvaripalle	PT	78.4725	13.4109	NREGS
159	Arikala	Goduvaripalle	PT	78.4809	13.4061	NREGS
160	Arikala	Gollapalle	PT	78.4867	13.4338	NREGS
161	Arikala	Gollapalle	PT	78.4873	13.4332	NREGS
162	Arikala	Gollapalle	PT	78.4895	13.4316	NREGS
163	Arikala	Gollapalle	PT	78.4883	13.4358	NREGS
164	Arikala	Gollapalle	PT	78.4910	13.4347	NREGS
165	Arikala	Gollapalle	PT	78.4947	13.4295	NREGS
166	Arikala	Gownivaripalle	PT	78.4782	13.4200	NREGS
167	Arikala	Gownivaripalle	PT	78.4822	13.4124	NREGS
168	Arikala	Gownivaripalle	PT	78.4745	13.4176	NREGS
169	Arikala	Gownivaripalle	PT	78.4663	13.4146	NREGS
170	Arikala	Gownivaripalle	PT	78.4676	13.4163	NREGS
171	Arikala	Manevaripalle	PT	78.4974	13.4370	NREGS
172	Arikala	Manevaripalle	PT	78.4978	13.4366	NREGS

173	Kuduru cheemanapalle	Kurapalle	PT	78.5112	13.3475	IWMP
174	Moogavadi	Errapalle	PT	78.4726	13.3388	IWMP
175	Kaplle	Bapanavaripalle	PT	78.4240	13.4148	IWMP
176	Kaplle	Bapanavaripalle	PT	78.4241	13.4180	IWMP
177	Kaplle	Byrajupalle	PT	78.4222	13.4239	IWMP
178	Kaplle	Pothurajupalle	PT	78.4304	13.4393	IWMP
179	Peddakurapalle	Manevaripalle	PT	78.4242	13.4053	IWMP
180	Peddakurapalle	Tallaripeddapalle	PT	78.4327	13.3877	IWMP
181	Peddakurapalle	Thirumalareddipalle	PT	78.4391	13.3848	IWMP
182	Peddakurapalle	Thirumalareddipalle	PT	78.4396	13.3837	IWMP
183	R.nadimpalle	Kondavarikothaindu	PT	78.3931	13.4007	IWMP
184	R.nadimpalle	R.Nadimpalle	PT	78.3956	13.3830	IWMP

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

S.No.	Mandal	Lattitude	Longitude	Structure_Type
1	Ramasamudram	13.4087	78.3914	Percolation Tank
2	Ramasamudram	13.4171	78.3880	Percolation Tank
3	Ramasamudram	13.4462	78.3825	Percolation Tank
4	Ramasamudram	13.3655	78.4355	Percolation Tank
5	Ramasamudram	13.3997	78.4323	Percolation Tank
6	Ramasamudram	13.4061	78.4329	Percolation Tank
7	Ramasamudram	13.4084	78.4464	Percolation Tank
8	Ramasamudram	13.4117	78.4580	Percolation Tank
9	Ramasamudram	13.4386	78.4545	Percolation Tank
10	Ramasamudram	13.3538	78.4876	Percolation Tank
11	Ramasamudram	13.3638	78.5153	Percolation Tank
12	Ramasamudram	13.3588	78.4968	Percolation Tank
13	Ramasamudram	13.4288	78.4735	Percolation Tank
14	Ramasamudram	13.4204	78.4266	Percolation Tank
15	Ramasamudram	13.4252	78.4384	Percolation Tank
16	Ramasamudram	13.4140	78.4364	Percolation Tank
17	Ramasamudram	13.3952	78.4050	Percolation Tank
18	Ramasamudram	13.3521	78.4309	Percolation Tank
19	Ramasamudram	13.3652	78.4554	Percolation Tank
20	Ramasamudram	13.4445	78.4781	Percolation Tank

Fig.1

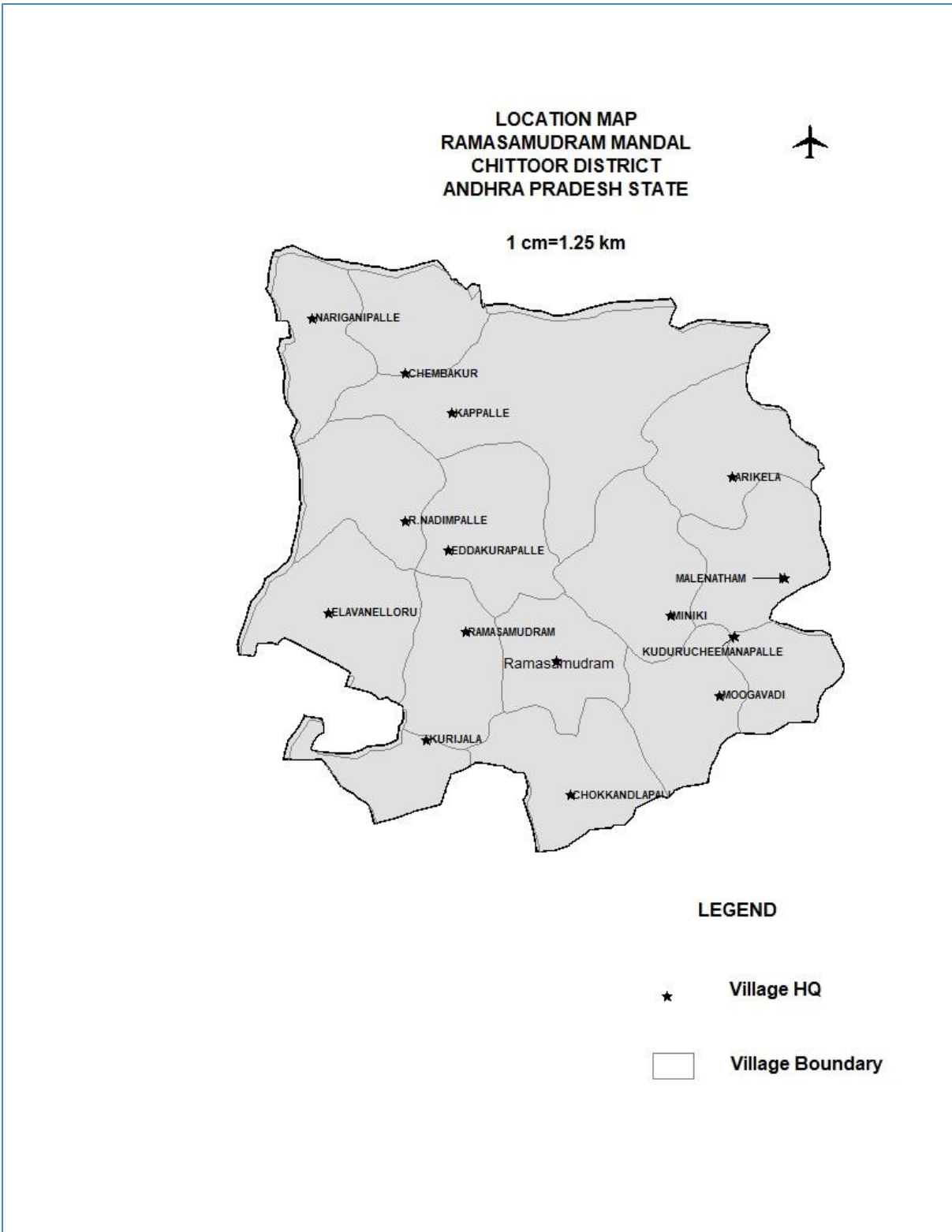


Fig.2

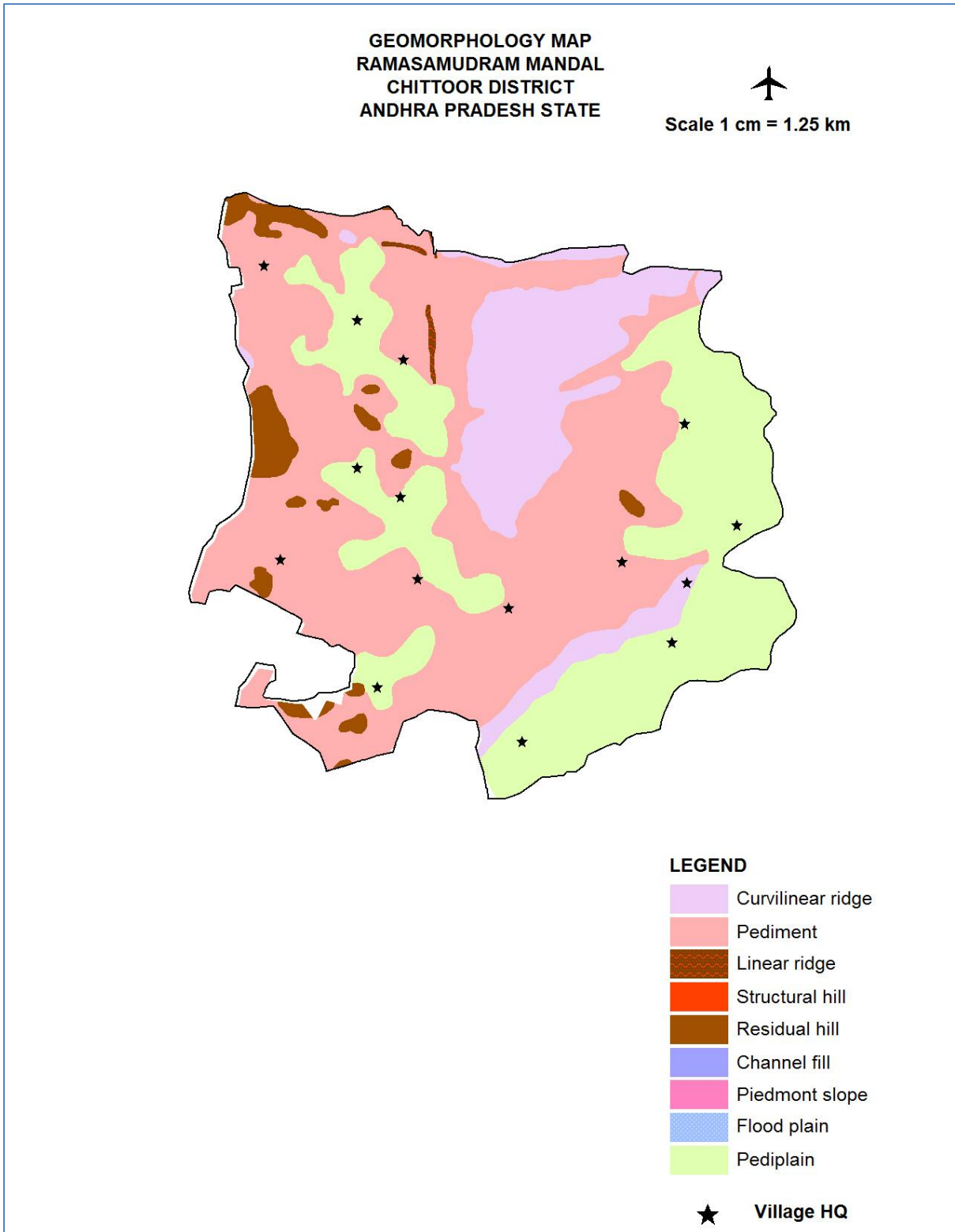


Fig.3

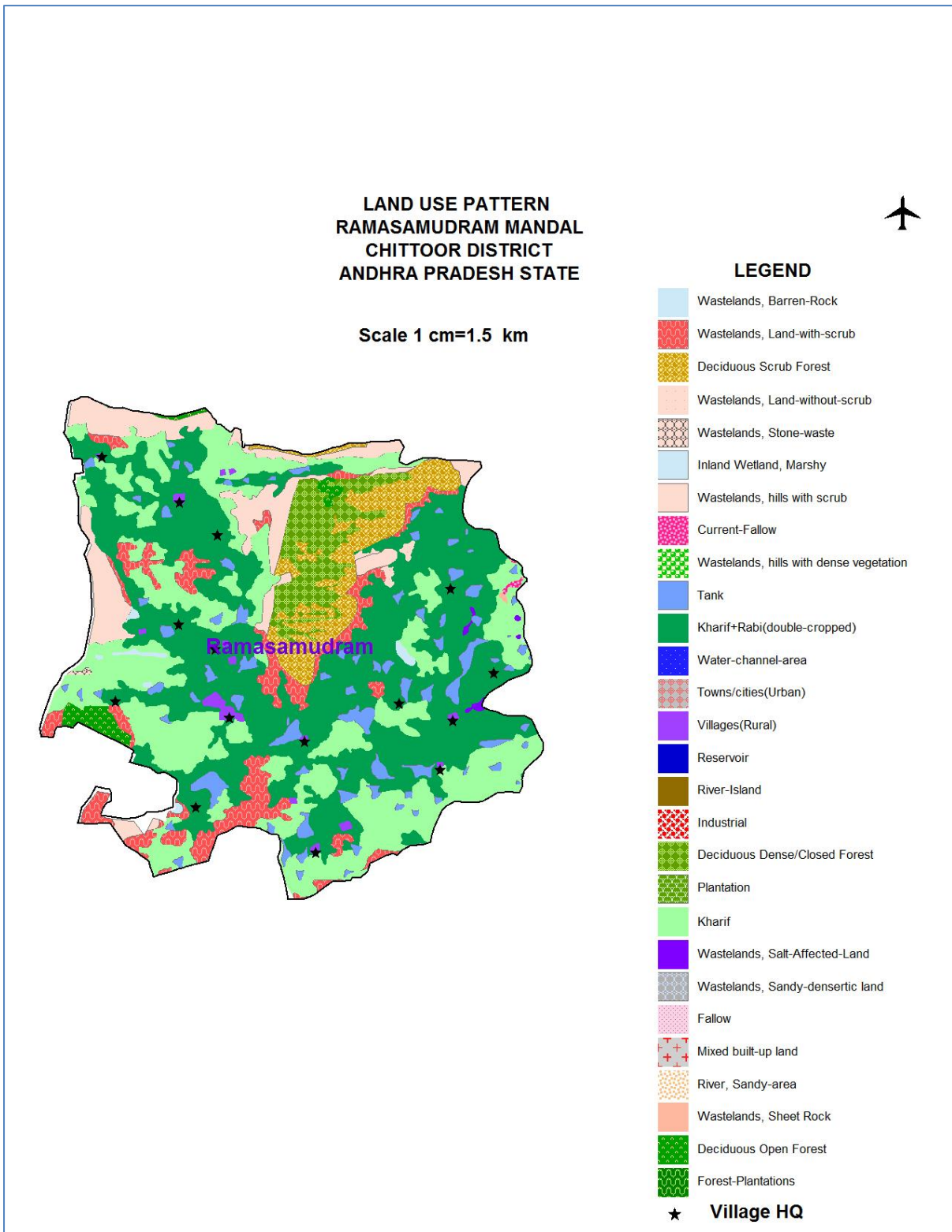


Fig.4

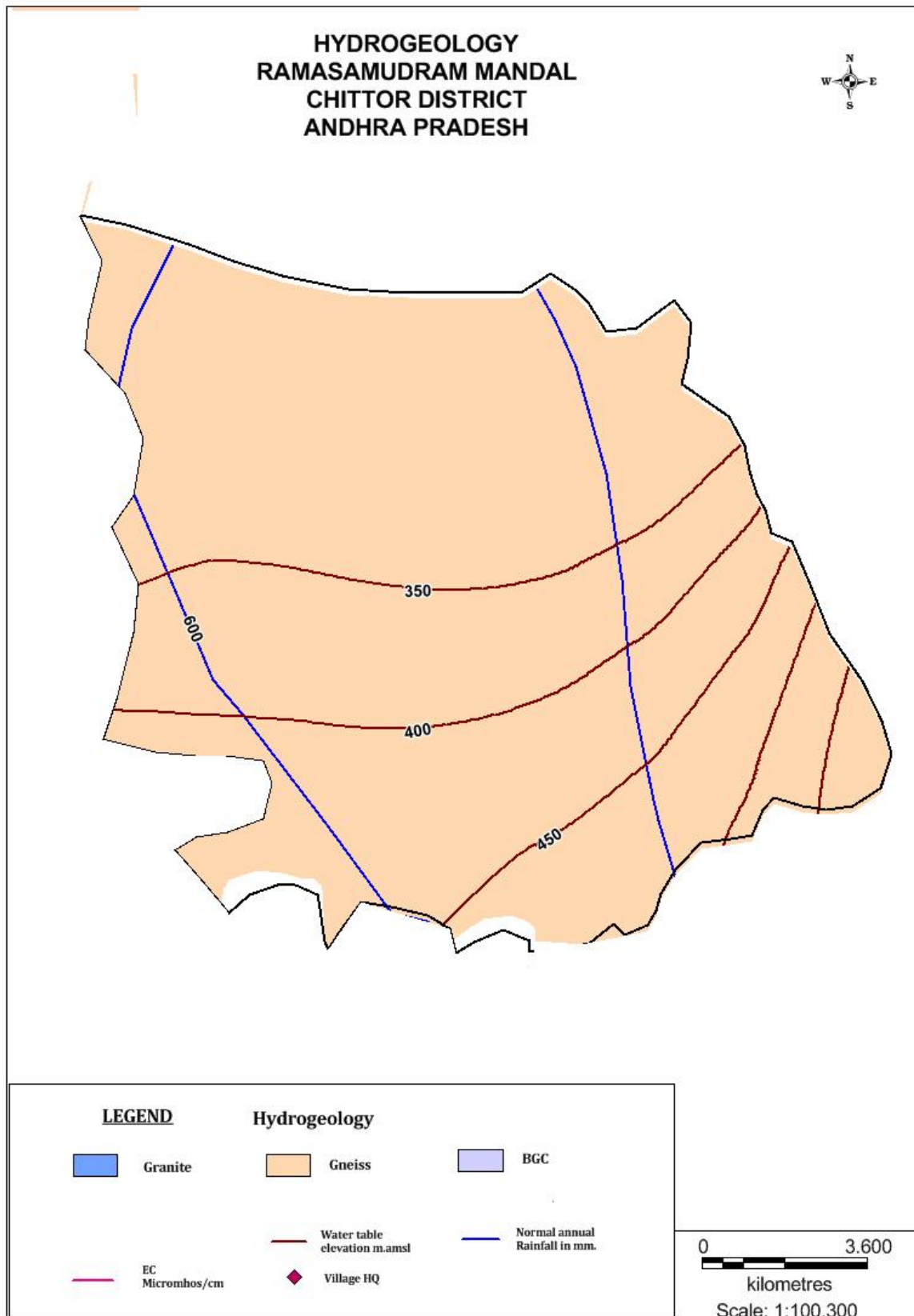


Fig.5

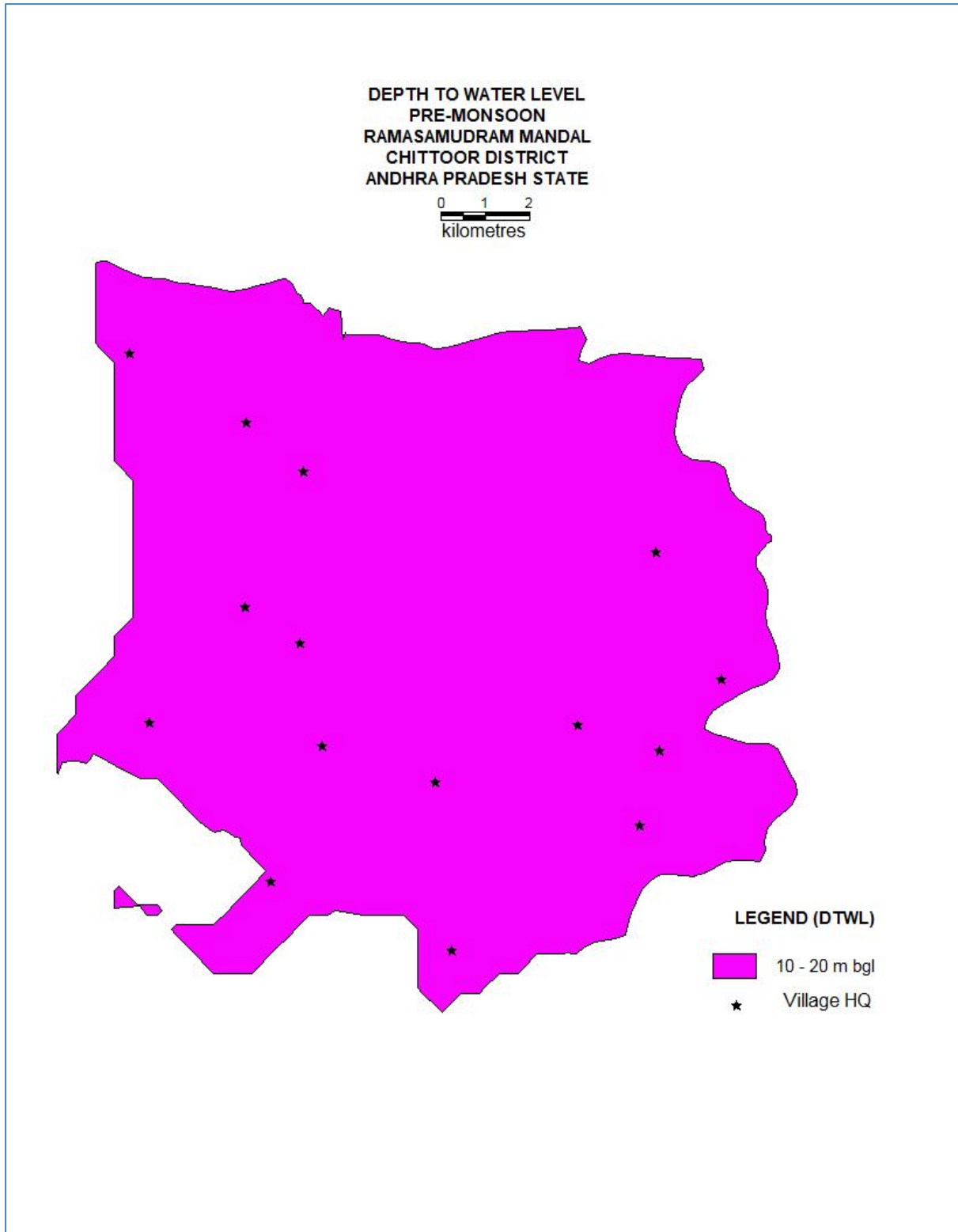


Fig.6

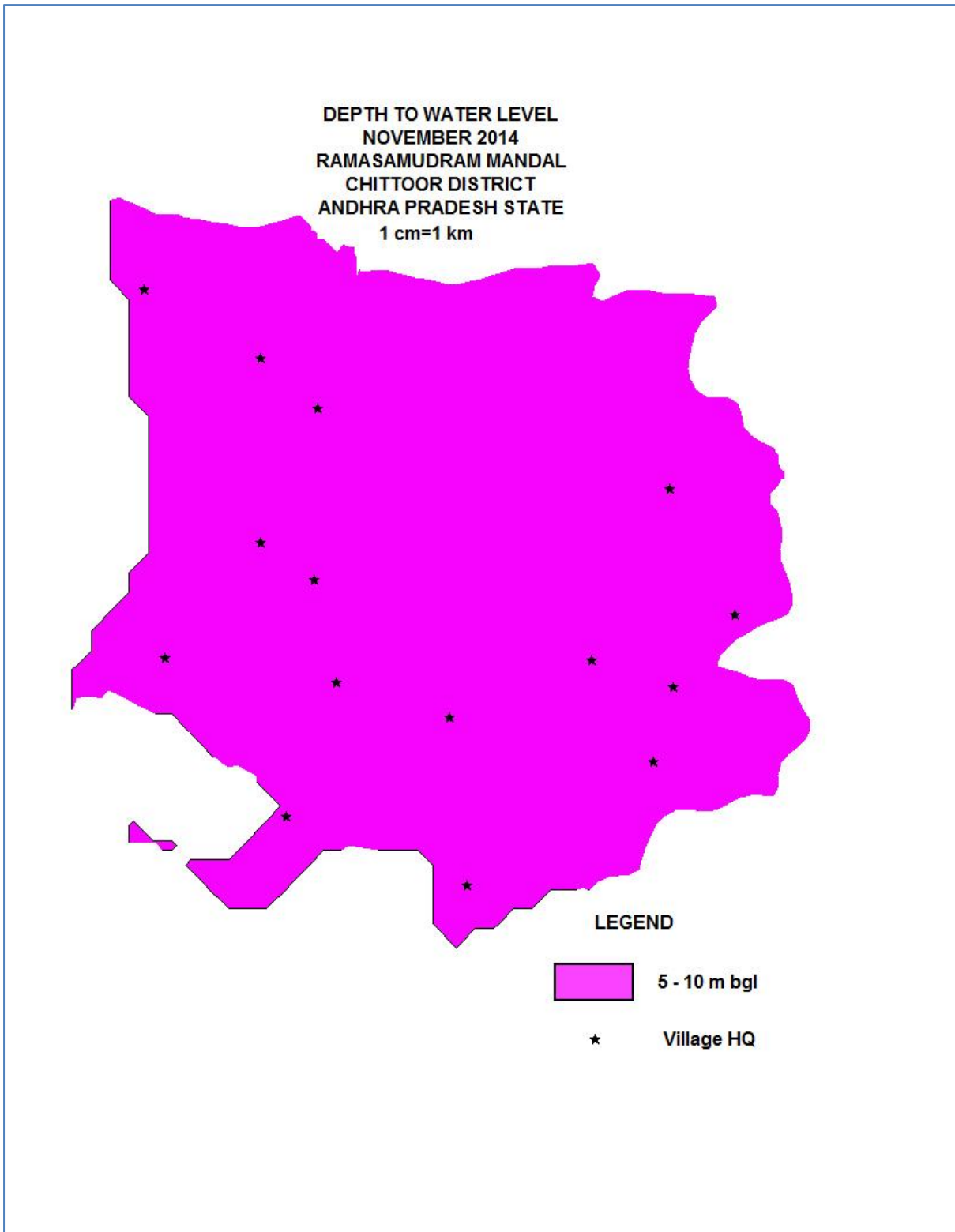


Fig.7

