



## केंद्रीय भूमि जल बोर्ड

जल संसाधन, नदी विकास और गंगा संरक्षण

विभाग, जल शक्ति मंत्रालय

भारत सरकार

### **Central Ground Water Board**

Department of Water Resources, River  
Development and Ganga Rejuvenation,

Ministry of Jal Shakti

Government of India

## **AQUIFER MAPPING AND MANAGEMENT OF GROUND WATER RESOURCES**

**TIRUPATI DISTRICT, ANDHRA PRADESH**

दक्षिणी क्षेत्र, हैदराबाद

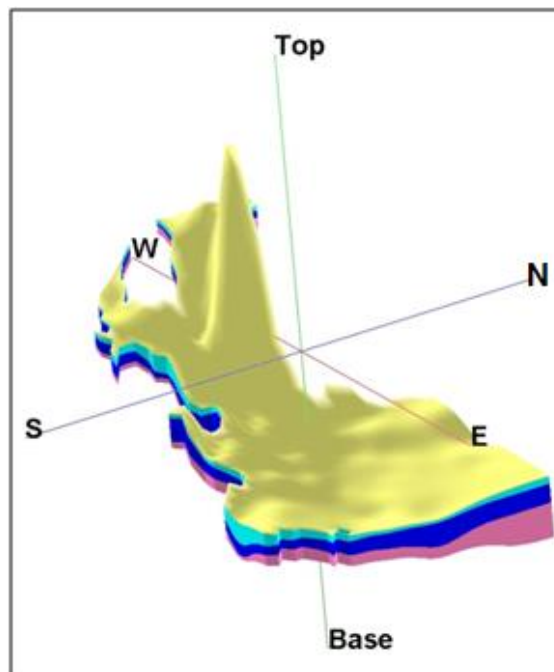
Southern Region, Hyderabad



## CENTRAL GROUND WATER BOARD

DEPARTMENT OF WATER RESOURCES, RIVER DEVELOPMENT AND GANGA REJUVENATION  
MINISTRY OF JAL SHAKTI  
GOVERNMENT OF INDIA

### REPORT ON AQUIFER MAPPING AND MANAGEMENT PLAN OF TIRUPATI DISTRICT, ANDHRA PRADESH



Central Ground Water Board  
Southern Region  
Hyderabad  
January 2023

## CONTENT

Tirupati District at a Glance.....	5
Executive Summary .....	8
1. INTRODUCTION .....	11
1.1 Objectives.....	11
1.2 Scope of study .....	12
1.3 Study Area.....	12
1.4 Climate and Rainfall.....	14
1.5 Geomorphology.....	15
1.6 Drainage and Structures: .....	16
1.7 Land use and cropping pattern .....	16
1.8 Soils.....	18
1.9 Irrigation.....	18
1.10 Prevailing water conservation/Recharge practices.....	19
1.11 Geology .....	20
2 DATA COLLECTION AND GENERATION.....	21
2.1 Hydrogeological Studies .....	23
2.2 Ground water occurrences and movement .....	23
2.3 Ground water Exploration.....	24
2.4 Depth to Water levels .....	24
2.5 Pre-monsoon water level (June 2022).....	25
2.6 Post-monsoon season .....	26
2.7 Water Level Fluctuations (May 2022 vs. December 2022) .....	27
2.8 Long term water level trend .....	28
2.9 Water Table Elevation.....	30
2.10 Geophysical Studies .....	31
2.11 Hydro-chemical Studies .....	31
2.12 pH and Electrical conductivity.....	31
2.13 Nitrate.....	32
2.14 Total Hardness.....	33
2.15 Piper diagram .....	33
2.16 Quality of Ground Water for Irrigation (USSL) .....	35
2.17 Fluoride .....	35

2.18	Uranium.....	36
3	DATA INTERPRETATION, INTEGRATION and AQUIFER MAPPING.....	38
3.1	Conceptualization of aquifer system in 3D.....	39
3.2	Hydrogeological Sections.....	39
3.3	North-South Section.....	39
3.4	West-East Section.....	40
3.5	Aquifer Characterization.....	40
4	GROUND WATER RESOURCES (2022).....	42
5	GROUND WATER RELATED ISSUES.....	46
5.1	Declining of water level.....	46
5.2	Geo-genic pollution (Fluoride).....	46
5.3	Anthropogenic pollution (Nitrate).....	47
6	MANAGEMENT STRATEGIES.....	47
6.1	Management plan.....	47
6.2	Supply side measures.....	48
6.3	Demand side measures.....	49
7	Outcome of NAQUIM.....	49
	Acknowledgment.....	50
	References:.....	50

### List of Figures

Figure 1	Location map of Tirupati district.....	13
Figure. 2	Isohyetal map of Tirupati district.....	14
Figure 3.	Geomorphology map of Tirupati district.....	15
Figure 4.	Drainage map of Tirupati.....	16
Figure 5.	Land use and land cover of Tirupati district.....	17
Figure 6	Soil map of Tirupati district.....	18
Figure 7	Details of irrigation projects, Tirupati district.....	19
Figure 8	Geology of Tirupati district.....	21
Figure 9.	Hydrogeological map of Tirupati district.....	24
Figure 10	Depth to water level, Pre-monsoon (May-2022).....	25
Figure 11	Depth to water level Post-monsoon (December -2022).....	26
Figure 12	Water Level Fluctuation (in m) (December-22 vs. May-2022).....	27
Figure 13	Long-term water level trends, Pre-monsoon (2011-2020).....	28
Figure 14	Long-term water level trends (Post-monsoon-2006-2015).....	29
Figure 15	Water Table Elevation Map.....	30
Figure 16	Distribution of Electrical conductivity (Pre-monsoon-2022).....	32

Figure 17 Distribution of Nitrate (Pre-monsoon-2022) .....	33
Figure 18.HillPiperDiagramrepresentingclassificationofwatersamplescollectedfrom Key wells ..	34
Figure 19 US Salinity Diagram of Tirupati District .....	35
Figure 20. Distribution of Fluoride (Pre-monsoon-2022).....	36
Figure 21. Distribution of Uranium (Pre-monsoon-2022).....	37
Figure 22.Aquiferdispositionin3-D Model, Tirupati district. ....	38
Figure 23.2 D Model of N-S cross Section.....	39
Figure 24.2 D Model of W-E cross Section.....	40
Figure 25.Thickness of weathered zone, Tirupati district.....	41
Figure 26. Depth of fractured zone (Maximum depth in 171 mbgl), Tirupati district. ....	42
Figure 27.Stage of Ground water Development in Tirupati district .....	46
Figure 28.Proposed artificial recharge structure Location.....	48

### List of Table

Table 1: Salient Features of Irrigation by different source during2019-20(Ha).....	19
Table 2 Data compilation and generations.....	21
Table 3 Data Used For Preparation of Various Maps/Figs-Tirupati District, Andhra Pradesh.....	22
Table 4: Ground Water Resources of Tirupati district (GWRA 2022).....	43

### Annexure

Annexure I Mandal Wise Drinking Water Facilities in Villages, 2019-20 .....	50
Annexure II Source wise Irrigation in Tirupati District.....	52
Annexure III Source wise, Mandal wise NET area Irrigated In hectare.....	53
Annexure IV Combined Water level data of Key wells and NHS .....	54
Annexure V Details of Exploratory wells (in house) in Tirupati District.....	57
Annexure VI Interpreted Results of VES in Tirupati District .....	58
Annexure VII Key wells samples rresults of Chemical Analysis Data of Tirupati district.....	60
Annexure VIII Tentative location details of Artificial Recharge Structure to be constructed .....	64

### Field Photos

Filed Photos 1 paddy a major crops cultivated around 79 % of total area of the district .....	84
Filed Photos 2 Sand dunes are converted as cultivated land, large scale of Ground nuts cultivated around Kothapatnam, Kota Mandal .....	85
Filed Photos 3 Canal irrigation practices most of the area .....	85
Filed Photos 4 Large Diameter dug wells used for Irrigation purposes .....	86
Filed Photos 5 Bore well / Tube wells are common irrigation practices in most of the mandals..	86
Filed Photos 6 Around Hundred years old dug well being used in Venad Island (Tada Mandal) .	87

## TIRUPATI DISTRICT AT A GLANCE

S. No	Item	Particulars
1	District	Tirupati
2	Revenue Divisions/Mandals	4/34
3	Villages	1107
4	Geographical area	8229Km <sup>2</sup>
5	Population(2011Census)	21.97lakhs
6	Density of population (2011Census)	267persons/Km <sup>2</sup>
7	Growth rate	13.36%
8	Locations	NorthLatitude13°21'54"-14°08'32" EastLongitude79°05'42"-80°04'10"
9	Annual Normal rainfall	1124.40 mm
10	Geomorphology	Pedi plain (80%), hills (5%), Pediments (5%), Beach ridges (3%) and others etc.
11	Major River	Swarnamukhi River
12	Land Utilization (Ha)(2019-20)	Forest: 271318 Net Area Shown: 163724 Area sown more than once: 17289Land put to non- agricultural use: 181459
13	The Gross cropped area(Ha)2019-20	Paddy: 104669 Groundnut: 10278 Sugarcane: 2777
14	Soils	Red loamy soils: 57%Redsandy: 34%9%blacksoils.
15	Irrigation	<b>Major Irrigation Projects:</b> (1)Telugu Ganga with a projected ayacut of 37,983 acres (2) S.S. Canal with Projected ayacut of 48,840 acres <b>Medium/Minor:</b> 05 (Swarnamukhi Anicut, Araniyar, Mallimadugu, Kalangi and Siddalagandi) <b>MI Tanks:</b> 2,638 with a total ayacut of1,09,646Hectaresduring 2019-20
16	Prevailing water conservation/Recharge practices	Farm Ponds :35713 Check Dams : 1419 Percolation Tanks : 541 Others: 24270
17	Geology	Banded Gneiss, Schist, Quartzite, Shale, Laterite, Sand stone and Alluvium etc

S. No	Item	Particulars
18	Exploratory Drilling (CGWB and SGWD)	CGWB: 17 wells and SGWD: 25 Nos
19	Number of ground water structures	Agriculturalborewells:56,669nos
20	Ground water yield (lps)	0.216-17
21	Depth to water levels (mbgl) (2022)	Pre-monsoon:0.27-8.39 Post-monsoon: -0.8-8.1
22	Water Level Fluctuations (May vs December 2022)	-1 to 5.43 m
23	Long term water level trends (2011-2020)(79 CGWB and SGWD Wells)	Pre-monsoon: Falling:59wellsMinimum: 0.003536 Maximum :2.209657 Average : 0.544086 Rising:20wells Minimum: 0.00806 Maximum:1.4674 Average:0.47042 Post-monsoon: Falling:38wells Minimum: 0.005485 Maximum : 1.644619 Average:0.344026 Rising:41 wells Minimum: 0.02643 Maximum :1.2928 Average : 0.34801
24	Geophysical data	56no's(VES) Weathered BGC:<100ohm( $\Omega$ )m,fracturedBGC:70-150 $\Omega$ mandMassiveBGC:>400 $\Omega$ m
25	Hydrochemistry	Total Number of samples : 76
25.1	Electrical Conductivity ( $\mu$ Siemens/cm)	65to5410
25.2	Nitrate mg/l	0 to 225.8
25.3	Fluoride mg/l	0.04 to 2.69
25.4	Uranium ppb	0.3 to 576

<b>S. No</b>	<b>Item</b>	<b>Particulars</b>	
<b>26</b>	<b>Details of Aquifer</b>		
26.1	Conceptualization	<b>Weathered zone</b>	<b>Fractured zone</b>
26.2	Aquifer Characterization	3.3 to 55 m (Annually) Average: 16 m	18-171 m but 90% fractures occur within 100m depth.
26.3	Groundwater yield	Average: 1.0lps	0.1-17lps
26.4	Transmissivity(m <sup>2</sup> /day)	01 to 5m <sup>2</sup> /day	01 to 54.83 m <sup>2</sup> /day
26.5	Specific Yield	1 to 3%	-
26.6	Storability	-	1.0x10 <sup>-4</sup> to 5.9x10 <sup>-4</sup>
<b>27</b>	<b>Ground water Resources(2022)MCM</b>		
27.1	Annual Extractable Ground Water Resource (Ham)	163890.4	
27.2	Total Extraction (Ham)	45010.85	
27.3	Annual GW Allocation for Domestic Use as on 2025 (Ham)	8649.07	
27.4	Net Ground Water Availability for future use (Ham)	118479	
27.5	Stage of Ground Water Extraction (%)	18.629	
27.6	Categorization of mandals	All the mandals are in safe category.	



## EXECUTIVE SUMMARY

Tirupati district is covering an area of 8229 Km<sup>2</sup> and it has four revenue divisions, namely Gudur, Srikalahasti, Sullurupeta and Tirupati. Tirupati is the administrative headquarters of the district. These revenue divisions are divided into 34 mandals and Tirupati is only one municipal corporation. The average annual rainfall of the district is 1124.40 mm of which, 37 % is contributed by South-West monsoon and 55 % by North-East monsoon. The North-East monsoon is more copious compared to the South-West Monsoon in the district. The population of the district is 21.97lakhs (2011 census) and showing 13.36% growth rate compare to previous census.

Pedi plains are the major Geomorphological features in the district and covering an area of around 50%, followed by denudational hills 15 %, pediments 10% and Beach ridges along the coastal area covering around 10%. Swarnamukhi is important river originates in Eastern Ghats and flows in NE direction and other rivers are Kushastali and Kalyani. The rivers flowing in the district are non-perennial in nature. Five medium/ minor Irrigation projects completed namely Swarnamukhi Anicut, Araniyar, Mallimadugu, Kalangi and Siddalagandi and 2638 Minor Irrigation tanks with total ayacut of 1,09,646Hectares during 2019-20. Telugu Ganga with an ayacut of 37,983 acres and S.S. Canal with Projected ayacut of 48,840 acres using for irrigation purposes.

The gross irrigated area during 2019-20 is 143863 ha. Ground water contributes 95 % of the net irrigated area and surface water contributes 5 %. There are 35713 farm ponds, 541 percolation tanks 1419Check dams and other structure are 24270 numbers of structures constructed to recharge the ground water by the state water resource department. The soils are mainly red loamy soils57% , red sandy soil is covering around 34% and black soils (9%). The rest of the area covered by Black Clay (3%), Black Loamy (2%), Black Sandy (1%) and Red Clay (3%).

Forests occupy 33 % of the total area, total cropped area of the district is 22% ha and net area shown is 22 % of total area. The major crops grown are Paddy104669 (57%) ground nut 12785Hec (7%) sugarcane 3580 (2%) and vegetables and pulses contributing around 6 %.

Total 42 Exploratory bore wells (CGWB and SGWD) have been analysed and interpreted to know the Lithological variation, depth of weathering, fractured depth and hydrogeological data interpretation. Based, on this data the thickness of weathering varies from 3.3 to 55 mbgl and most of the potential fractured encountered within 100 mbgl. The Transmissivity are varies from

01 to 5 m<sup>2</sup>/day at weathered zone and 01 to 54.83 m<sup>2</sup>/day at fractured zone and Storativity values are  $1.0 \times 10^{-4}$  to  $5.9 \times 10^{-4}$ .

Water levels are monitored through 98 wells including key wells during pre-monsoon and post-monsoon season of 2022. The Depth to water level varies from 0.27 to 8.39 m and during the post monsoon season varies between 0.8 to 8.10 mbgl. Water level fluctuation analysed between May 2022 to December 2022 ranges from -1 to 5.43 mbgl. Long-term water levels trends from 79 wells shows a falling trend in 59 wells (minimum 0.003536 maximum 2.2096 at an average of 0.544 m/yr) and 20 wells shows rising trend (minimum -0.008 maximum 1.467 at an average of 0.470 m/yr). During post-monsoon season 38 shows falling trend (between 0.005 to 1.644 an average of 0.344 m / year) whereas 41 wells show rising trend in between 0.026 to 1.292 an average of 0.348 m/year. Total 56 numbers of resistivity data have been analyzed and it is observed that the weathered granite shows < 100 ohm m and fractured shows the resistivity values between 70 to 150. The massive hard rock formation having resistivity values are >400-ohm m.

Total 76 ground water samples have been collected during the pre-monsoon period and were analyzed to know the quality of ground for various uses. Electrical Conductivity is range between 65 to 5410  $\mu$  Siemens/cm The Nitrate concentration ranges from 0 to 225.8 mg/l whereas the fluoride ranges from 0.04 to 2.69 mg/l. The uranium sample shows that it ranges from 0.3 to 576 ppb.

Based on the available hydrogeological data aquifers are classified and conceptualized as 1) Top weathered zone (55 m) and 2) fractured zone (18-171m). The average yield of this zone is 1.1 lps and T in the range of 2 to 20 m<sup>2</sup>/day. Depth of fracture varies from 18 to 171 m and 95 % of fractures occur within 100m depth. Groundwater yield from fractured zone varies from 0.216 to 17 lps. The hydraulic properties of weathered and fractured zone like Transmissivity (T) and Storativity (S) varies from 01 to 54.83 m<sup>2</sup>/day and  $1.0 \times 10^{-4}$  to  $5.9 \times 10^{-4}$  respectively.

The Ground water estimation was carried out during year 2022; it is observed that Annual Extractable Ground Water Resource is 163890 Ham and Total present Extraction is 45010.85. Annual GW Allocation for Domestic Use as on 2025 is 8649.07 Ham and Net Ground Water Availability for future use 118479 Ham. The stage of ground water development varies from 09 to 66 % (average: 18.629 %).

Major issues observed in the district is most of the area shows Low yields during the drilling of bore wells due to massive hard rock and lack of fracture, declining of water levels and Ground water pollution both anthropogenic mostly Nitrate and geogenic is Fluoride.

Though all the mandals categories as safe categories the management strategies are inevitable this replenishable resource for future developments. The management strategies mainly include both supply side and demand side. The supply side measure includes the state water resources department carried out construction of different recharge structures includes de-silting of available minor irrigation tanks .In addition to above as per our GEC recommendations Additional Irrigation Potential Likely to be created 7307.93(ha) by constructing 683 Check Dams and 46 Percolation at cost of 2397.93 lakhs. The demand side management is GW Resource available for development up to 60 % of stage of ground water extraction (Ham) from all the mandals except Pakala mandal is 53497 (Ham). To develop this much of ground water total 54582 of dug wells and 25325 bore wells feasible can be constructed.

## **1. INTRODUCTION**

Ground water is of paramount importance for drinking, domestic, agriculture and industrial purposes. As large parts of India particularly hard rock's terrain have become water stressed due to rapid growth in demand for water due to growth of population, demand for irrigation, rapid urbanization and changing life style. Therefore, in order to have an accurate and comprehensive micro-level estimation of ground water in India, the aquifer mapping in different hydrogeological settings at the appropriate scale is devised and implemented to enable robust groundwater management plans. This will help in achieving drinking water security, improved irrigation facility and sustainability in water resources development in large parts of rural and urban India. The aquifer mapping program is important for planning suitable adaptation strategies to solve the water shortage.

In hard rock's terrain due to lack of primary porosity, the groundwater occurrence is limited to secondary porosity which is developed by weathering and fracturing. Weathered zone is the potential recharge zone for shallow and deeper fractures and excessive withdrawal from this zone leads to drying up in places and reducing the sustainability of structures. Besides these, groundwater quality also represents major challenges which are threatened by both geogenic and anthropogenic pollution. In some places, the aquifers have high level of geogenic contaminants, such as fluoride and arsenic rendering them unsuitable for drinking purpose. High utilization of fertilizers for agricultural production and improper development of sewage system in rural and urban areas leads to point source of pollution viz nitrate and chloride.

### **1.1 Objectives**

The foremost objective of the Aquifer Mapping can be specified as "Know your Aquifer, Manage your Aquifer". Systematic mapping of an aquifer incorporates activities such as collection, generation and compilation of available information on aquifer systems, demarcation of their location, extents and their characterization, analysis of data gaps, generation of additional data for filling the identified data gaps and finally preparation of aquifer maps at the desired scale. The two major objectives of the aquifer mapping is the delineation of lateral and vertical disposition of aquifers and their characterization on 1: 50,000 scale in general and further detailing up to 1: 10,000 scale in identified priority areas and the quantification of ground water availability and assessment of its quality to formulate aquifer management plans to facilitate sustainable management of ground water resources at appropriate scales through participatory management approach with active involvement of stakeholders.

## 1.2 Scope of study

The main scope of study is summarized below.

1. Compilation and interpretation of existing available data (via. Exploration, geophysical, water level and water quality with geo-referencing information and identification of principal aquifer units.
2. Long term and dynamic ground water regime monitoring (for water levels and water quality) for creation of time series data base and groundwater source estimation.
3. Quantification of ground water availability and assessing its quality.
4. To delineate aquifer in 3-D along with their characterization on 1:50,000 scale.
5. Capacity building in all aspects of ground water development and management through information, education and communication (IEC) activities, through information dissemination, education, awareness and training.
6. Enhancement of coordination with concerned central/state govt. organizations and academic/research institutions for sustainable ground water management.

## 1.3 Study Area

Tirupati Balaji district derives its name from Lord Sri Venkateswara Swamy of Tirumala Hills and covers an area of 8229 sq.km. Tirupati is headquarters of the district and it is one of the eight districts in the Rayalaseema region of the Andhra Pradesh state. The district is located between the Northern Latitudes of 13°21'54" and 14°30'40" and 14°08'32" and between the Eastern Longitudes 79°05'42" and 80°04'10" and surrounded by Nellore district in the North, Chittoor and Annamayya districts in the west Chittoor and Tiruvallur district of Tamil Nadu in the south and Bay of Bengal in the East.

Tirupati district has four revenue divisions, namely Gudur, Srikalahasti, Sullurupeta and Tirupati and it has 34 mandals. Tirupati city is the only municipal corporation. The district also comprises five municipalities namely, Srikalahasti, Gudur, Sullurpeta, Puttur and Venkatagiri as well as one nagar panchayat at Naidupeta. Tirupati district also comprises 822 Gram Panchayats and 1107 villages.

National highway 716 connecting Chennai, Tamil Nadu and Kadapa, Andhra Pradesh passes through Tirupati district, which is a part of golden quadrilateral that connects Kolkata-Chennai passes through Sullurpeta and Gudur towns in the district. Location map of Tirupati district is given in Fig.1

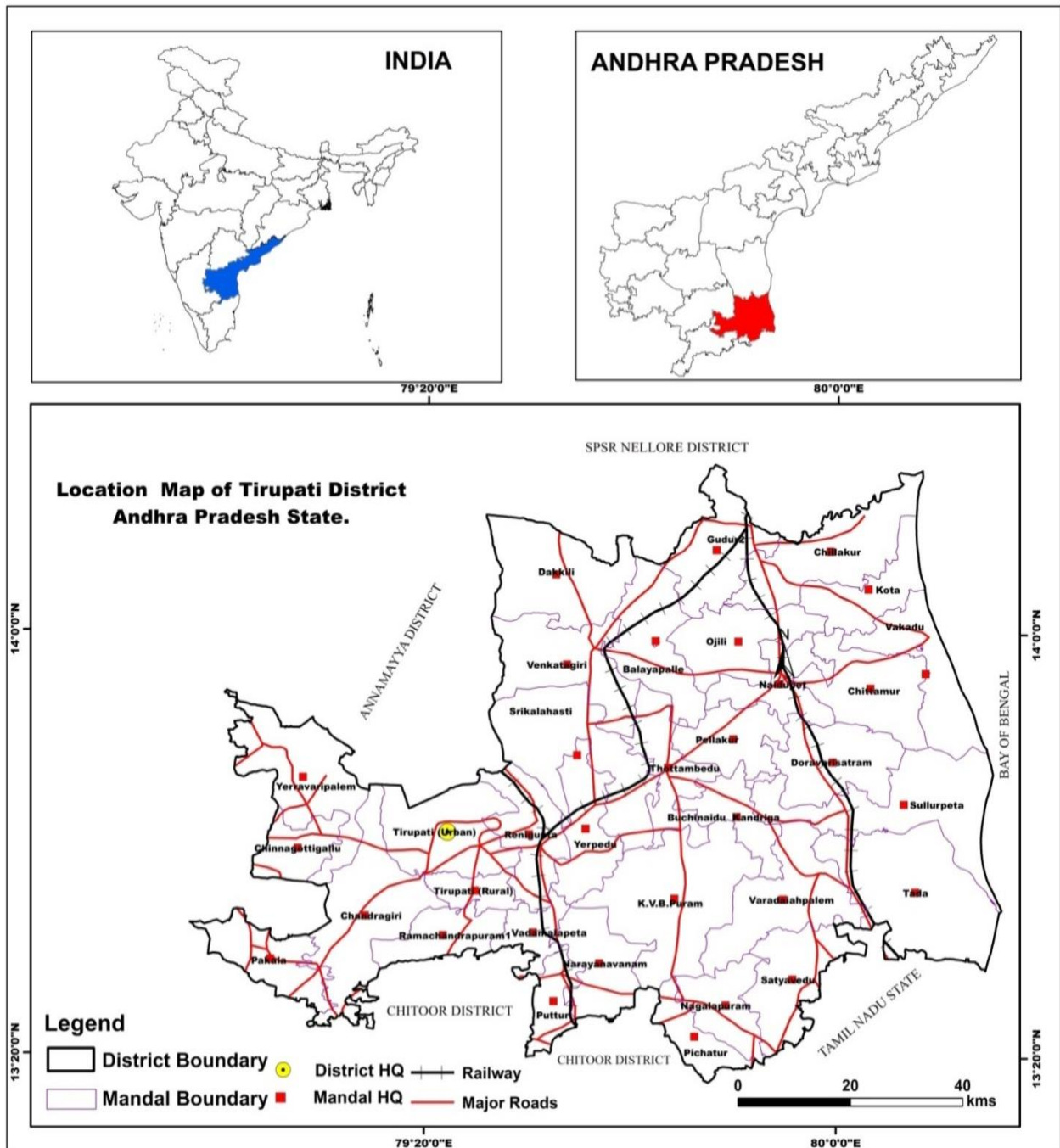


Figure 1 Location map of Tirupati district

## 1.4 Climate and Rainfall

A tropical wet and dry climate prevails in Tirupati district. In winter the minimum temperatures are between 18° and 20 °C the summer extends from March to June and the temperature ranges from 40°C to 26.6°C. The hottest month is May with temperature of 38.3°C. The coldest month of the year in Tirupati is December, with an average low of 17.7°C and high of 28.8°C. The relative humidity ranges from 37 % (May) to 69 % (November). The district experiences heavy rainfall in the month of November during the North- East monsoon season. The area receives an average annual normal rainfall of 1124.40 mm of which 37 % is contributed by South-West monsoon and 55 % by North-East monsoon. The North-East Monsoon is more copious compared to the South-West Monsoon in the district. The rainfall pattern of the area changes from east to west where the rainfall gradually decreases towards western side of the study area. Further it is observed that the rain fall drastically decreases in the south western part of district. The isohyetal map of the district is presented in Fig. 2.

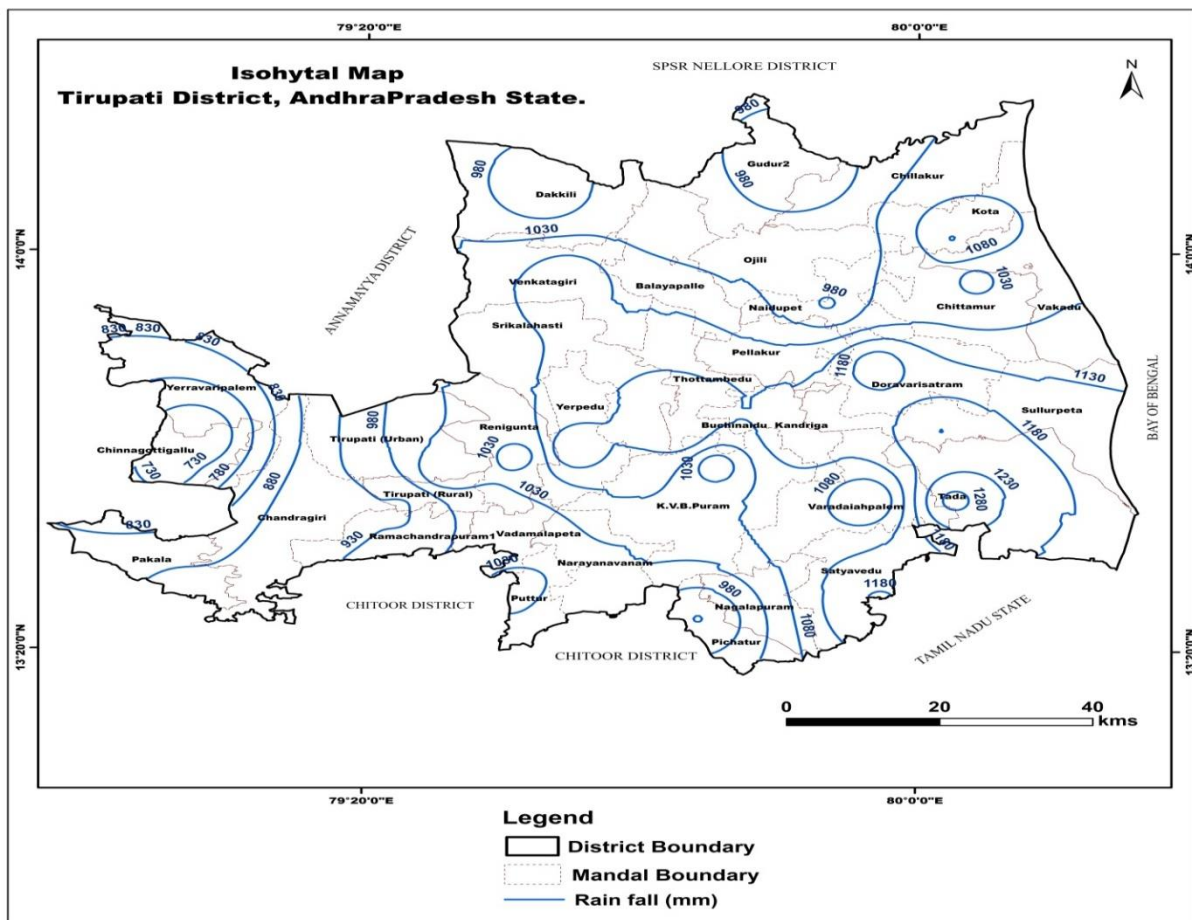
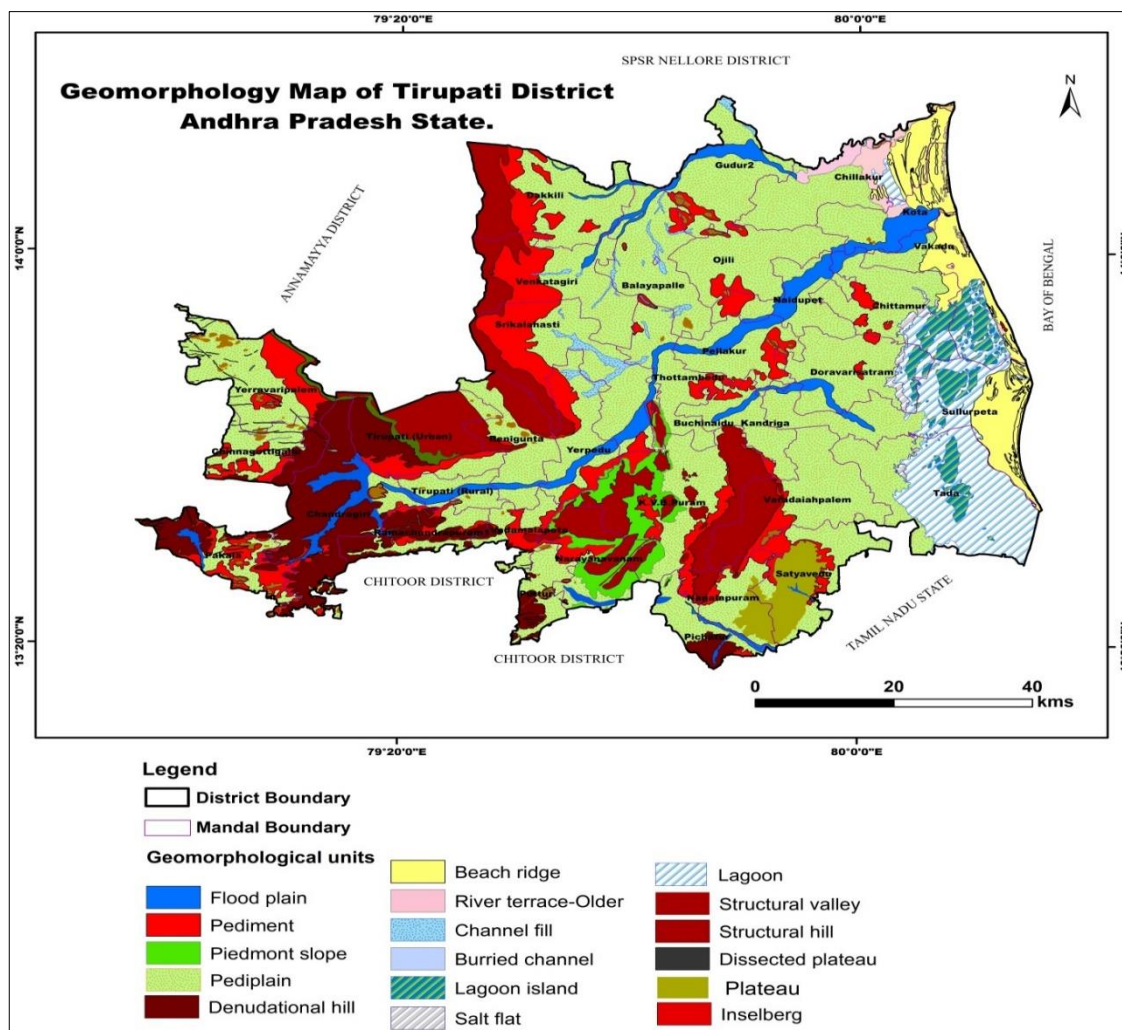


Figure 2 Isohyetal map of Tirupati district

## 1.5 Geomorphology

Pedi plains are the major Geomorphological features in the district covering an area of around 50% and followed by denudational hills 15 %, pediments 10% and Beach ridges along the coastal area covering around 10%. The eastern/southern parts particularly Satyavedu, Tottambedu, Renigunta, Erpedu and Srikalahasty areas have an altitude of less than 300 mamsl. Vertical rock cliffs are developed at several places and important one is Tirumala which shows a drop of 100m from 500 to 400 mamsl. The other land forms are denudational hills, structural hills and residual hills, buried channels, flood plain, dissected plateau and lagoons prevails in the district. The Geomorphological map is shown in Fig.3



**Figure 3 Geomorphology map of Tirupati district**



## 1.6 Drainage and Structures:

Swarnamukhi is important river originates in Eastern Ghats and flows in NE direction and this is non-perennial in nature other important rivers are Kushastali and Kalyani River. The drainage pattern is dendritic to sub-dendritic in nature. The district is blessed with huge number of village tanks and water bodies, which are seen in most places and are used for irrigation purposes. Drainage map of Tirupati given in Fig.4

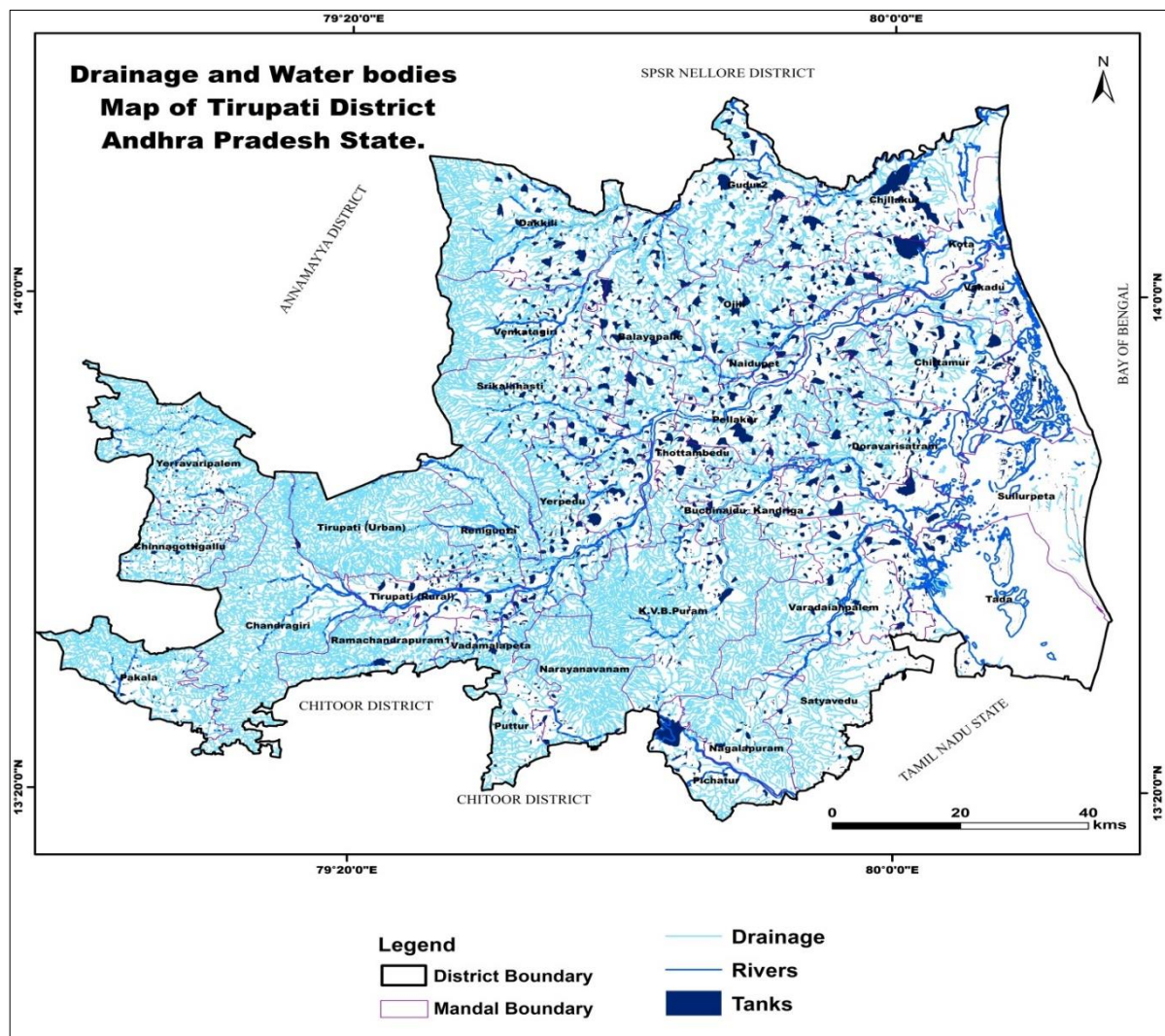
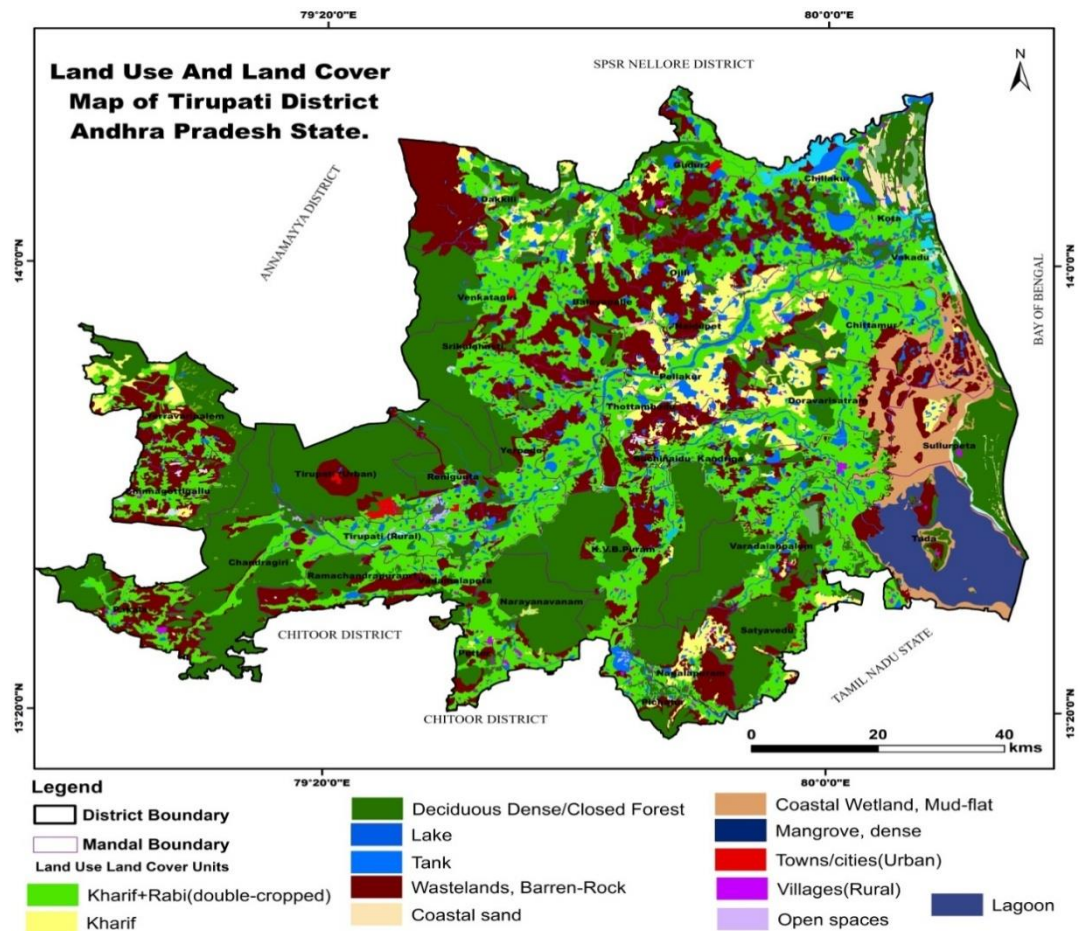


Figure 4 Drainage map of Tirupati

## 1.7 Land use and cropping pattern

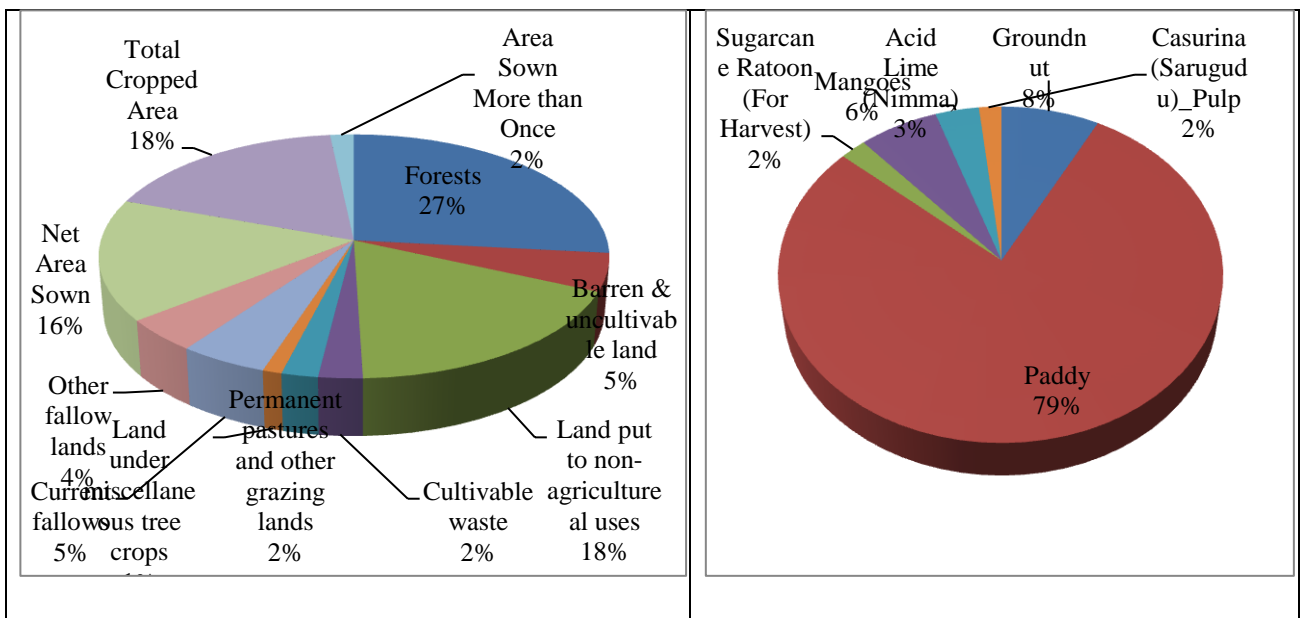
As per the land use and land utilization data of 2019-20, Forests occupy 271318 (33%) of the total area. Barren and un-cultivable land is 51035 ha (06 %), land puttonon-agriculturalusesis181459 ha (22%), permanent pastures and other grazing lands 20846, 2.5% of the total geographical area. The major crops grown in the district are paddy, groundnut, sugarcane, vegetables, pulses and other crops grown are maize, ragi, bajra etc. Total cropped

area of the district is 181013 (22%) ha and net area shown is 163724 (20 %) of total area. The major crops grown are paddy 104669 (57%) ground nut 12785Hec (7%) sugarcane 3580 (2%) and vegetables and pulses contributing around 6 %.In this district there are 5.15 lakh farmers and agriculture laborers spreading all the mandals. Land use and land cover map presented in Fig.5 and Fig 5a and 5b shows percentage of land use pattern and cropping pattern respectively.



**Figure 5.Landuse and land cover of Tirupati district.**

Fig.5a and 5b percentage of land use pattern and cropping pattern



## 1.8 Soils

The soils are mainly red loamy (Fine mixed red soils 57%), red sandy soil (34%) and black soils (9%). The rest of the area covered by Black Clay (3%), Black Loamy (2%), Black Sandy (1%) and Red Clay (3%). In the eastern part of the area kaolinite mixed soil are seen. The soil map is shown in Fig.6

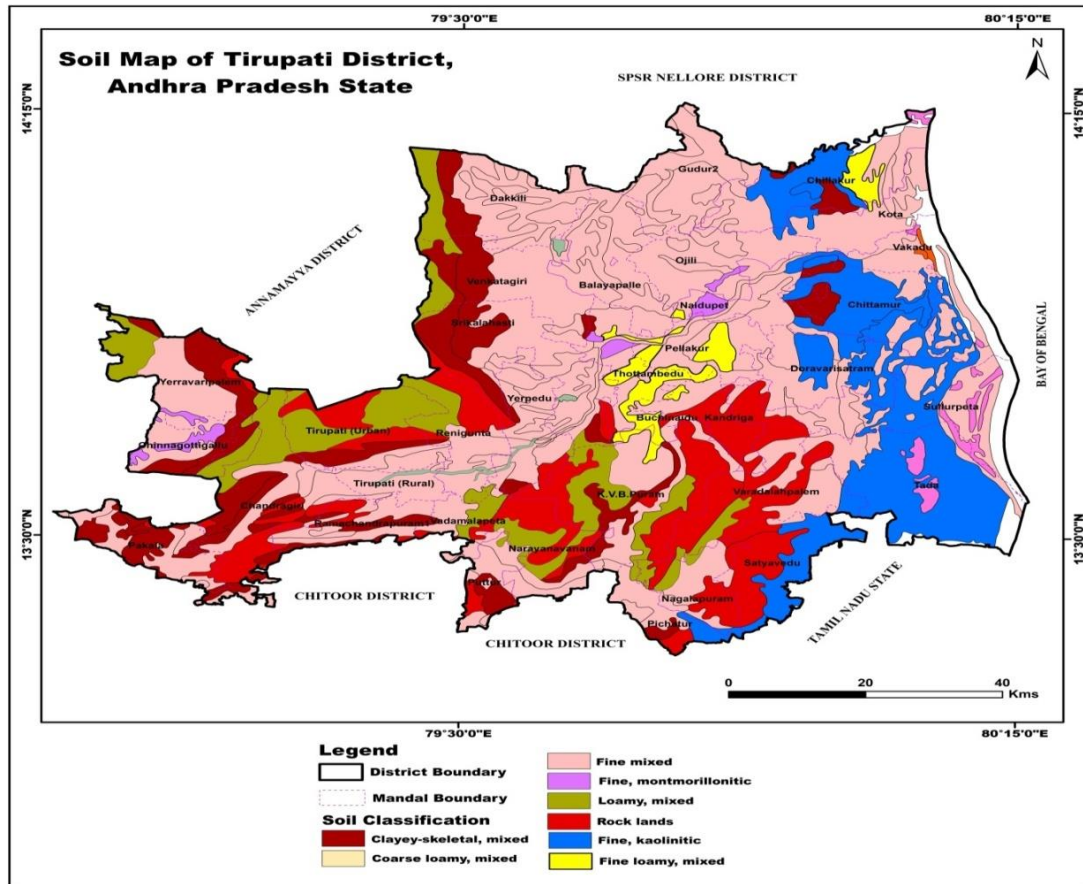
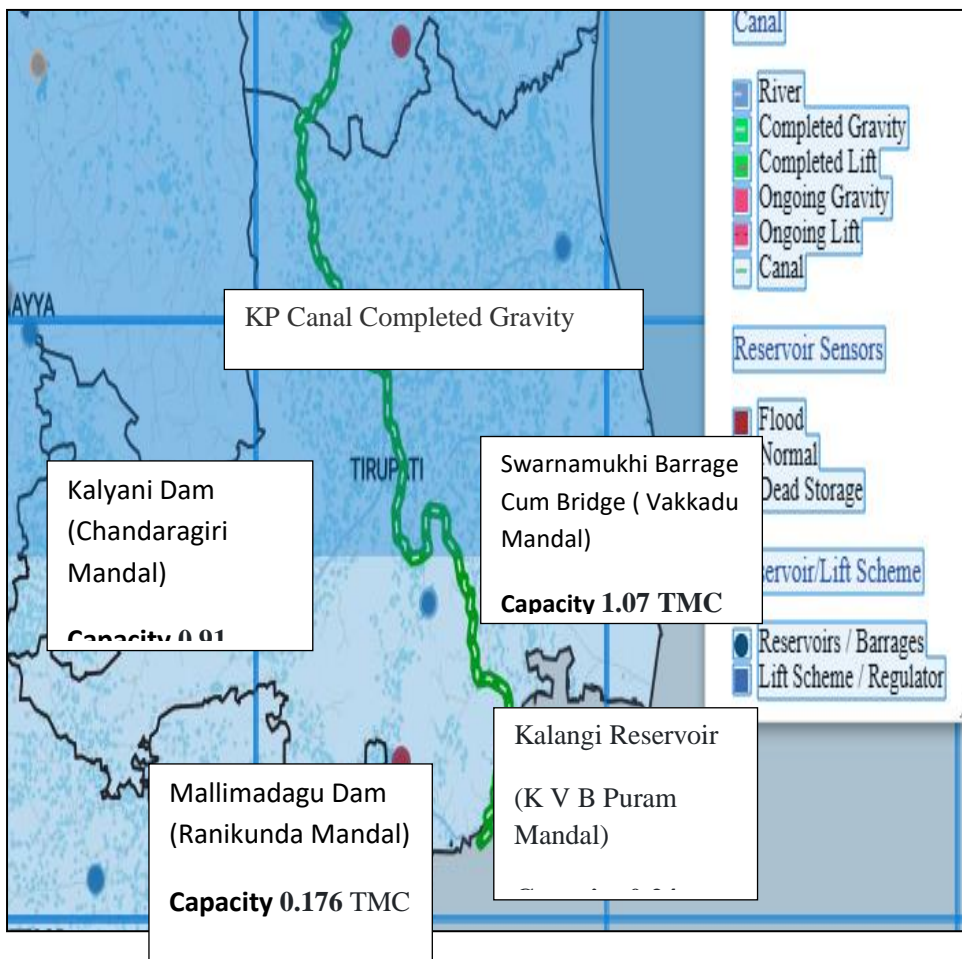


Figure 6 Soil map of Tirupati district.

## 1.9 Irrigation

The gross irrigated area during 2019-20 is 143863 ha. Groundwater contributes 95 % of the net irrigated area and surface water contributes only 5%. There are 35713 farm ponds, 541 percolation tanks, 1419 Check dams and other structures are 24270 numbers constructed to recharge the ground water by the state water resource department. Area showing details of irrigation projects is given in Fig.7. Source wise Irrigation and Source wise, mandal wise NET area Irrigated In hectare give in Annexure II and III respectively.



**Figure 7** Details of irrigation projects, Tirupati district

**Table 1:** Salient Features of Irrigation by different source during 2019-20(Ha).

Source of Irrigation	Irrigation Structures	Total (Numbers)	Total (%)
Ground Water	Bore wells	33384	95%
	Dug wells	20753	
Surface Water	Canals	1757	5%
	Tanks		
	Lift Irrigation	775	
Gross irrigated area		14386 ha	

### 1.10 Prevailing water conservation/Recharge practices

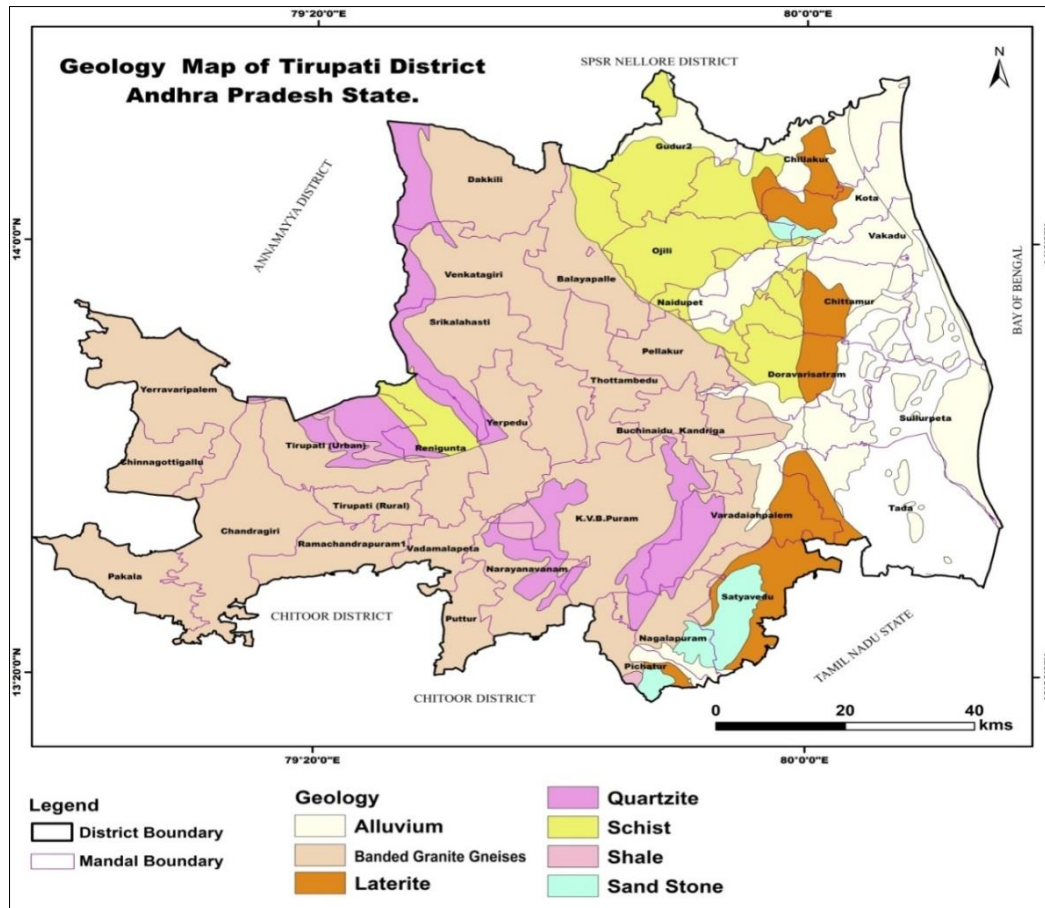
There are 35713 farm ponds, 541 percolation tanks 1419 Check dams and other structures are 24270 numbers of constructed to recharge the ground water by the state water resource department (APWRIMS)

## 1.11 Geology

The district is underlain by formations of Archaean, Proterozoic, Jurassic, Cretaceous, Tertiary and Quaternary ages. The oldest rocks in the area belong to Migmatite Complex, represented by migmatized quartzo-felspathic gneiss and are exposed in the northwestern part of the district. Older metamorphic comprise amphibolites, hornblende-talc-mica-schist, fuchsite quartzite, calc-silicate rock, marble and banded ferruginous quartzite. These older metamorphic occur as enclaves within Peninsular Gneissic Complex (PGC). The PGC comprises a complex assemblage of gneissic variants and granitic rocks, which occupy almost major part of the district. PGC in the area is represented by biotite-hornblende gneiss, biotite granite and migmatite. The Dharwad Supergroup of rocks represented by quartz-mica schist, amphibolite schist, quartzo feldspathic mica schist, Champion gneiss, Meta basalt, and banded ferruginous quartzite, belonging to various schist belts and occurs as long linear N-S trending belts and overlie PGC non-conformably. Acid intrusive of Proterozoic Age comprises granite and quartz veins. The granite plutons are exposed as patches and linear bodies in southwestern and northern parts of the district respectively. The basic dykes include dolerite. Three sets of dolerites dykes trends in E-W, N-S, and NW-SE directions. The southern tip of the well-known Cuddapah Basin falls in the northeastern part of the district. Shale and quartzite of Bairenkonda Formation, shales/phyllite and limestone of Cumbum Formation are exposed in the district. The rocks of Gondwana Super group occur none conformably over the PGC in southeastern part of the district, represented by Satyavedu Formation (Upper Gondwana) and comprise molted, ferruginous quartzite and conglomerate with plant fossils. Laterite capping occurs over Gondwana formations. Large tracts of Alluvium occur eastern part along coastal tract and the major rivers/streams, which belong to Recent Age.

### **Eparchaeon Unconformity (Tirupati hills)**

National Geo-heritage Monument is a major discontinuity of strati-graphic significance that represents a period of remarkable serenity in the geological history of the earth. The boundary is between sedimentary rocks of the Cudappah Super group (1600 million), and Achaeon rocks comprising granites, gneisses and dolerite dykes that are more than 2100 million years old, a 500-million-year gap of deposition. Sudden changes and discontinuity in the rock layers in earth's crust provides an insight into the formation of the subcontinent, the orogeny, the paleo environment and the exotic collection of paleo-flora and fauna. The Geology map of Tirupati district is given in Fig. No.8



**Figure 8 Geology of Tirupati district**

## 2 DATA COLLECTION AND GENERATION

Collection and compilation of data for aquifer mapping studies is carried out in conformity with Expenditure Finance Committee (EFC) document of XII plan of CGWB encompassing various data generation activities (Table-2)

**Table 2 Data compilation and generations**

S. No.	Activity	Sub-activity	Task
1	Compilation of existing data/ Identification of	Compilation of Existing data on groundwater	Preparation of base map and various thematic layers, compilation of information on Hydrology, Geology, Geophysics, Hydrogeology, Geochemical etc. Creation of database of Exploration Wells, delineation of Principal aquifers (vertical and lateral) and compilation of Aquifer wise water level and draft data etc.

S. No.	Activity	Sub-activity	Task
	Principal Aquifer Units and Data Gap	Identification of Data Gap	Data gap in thematic layers, sub-surface information and aquifer parameters, information on hydrology, geology, geophysics, hydrogeology, geochemical, in aquifer delineation (vertical and lateral) and gap in aquifer wise water level and draft data etc.
2.	Generation of Data	Generation of geological layers (1:50,000)	Preparation of sub-surface geology, geomorphological, analysis of land use pattern.
		Surface and sub-surface geo-electrical and gravity data generation	Vertical Electrical Sounding (VES), bore-hole logging, 2-D imaging etc.
		Hydrological Parameters on ground water recharge	Soil infiltration studies, rainfall data analysis, canal flow and recharge structures.
		Preparation of Hydrogeological map (1:50,000 scale)	Water level monitoring, exploratory drilling, pumping tests, preparation of sub-surface hydrogeological sections.
		Generation of additional water quality parameters	Analysis of ground water for general parameters including fluoride.
3.	Aquifer Map Preparation (1:50,000 scale)	Analysis of data and preparation of GIS layers and preparation of aquifer maps	Integration of Hydrogeological, Geophysical, Geological and Hydro-chemical data.
4.	Aquifer Management Plan	Preparation of aquifer management plan	Information on aquifer through training to administrators, NGO's, progressive farmers and stakeholders etc. and putting in public domain.

**Table 3 Data Used For Preparation of Various Maps/Figs-Tirupati District, Andhra Pradesh**

S. No.	Data	Source		
		CGWB	SGWD	Well Inventory
1	Panel Diagram(3-D)	EW 17:VES:56	38	63
2	Hydrogeological Sections	EW 17:VES:56	38	63
3	Fence/panel Diagrams	EW 17:VES:56	38	63
4	Depth of weathering	EW 17:VES:56	38	63
5	Depth of fracturing	EW 17:VES:56	38	63
8	Depth to Water Level Maps(2015)	34	58	63
9	Water Level Fluctuation	34	58	63
10	Water quality Pre	-	-	76

## 2.1 Hydrogeological Studies

The principal aquifer in the district is Banded granite gneiss and coastal sediments in the eastern part. The occurrence and movement of ground water in these rocks are controlled by the degree of interconnection of secondary pores/voids developed by fracturing, weathering and sediments. Ground water occurs under unconfined conditions in weathered zone and semi-confined to confined conditions in fractured zone and flows downward from the weathered zone into the shallow and deep fracture zone.

The shallow aquifers constitute the weathered zone at the top, followed by fractured zone at the bottom, generally extending down to 100 m depth. The storage in these rocks is primarily confined to the weathered zone. At present, ground water extraction is mainly through boreholes of 50-200 m depth. Majority of fractures occur within 100 m depth. Quartzite and Quartz feldspathic rocks occupying the uplands and hilly areas and are massive and compact and possess meager groundwater potential. Alluvium which is confined to eastern part, mainly used for irrigation purpose, has resulted in de-saturation of weathered zone along rivers, ground water is developed through filter points and shallow dug wells of 10 to 15 m depth.

## 2.2 Ground water occurrences and movement

Ground water occurs under unconfined conditions in weathered zone and semi-confined to confined conditions in fractured zone and flows downward from the weathered zone into the fracture zone. The storage in these rocks is primarily confined to the weathered zone and its overexploitation, mainly for irrigation purpose has resulted in desaturation of weathered zone at places. At present, extraction is mainly through boreholes of 60-200 m depth, with yield between <0.1 and 17 liters/second (lps). Majority of fractures occur within 100 m depth and deepest fracture is encountered at the depth of 171 m at Kammalapalle in Ramachandrapuram mandal. The hydrogeological map of the area is presented in **Fig. 9**



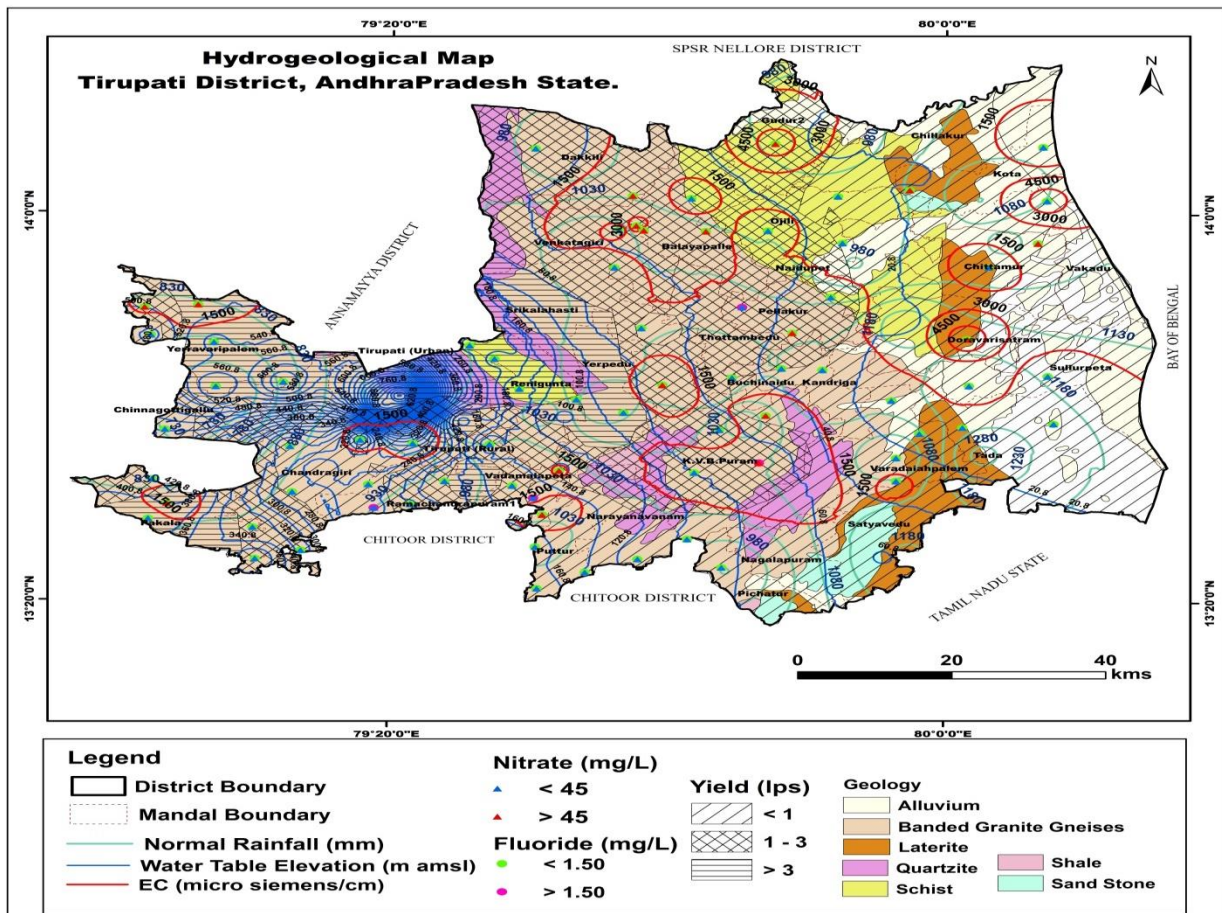


Figure 9. Hydrogeological map of Tirupati district.

### 2.3 Ground water Exploration

Total 26 exploratory wells (17+9) were constructed in the basin down to a maximum depth of 200 m with 0.4 to 14 lps yield. The specific capacity ranges from 6 to 10 lpm/m/d. The Transmissivity ranges from 1-222 m<sup>2</sup>/day. Out of 17 exploratory wells, 5 wells yielded <1LPs, 9 wells yielded 1 to 3 lps, 3 wells yielded 3 to 5 lps. The detailed of Exploration is given Annexure - VI

### 2.4 Depth to Water levels

Ground water levels from 98 wells (CGWB: 22 and Key wells: 76 consisting of dug wells and bore wells) were monitored for pre-monsoon and post-monsoon seasons. Comparatively shallow water levels are observed in eastern part and deep in western part of the district. The combined depth to water level details are given in Annexure - V

## 2.5 Pre-monsoon water level (June 2022)

Majority of the water levels during pre-monsoon season are in the range of 2-5.0 mbgl and followed by 5-10 m bgl. Shallow water levels in the range of 0-2 m bgl are seen at patches particularly eastern part of the district. The pre-monsoon depth to water levels ranges from 0.27 meters below ground level (mbgl) at Sivanadapalaem (Parlapalee) in Tottambedu mandal to a maximum of 9.00 m bgl at Kukkala Doddi in Renigunta mandal in the district. Most of the area falls in 2 to 5.0 m bgl category in the district and 5 to 10 m bgl falls in the Yerapalle, Renigunta, Tirupati, Chandragiri and Chinnagottigallu mandalas of the district. The pre-monsoon depth to water level map is given in Fig.10

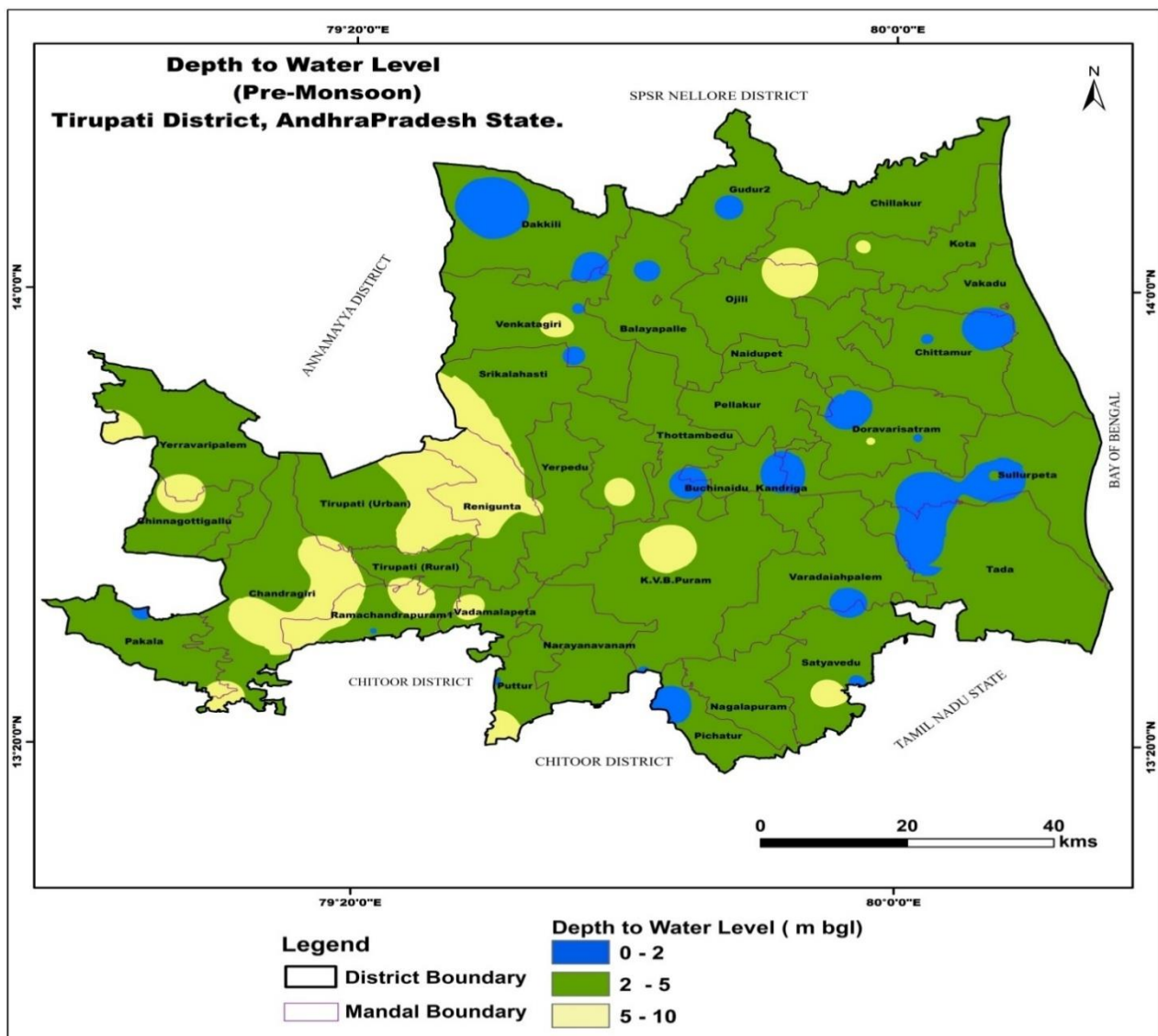


Figure 10 Depth to water level, Pre-monsoon (May-2022)

## 2.6 Post-monsoon season

During the post monsoon water level which was monitored during the month of December 2022 is in the range of 0-2 m bgl covering >50% of area, followed by 2-5 m bgl. Deep water levels in the range of 5 to 10 m bgl are seen in small pockets of the area. The post -monsoon depth to water level map is given in Fig.11

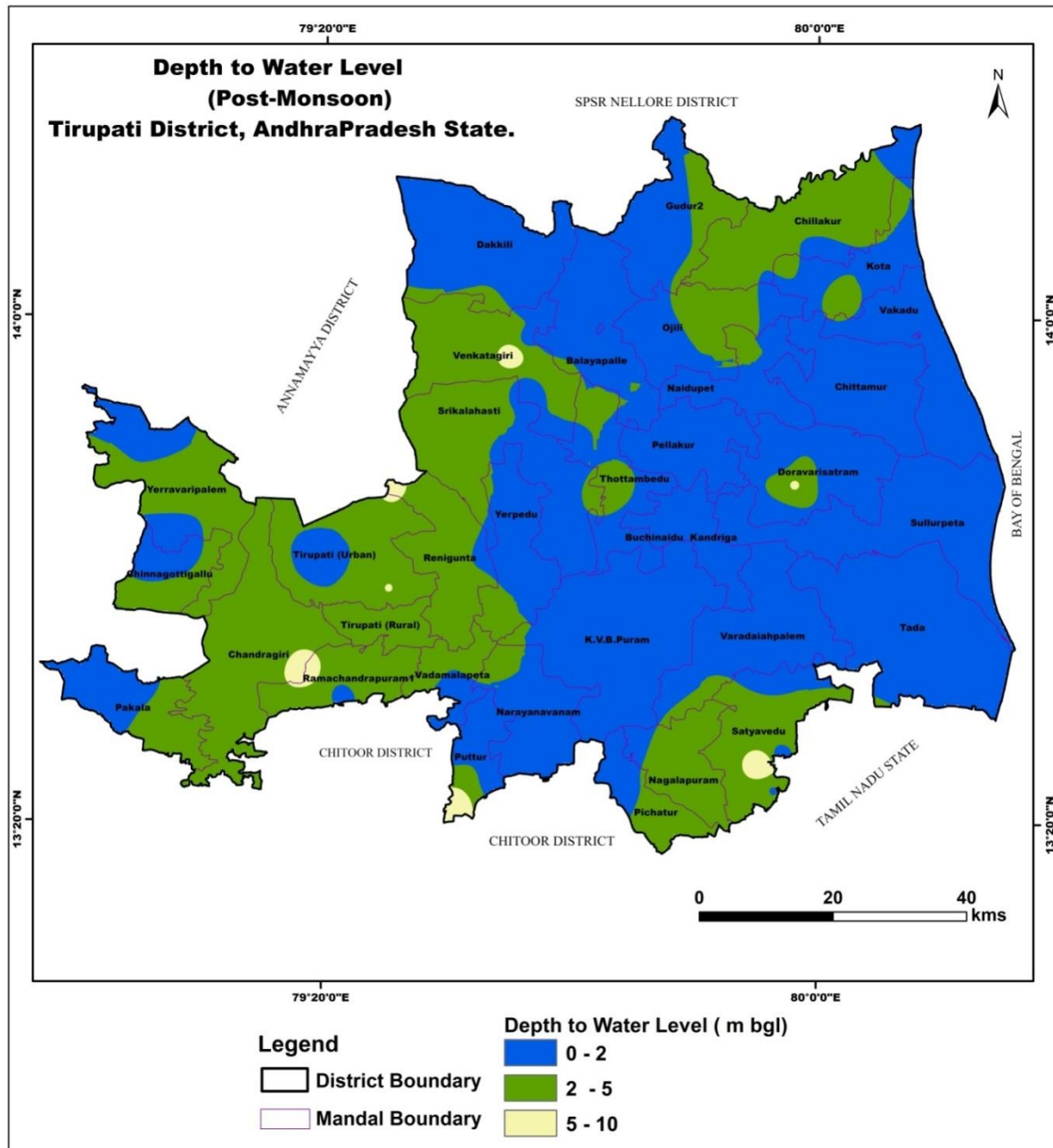


Figure 11 Depth to water level Post-monsoon (December -2022)

## 2.7 Water Level Fluctuations (May 2022 vs. December 2022)

Comparison of water level data of pre-monsoon and post-monsoon data shows that majority of area shows rise in water level in the range of 0 -5 m. The water level fluctuations vary from 0 to 2.0 m fall in the southern and northern part of district where as rest of the area shown rise up to 4m. The water level falling observed in Sathyaveedu , part of Pichatur , Nagalapuram , Tada, Dakkili, Vengatagiri, Chandragiri, Gundur and Dorvari satram mandals. Water Level Fluctuations (m) (December-22 vs May-2022 given in Fig.12

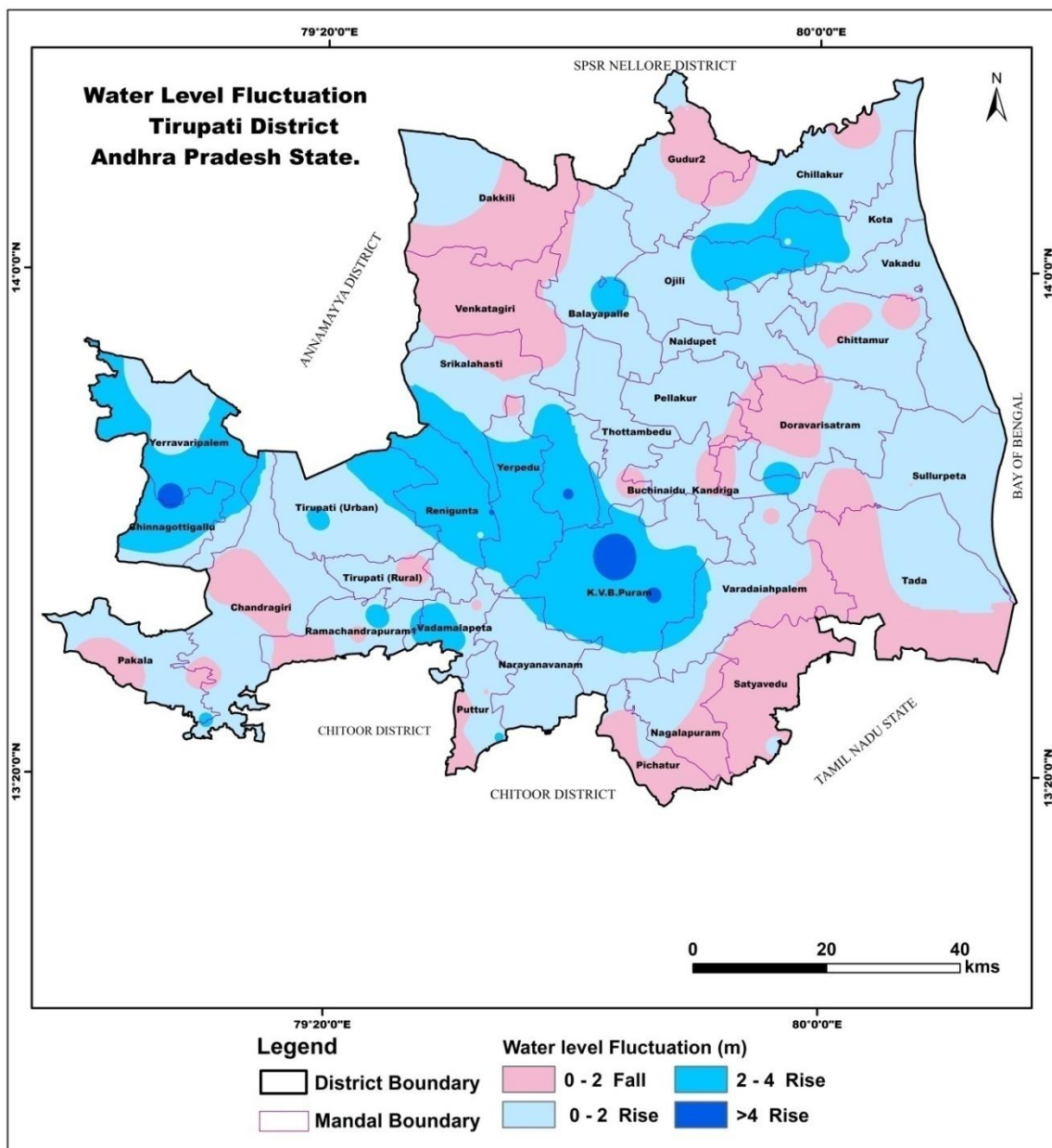


Figure 12 Water Level Fluctuation (m) (December-22Vs.May-2022)

## 2.8 Long term water level trend

The long-term water level trend analysis by using 79 hydrograph stations of CGWB and SGWD shows that during pre-monsoon long term trend shows falling trend in 59 wells in the range from 0.003 to 2.20m, and an average of 0.544m. Rising trend is reflected in 20 wells ranges from 0.008 to 1.467 (Fig.13).

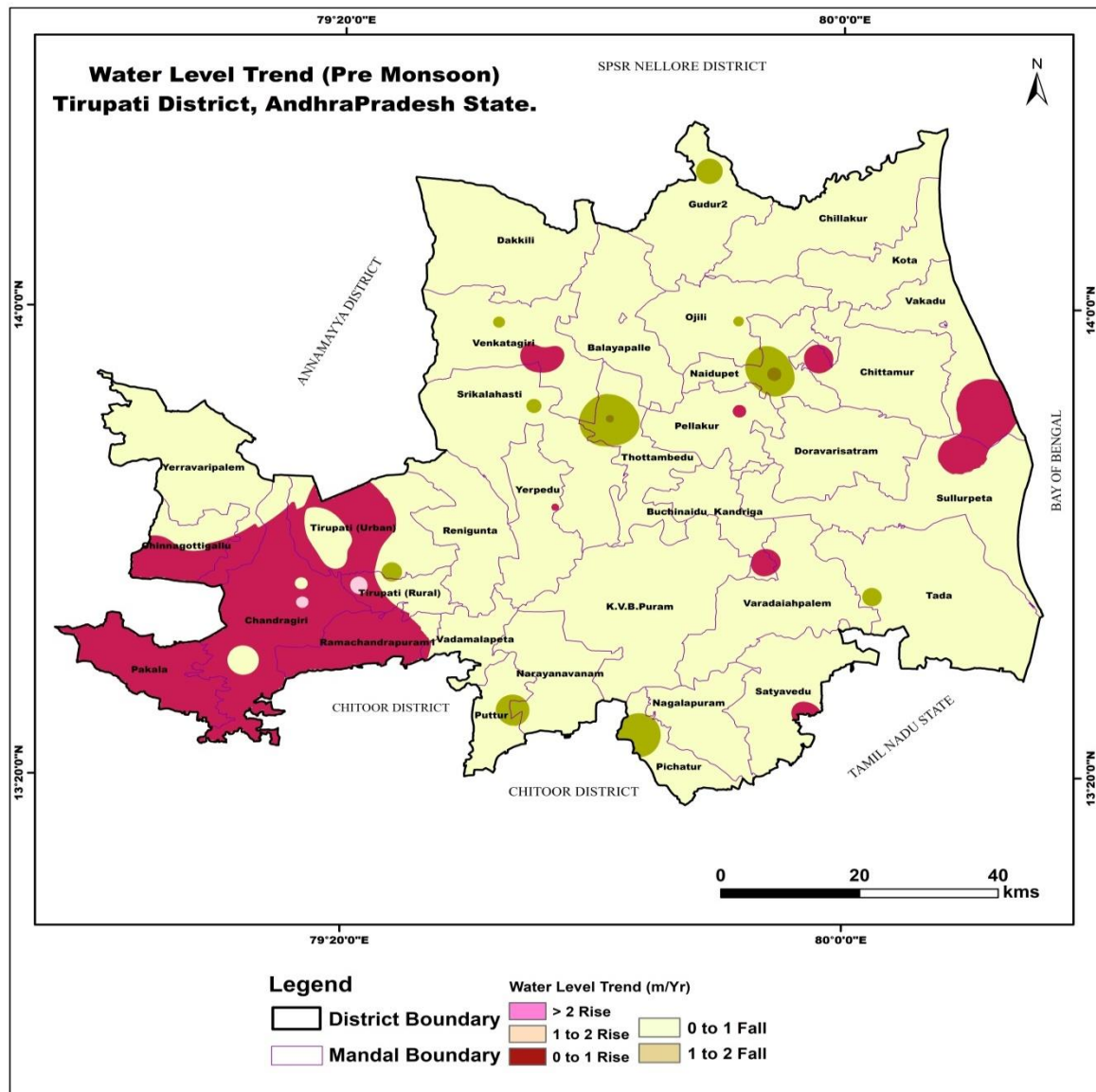


Figure 13 Long-term water level trends, Pre-monsoon (2011-2020)

Post monsoon long term trend shows a falling trend in 38 wells that ranges from 0.005 to 1.644m bgl with an average of 0.344m. While rising trend is noticed in 41 wells in the range from 0.02 to 1.292. (Fig.14)

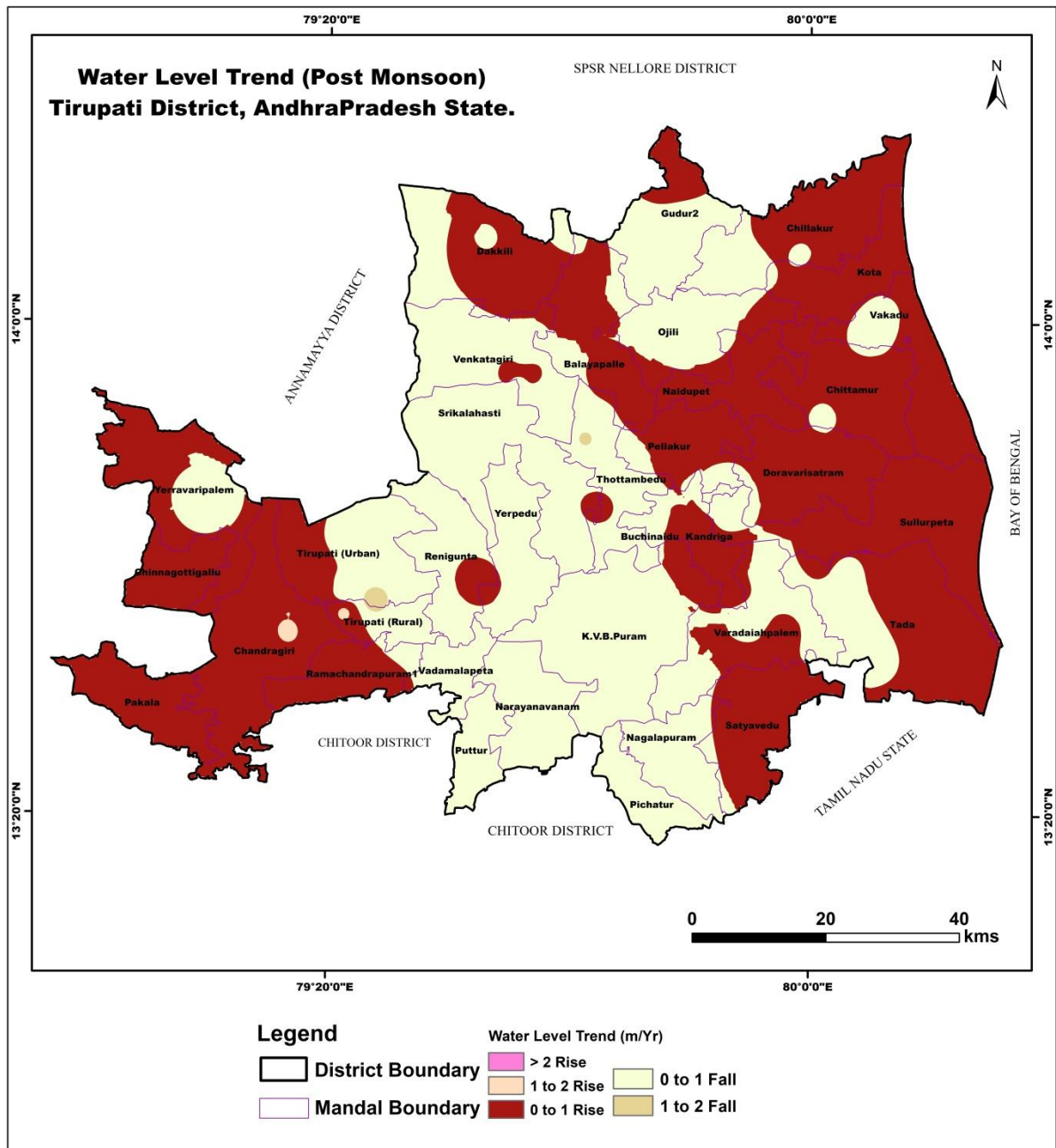


Figure 14 Long-term water level trends (post-monsoon-2006-2015)

## 2.9 Water Table Elevation

The water table elevation map has been prepared with reference to above mean sealevel data shows that the closer intervals are seen in the western part of the area and water table flow toward the eastern direction of district. Water Table Elevation Map is presented in Figure No.15

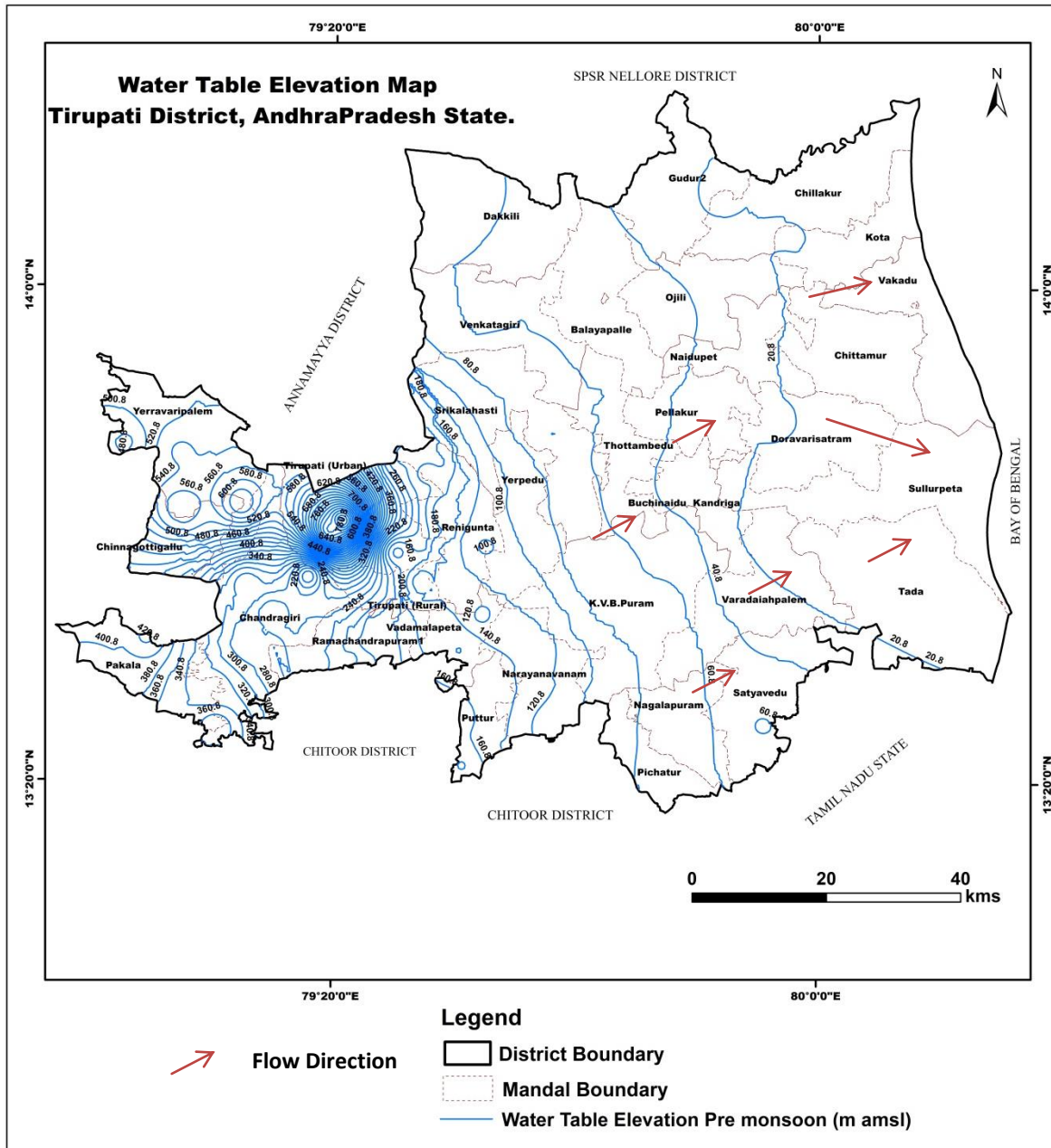


Figure 15 Water Table Elevation Map

## **2.10 Geophysical Studies**

Around 56 numbers of geophysical resistivity data has been used to know the geological hydrogeological condition of district. It is observed from the interpreted data that resistivity <100-ohm m is noticed for weathered Granite gneiss, 70 -150 ohm m for fractured and more than 400 ohm m for massive rock. The geophysical interpreted result of Tirupati District given Annexure -VI

## **2.11 Hydro-chemical Studies**

During pre-monsoon period, total 76 water samples have been collected from dug wells, bore wells, hand pumps and surface water to know the quality of water in the districts. The samples have been analyzed at Regional chemical laboratory, Southern Region, Hyderabad as per NABL standards for both cation and anions. Further, heavy metal such as Uranium was also analyzed. Key wells samples results of Chemical Analysis Data of Tirupati district given in Annexure VII.

## **2.12 pH and Electrical conductivity**

The pH of water samples from Tirupati district ranges from 6.7 to 8.20. As per BIS (IS10500:2012) recommendation, all the water samples of this district has recorded pH within the permissible limits of 6.7 to 8.5. The maximum pH has been recorded in the water sample collected from Vengateswarapuram is 8.22 (Dakkili Mondal). The ground water of the study area is slightly alkaline. The electrical conductivity of ground water samples in Tirupati district varies from 65 to 5410  $\mu\text{S}/\text{cm}$  at 25°C. In 52 water samples, electrical conductivity less than 1000  $\mu\text{S}/\text{cm}$  have been reported while in 14 nos. EC is <1000  $\mu\text{S}/\text{cm}$ . In general the ground water quality in Tirupati district is good. The maximum electrical conductivity has been observed in the water sample of Maneri (Suragunta Tagelu) i.e. 5410  $\mu\text{S}/\text{cm}$  at 25 °C. Distribution of Electrical conductivity (Pre-monsoon-2022) is shown in Fig.No.16



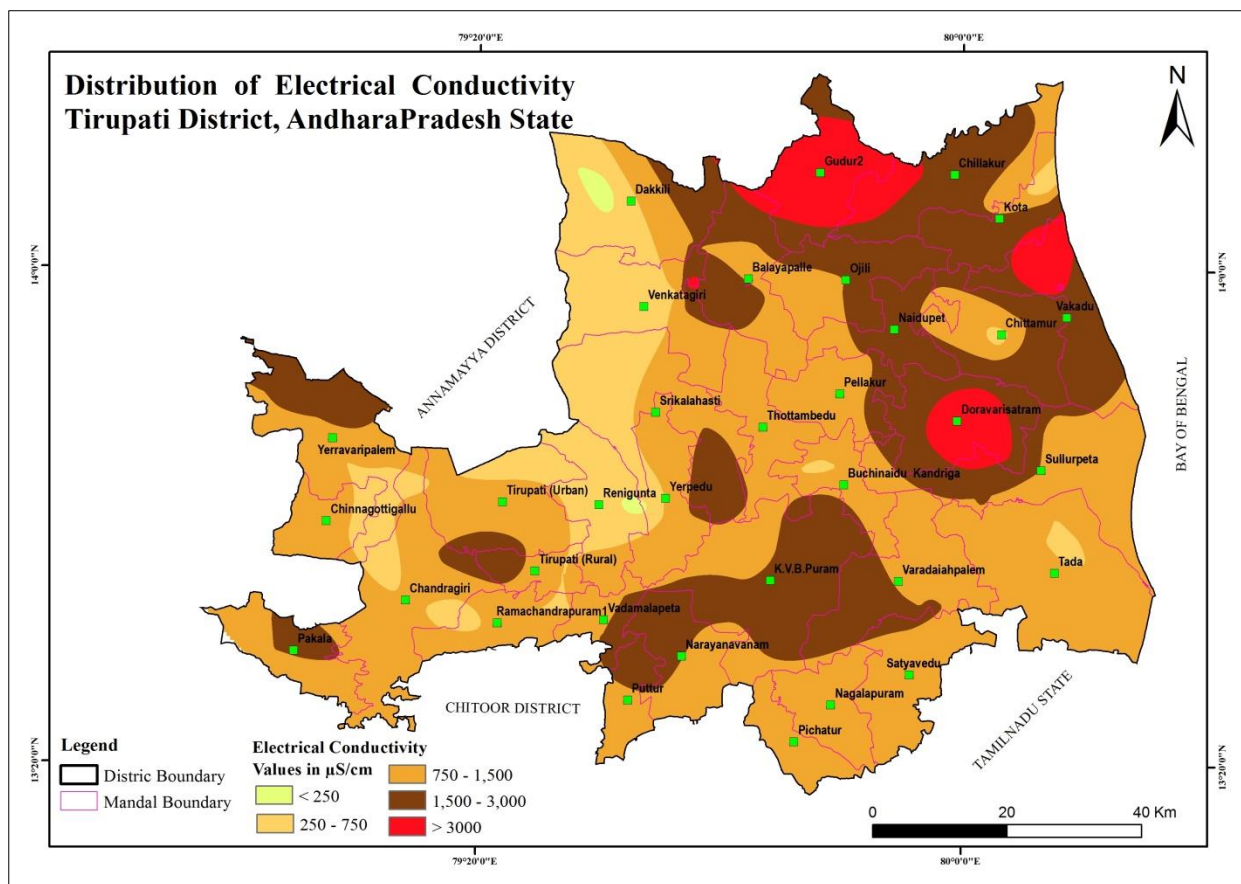


Figure 16. Distribution of Electrical conductivity (Pre-monsoon-2022)

### 2.13 Nitrate

Nitrate in ground water samples of Tirupati district falls in the ranges of 0 to 225.8 mg/l. It is observed that most of the samples are within the desirable limit i.e. 45 mg/l, while rest samples have concentration less than acceptable limit. Highest nitrate is reported in the water sample of Siddagonta (Muddampalle 225.80 mg/l). The high concentration of nitrate in ground water samples may be due to anthropogenic activities or excessive use of fertilizers and Distribution of Nitrate (Pre-monsoon-2022) given in Fig. No.17

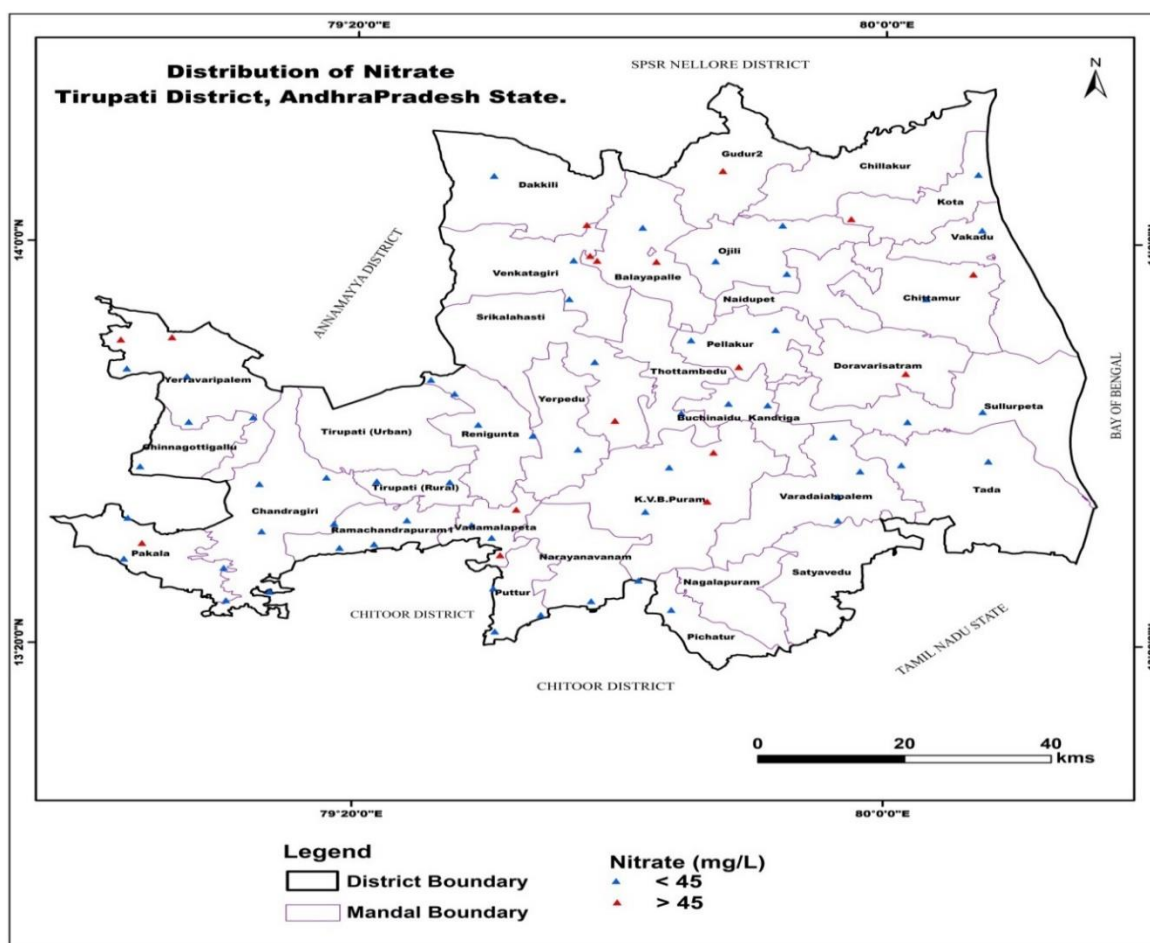


Figure 17 Distribution of Nitrate (Pre-monsoon-2022)

## 2.14 Total Hardness

The range of Total Hardness as  $\text{CaCO}_3$  in groundwater samples in the district ranges from 25 to 1600mg/l. In all locations, total hardness concentrations are within the permissible limit of 600 mg/l except six locations. The maximum concentration of total hardness observed in the village of Valamedu i.e 1600mg/l in Vakkadu mandal.

## 2.15 Piper diagram

Groundwater quality is influenced by geochemical reactions of parent rocks and mixing of water. Groundwater movements and quality can be determined by using hydro-geochemical facies analysis by plotting on Piper tri-linear diagram. The piper tri-linear diagram has two triangle fields (where the major cat ion and anions percentage epm values are plotted) and a central diamond-shaped field shows the nature of water quality.

The piper diagram of Tirupati district shows that the ground water samples are mostly falls in fresh water which is Calcium-Bicarbonate type and while reaching towards coastal zone

gradually became i.e. Sodium chloride type. Calcium Chloride types at places it is observe that more saline and May became brine water. The piper diagram of Tirupati district is presented in Fig. No.18

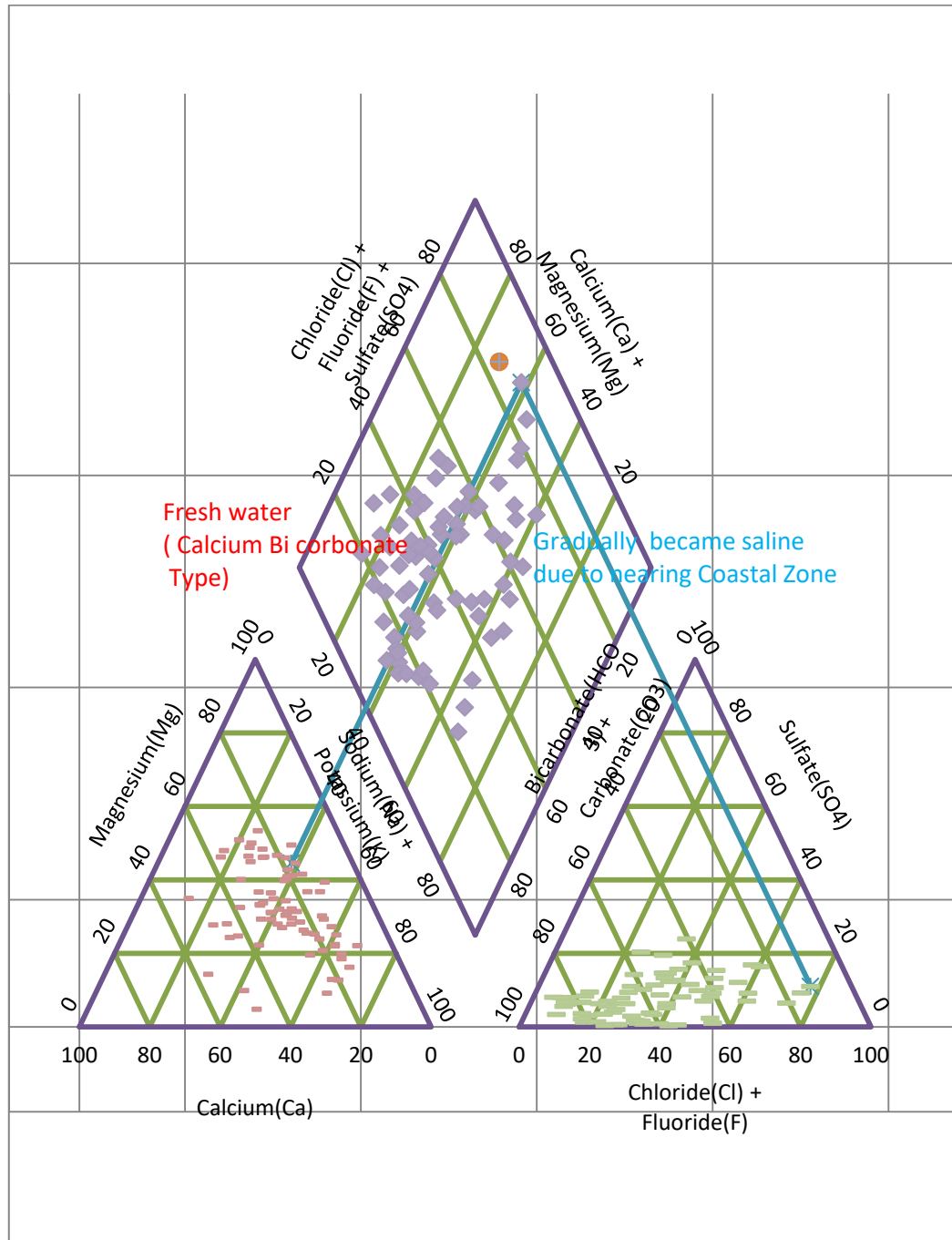


Figure 18 Hill Piper Diagram representing classification of water samples collected from Key wells

## 2.16 Quality of Ground Water for Irrigation (USSL)

It is assumed that the water will be used for irrigation purpose based upon its soil texture, infiltration rate, drainage and climate. The USSL classification used for interpretation of water used for irrigation purposes, the chemical data of all the water samples from Tirupati district is plotted on U.S. Salinity Laboratory diagram.

It is clear that around 60% samples are falls under C3-S1 Class which is showing that High Salinity with Low Alkalinity and around 20 % samples of study area are falling in C2-S1 Class and its indicates Medium Salinity with Low alkalinity which means that the sweaters can be used for Irrigation purposes for most of the crops, Water from the sea areas can be used for irrigation, considering the salinity content of the ground water. The USSL diagram given in Fig.No.19

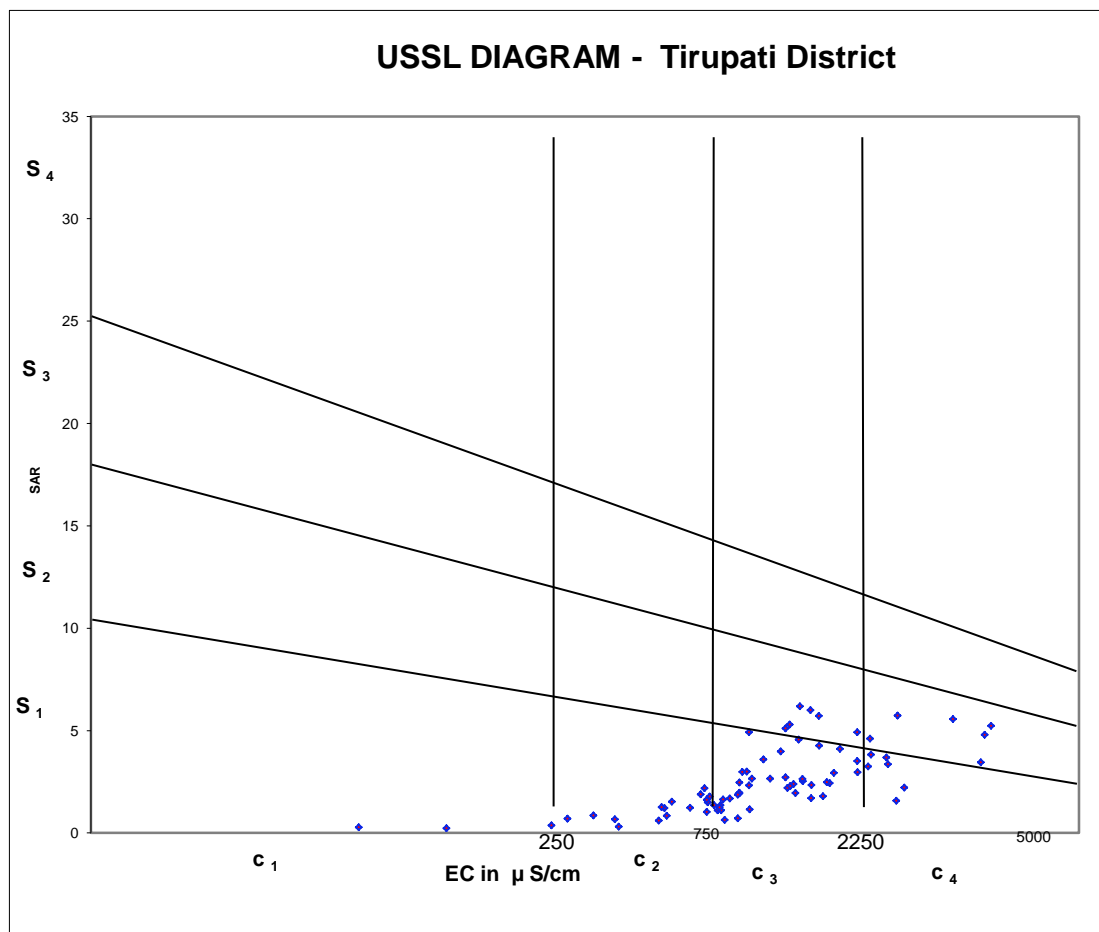


Figure 19 US Salinity Diagram of Tirupati District

## 2.17 Fluoride

The fluoride concentration in Tirupati district ranges between 0.04 to 2.69 mg/land the permissible limit is 1.5mg/l as per BIS(IS 10500: 2012) and three place shows more

than permissible limit. The highest fluoride is recorded at Eguvapundi village i.e. 2.69 mg/l. The distribution of Fluoride is given in Fig. No.20

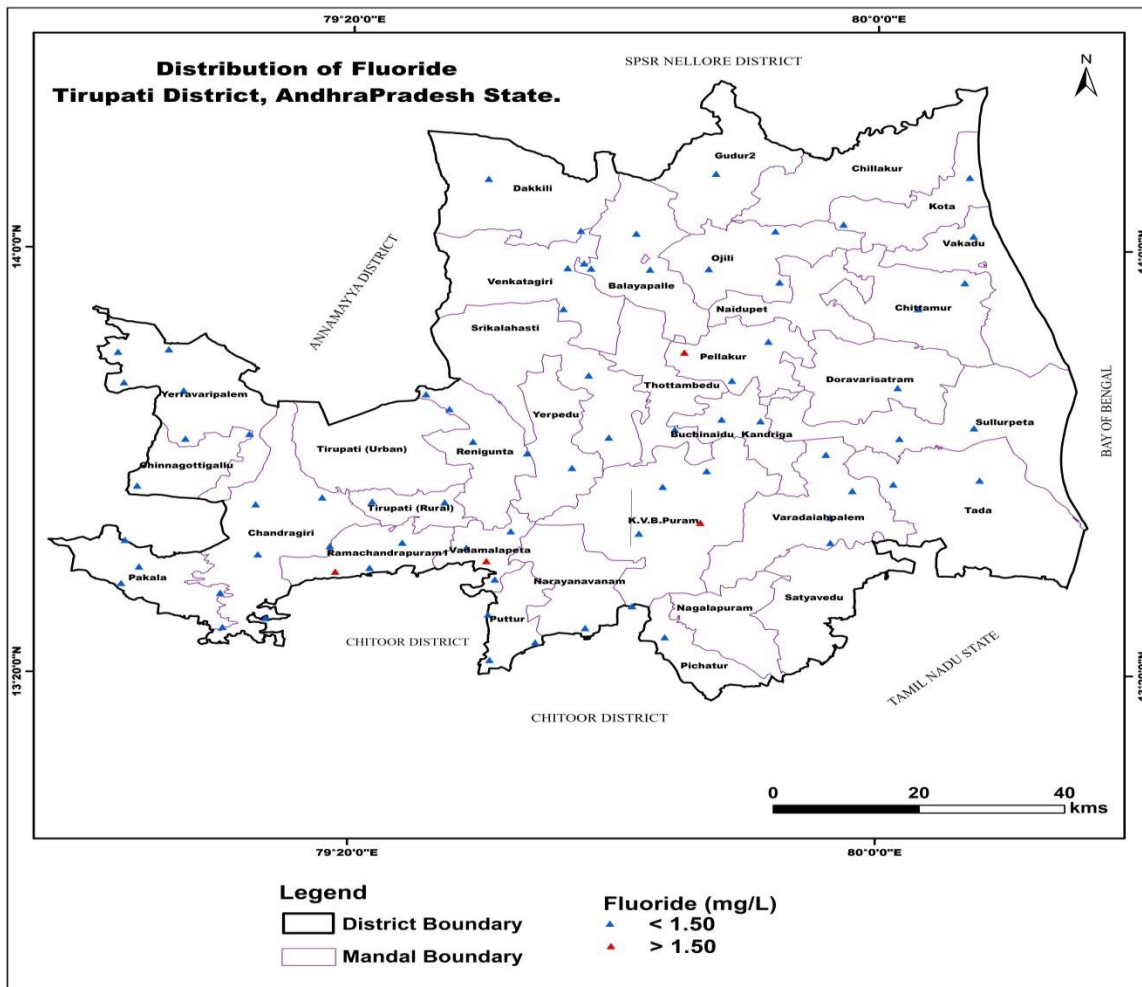


Figure 20. Distribution of fluoride (Pre-monsoon-2022)

## 2.18 Uranium

The Uranium concentration in Tirupati district ranges between 0.30 to 576ppb and the permissible limit is 30 PPB as per BIS(IS 10500: 2012) and 26 % of sample shows more than permissible limit and the highest Uranium is recorded at Mogarala (Yenumalavaripalle) i.e., 576 ppb. In this area the details study to be taken up ion future to know the extent of distribution as well as source. The distribution of Uranium is given in Fig. No 21

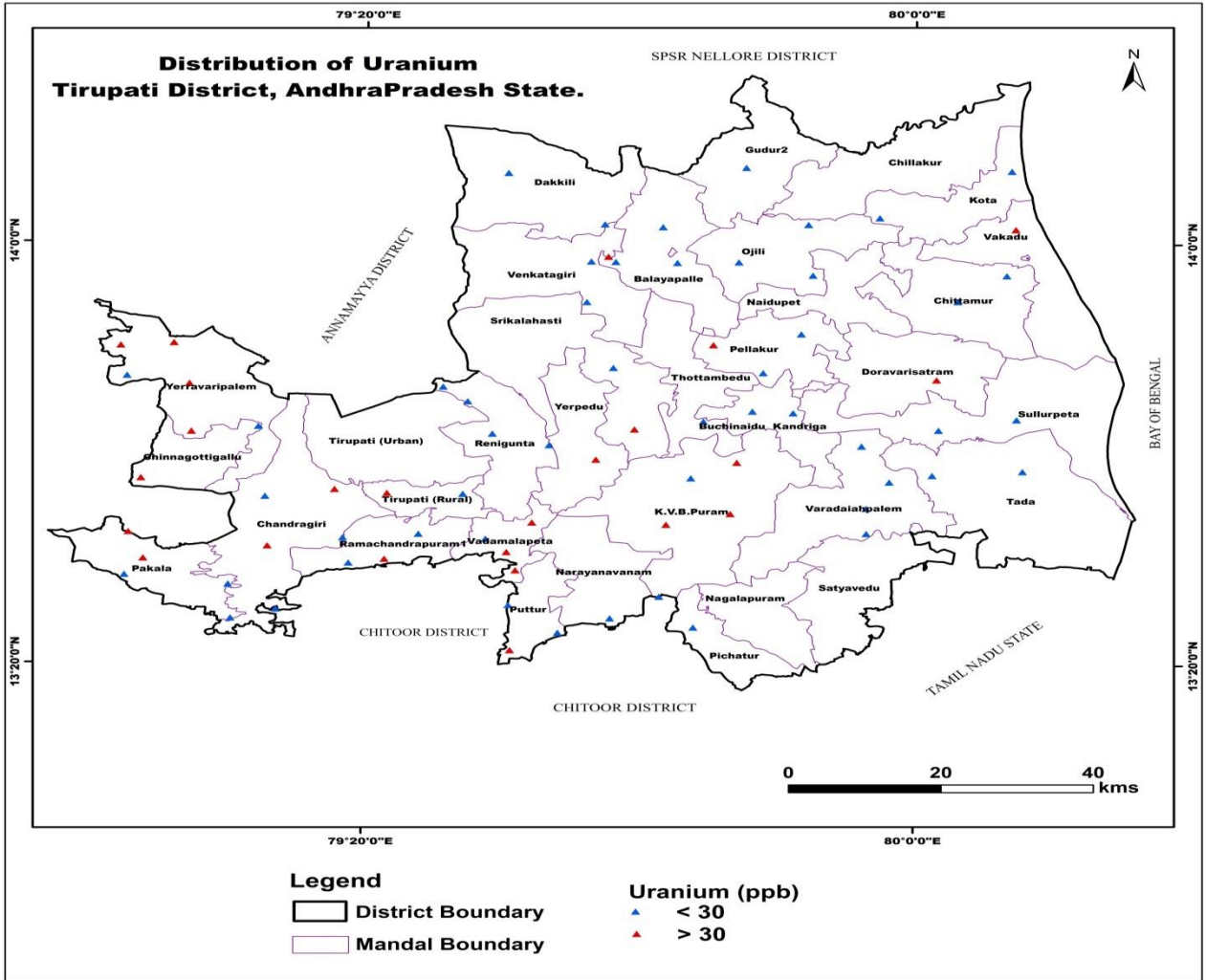


Figure 21 Distribution of Uranium (Pre-monsoon-2022)

### 3 DATA INTERPRETATION, INTEGRATION and AQUIFER MAPPING

Conceptualization of 3-D hydrogeological model was carried out by interpreting and integrating representative exploratory wells of CGWB and SGWD. The exploratory data of down to 200 m is used for preparation of 3-D map, panel diagram and hydrogeological sections. 3-D map is generated for Granitic Gneiss area only as sufficient data is not available from other sedimentary formations. The data is calibrated for elevations with Shuttle Radar Topography Mission (SRTM) data. The lithological information was generated by using the RockWorks-16 software and generated 3-D map for Tirupati district along with panel diagram and 2D sections (Fig-22).

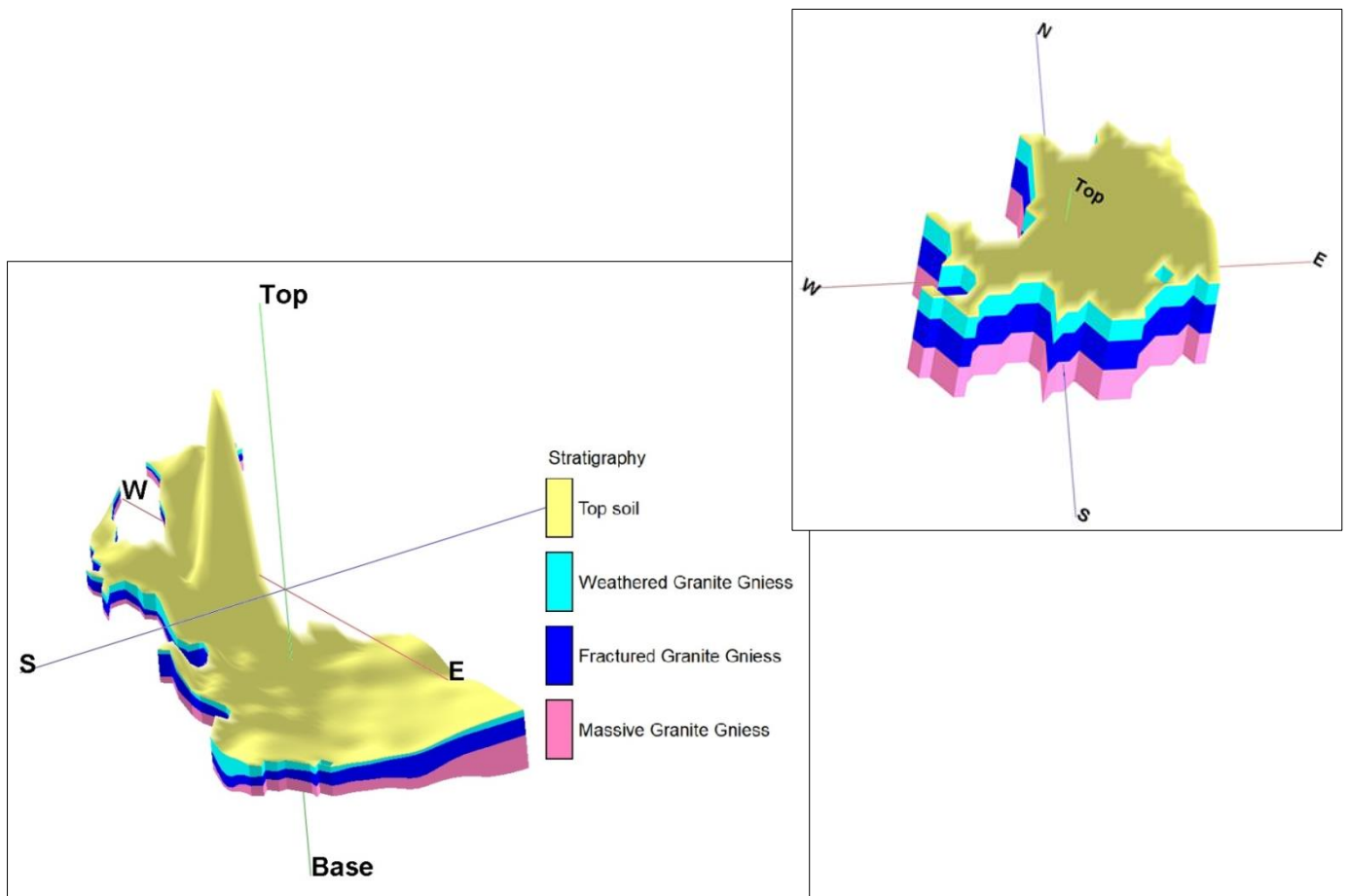


Figure 22 Aquifer disposition in 3-D Model, Tirupati district

### 3.1 Conceptualization of aquifer system in 3D

Aquifers were characterized in terms of potential and quality based on integrated hydrogeological data and various thematic maps. Weathered zone is considered up to maximum depth of weathering and first fracture encountered in general down to depth of 30 m (average 15 m) and the fractured zone (fractured BGC) is considered up to the depth of deepest fracture below weathered zone and down to 177 m.

### 3.2 Hydrogeological Sections

Two vertical sections are prepared N-S and W –E to know the geological and hydrogeological information the area. The details area given below

### 3.3 North-South Section

The vertical section drawn along the N-S direction covering a distance of around 70 kms. It depicts a uniform weathered zone in entire area and shallow fractures are encountered between 20 and 40 kms distance from NS side and shallow fractures are observed in entire section with different depth and 2D model of N-S cross Section presented in Fig. No. 23

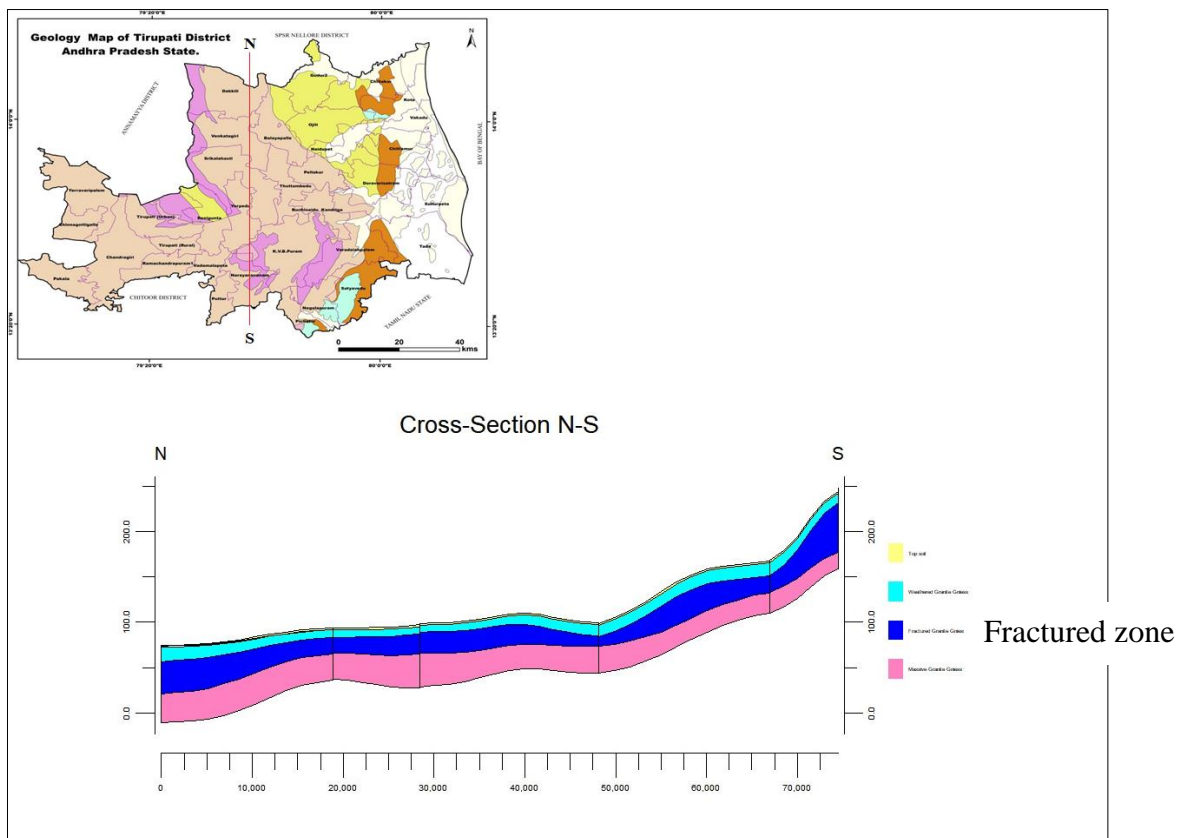


Figure 23.2 D model of N-S cross Section



### 3.4 West-East Section

The horizontal section drawn along the W–E direction covering distance of around 70 kms including famous Tirumala Hills. It depicts shallow weathered zone between 10 and 20km and deep fractures has been observed in east of Tirumala Tirupati town. Moderate deep fractures are encountered in eastern part up to 50 kms. The section drawn up to the Granitic gneissic area and 2D model of W-E cross Section given Fig. No.24

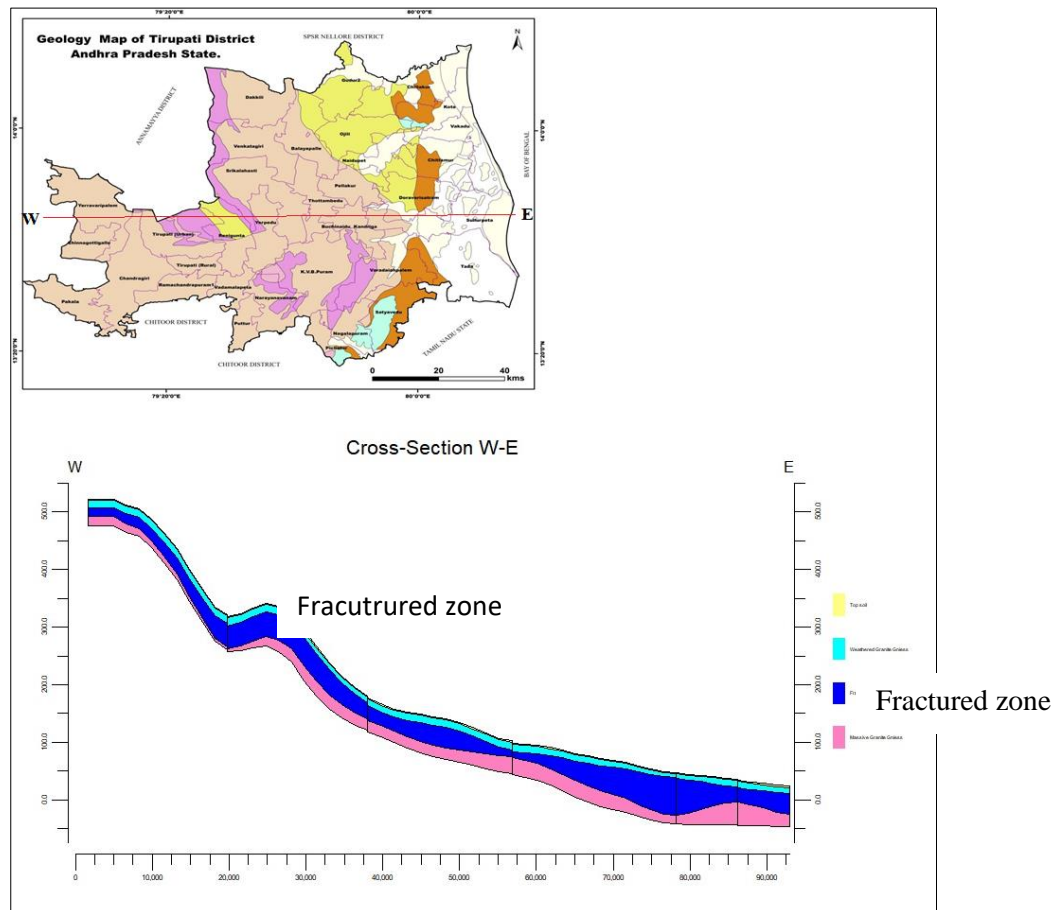


Figure 24.2 D model of W-E cross Section

### 3.5 Aquifer Characterization

**Weathered zone:** Average depth of weathering in the district is 17 m and it ranges from 3.3 to 62 m. In majority of area, thickness of weathered zone is in the range of < 20 m represented by 69% of total area followed by >20 m which is around 31%. Yield varies from < 0.5 to 17 lps and Transmissivity in the range of 2 to 54.83 m<sup>2</sup>/day and specific yield ranges from 1 to 3 %.Thickness of weathered zone of Tirupati district. Presented in Fig. 25

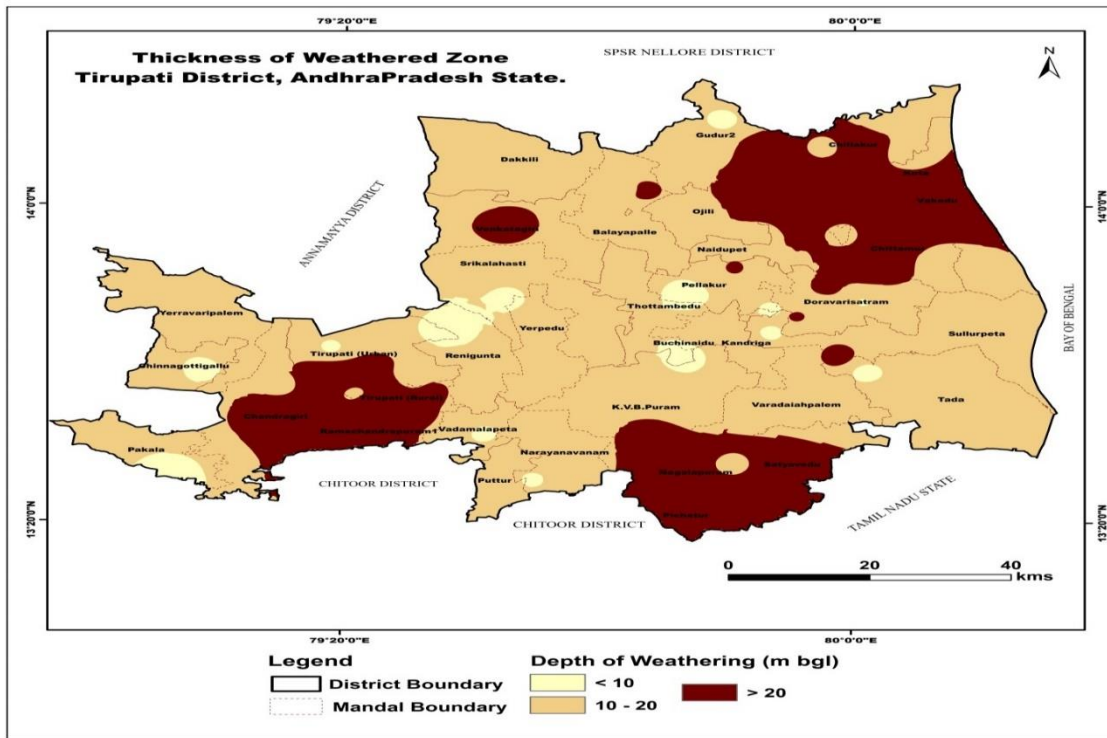


Figure 25. Thickness of weathered zone, Tirupati district.

**Fractured zone:** Depth of fracturing varies from 9 to 171 m (Kammapalle). Around 90 % of fractures occur within 100 m depth and rest occurs to a depth more than 100m bgl. Ground water yield from fractured zone varies from <0.1 to 17 lps. The hydraulic properties of weathered and fractured zone like specific capacity, Transmissivity (T) and Storativity (S) varies from 1.0 to 54 m<sup>2</sup>/day and  $1.6 \times 10^{-4}$  to  $5.9 \times 10^{-4}$  respectively. The depth of fracture map is presented in Fig.26

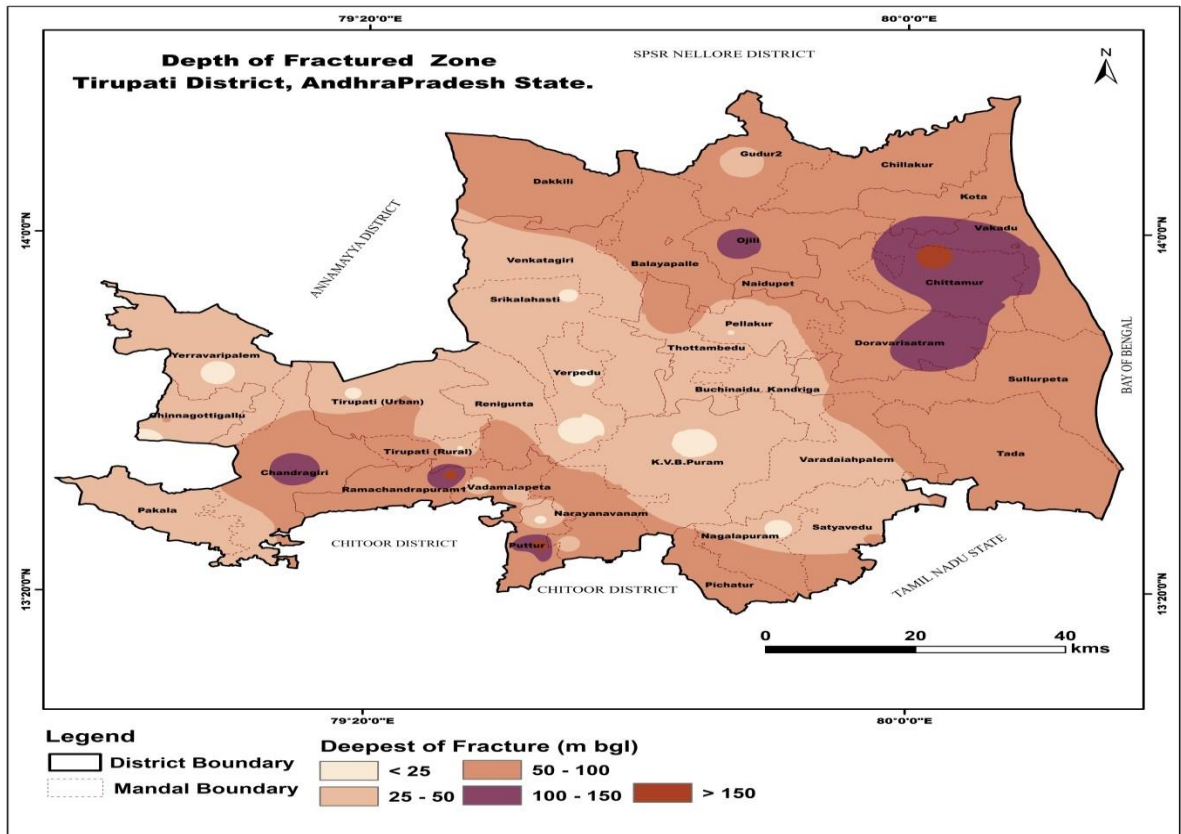


Figure 26 Depth of fractured zone (Maximum depth in 171 mbgl), Tirupati district

#### 4 GROUND WATER RESOURCES (2022)

As per GWRA 2022report, the net dynamic replenishable groundwater availability is 163890 Ham, gross ground water extraction for all uses is 45010.85 Ham, provision for drinking and domestic use for the year 2025 is 8649 Ham and net annual ground water available for future use is 118479 Ham. Stage of ground water development varies from 09% in Tadamandal to 66 % in Pakala mandal. All the mandals are classified as Safe Category. Summarized mandal wise groundwater resources are given in Table-4.2 and Figure No. 27

**Table 4: Ground Water Resources of Tirupati district (GWRA 2022)**

Sl. No	Mandal Name	Total area of assessment unit (Ha)	Recharge worthy area (Ha)	Recharge from Rainfall-MON	Recharge from Other Sources-MON	Total Annual Ground Water (Ham) Recharge	Total Natural Discharges (Ham)	Annual Extractable Ground Water Resource (Ham)	Irrigation Use (Ham)	Industrial Use (Ham)	Domestic Use (Ham)	Total Extraction (Ham)	Annual GW Allocation for Domestic Use as on 2025 (Ham)	Net Ground Water Availability for future use (Ham)	Stage of Ground Water Extraction (%)	Categorization (OE/Critical/Semi critical/Safe)
1	Chandragiri	45556	42154	3642.54	567.63	4917.85	245.92	4671.93	1309.9255	41.85	60.624548	1412.37	154.96	3391.18	30.23	safe
2	Pichatur	15074	13418	1400.63	797.22	3010.8	150.57	2860.23	1214.994	11.05	38.377742	1264.45	85.92	1618.15	44.21	safe
3	Kota	18227	18177	2569.51	826.88	5887.93	294.42	5593.51	1469.806	6.56	44.2692	1520.7	146.19	3982.27	27.19	safe
4	Buchinaidu Khandri	25737	25382	2020.82	917.95	5288.86	264.47	5024.39	1078.932	28.65	53.48914	1161.08	96.46	3820.34	23.11	safe
5	Ojili	24174.2	24104.22	2290.18	534.54	5233.08	261.66	4971.42	1151.0285	47.55	126.80628	1325.41	137.12	3643.79	26.66	safe
6	Sullurpeta	40080	40080	7660.98	384.52	11005.2	550.31	10454.9	1020.403	22.87	317.74152	1361.09	357.8	9053.75	13.02	safe
7	Varadaiahpalem	22666	22616	2038.29	561.21	4941.31	247.06	4694.25	647.6995	64.6	58.94296	771.23	124.08	3857.87	16.43	safe
8	Srikalahasti	32658	31315	3074.92	2812.04	8861.28	443.12	8418.16	2053.6215	60.2	566.90669	2680.78	655.59	6112.11	31.85	safe
9	Puttur	18946	17508	1780.42	334.67	2579.77	129.01	2450.76	1006.899	64.55	189.23324	1260.71	417.03	1263.86	51.44	safe
10	Chinnagottigallu	18032	17211	1178.49	690.18	2608.95	130.44	2478.51	1182.2275	10.2	32.022552	1224.47	69.46	1216.6	49.4	safe
11	Tirupati	11219	10803	927.66	284.76	1553.83	77.68	1476.15	820.0065	52.7	93.055144	965.78	399.4	473.61	65.43	safe
12	Ramachandrapuram-17	14285	11355	1046.78	444.13	2004.92	100.25	1904.67	805.0225	23.8	32.09772	860.87	83.21	1023.97	45.2	safe

Sl. No	Mandal Name	Total area of assessment unit (Ha)	Recharge worthy area (Ha)	Recharge from Rainfall-MON	Recharge from Other Sources-MON	Total Annual Ground Water (Ham) Recharge	Total Natural Discharges (Ham)	Annual Extractable Ground Water Resource (Ham)	Irrigation Use (Ham)	Industrial Use (Ham)	Domestic Use (Ham)	Total Extraction (Ham)	Annual GW Allocation for Domestic Use as on 2025 (Ham)	Net Ground Water Availability for future use (Ham)	Stage of Ground Water Extraction (%)	Categorization (OE/Critical/Semi critical/Safe)
13	Pellakur	18478.2	18478.21	1557.24	1546.13	7681.73	384.07	7297.66	1641.4645	17.5	94.23768	1753.26	105.25	5533.39	24.02	safe
14	Tirupati Urban	21790	10499	763.76	119.75	1021.17	51.07	970.1	30.326	22.65	288.48774	341.48	2425.9	516.72	35.2	safe
15	Renigunta	21940	13214	1092.1	553.18	2708.38	135.44	2572.94	745.381	134.35	220.08239	1099.79	289.63	1620.24	42.74	safe
16	Venkatagiri	30576	27478	2673.71	647.44	5435.65	271.85	5163.8	1780.186	11.3	105.91675	1897.49	424.57	3257.75	36.75	safe
17	Gudur	24566	24566	2191.61	545.75	4916.81	245.87	4670.94	1461.555	58.91	103.04836	1623.59	219.31	2978.04	34.76	safe
18	K V B Puram	38953	36439.4	3458.75	766.01	6021.94	301.14	5720.8	1918.4375	16.8	83.593408	2018.86	174.57	3775.69	35.29	safe
19	Satyavedu	25044	24991	1782.01	586.29	3637.99	181.93	3456.06	674.724	99	56.145236	829.86	139.71	2542.65	24.01	safe
20	Pakala	18155	16069	1360.55	631.95	2725.05	136.25	2588.8	1660.1485	17	50.24648	1727.4	152.03	849.53	66.73	safe
21	Tada	24924.8	24924.75	4516.41	210.58	6582.03	329.08	6252.95	446.2465	68.62	58.152132	573.06	145.32	5592.72	9.165	safe
22	Nagalapuram	19238	18861	1201.65	613.3	2414.3	120.72	2293.58	881.244	20.4	42.56382	944.25	92.34	1302.97	41.17	safe
23	Doravarisatram	27626	27626	3070.45	736.55	7334.23	366.72	6967.51	830.679	3.24	101.5362	935.56	114.73	6018.75	13.43	safe
24	Narayanavanam	11389	10776	1033.96	369.86	1926.82	96.36	1830.46	773.747	58.85	34.6476	867.27	135.04	930.07	47.38	safe
25	Vakadu	23592	23592	4483.12	267.52	7962.96	398.16	7564.8	1462.5875	8.9	54.73184	1526.29	112.15	6001.74	20.18	safe
26	Yarravaripalem	24568	15745	1006.38	1640.5	4389.96	219.5	4170.46	679.346	5.95	31.14738	716.45	73.83	3411.33	17.18	safe

Sl. No	Mandal Name	Total area of assessment unit (Ha)	Recharge worthy area (Ha)	Recharge from Rainfall-MON	Recharge from Other Sources-MON	Total Annual Ground Water (Ham) Recharge	Total Natural Discharges (Ham)	Annual Extractable Ground Water Resource (Ham)	Irrigation Use (Ham)	Industrial Use (Ham)	Domestic Use (Ham)	Total Extraction (Ham)	Annual GW Allocation for Domestic Use as on 2025 (Ham)	Net Ground Water Availability for future use (Ham)	Stage of Ground Water Extraction (%)	Categorization (OE/Critical/Semi critical/Safe)
27	Yerpedu	25977	24820	2801.16	1492.19	7077.45	353.86	6723.59	2219.878	45.05	80.370712	2345.32	153.6	4350.5	34.88	safe
28	Thottambedu	19390	18876	1487.04	1394.94	5696.7	284.83	5411.87	1152.478	46.75	69.765564	1269	122.06	4102.75	23.45	safe
29	Vadamalapeta	16599	15964	1633.93	441.85	2543.07	127.17	2415.9	1096.8135	11.05	46.83212	1154.73	91.51	1226.04	47.8	safe
30	Balayapalle	26422	26422	2173.12	1004	6049.47	302.49	5746.98	1168.514	3.24	161.08349	1332.87	177.28	4397.92	23.19	safe
31	Chillakur	33406	33406	3995.44	472.79	6907.66	345.42	6562.24	1057.162	204.12	56.74422	1318.08	145.59	5155.32	20.09	safe
32	Chittamur	27609	27609	3710.85	580.33	8855.66	442.82	8412.84	1223.3085	12.96	87.89986	1324.21	123.16	7073.26	15.74	safe
33	Dakkili	39660	31698	2691.64	894.74	7324.39	366.2	6958.19	1866.9355	0.72	111.49316	1979.16	150.47	4940.04	28.44	safe
34	Naidupeta	16379.4	16349.39	2192.44	470.55	5409.54	270.52	5139.02	1315.15	85.41	223.32693	1623.93	353.83	3444.03	31.6	safe

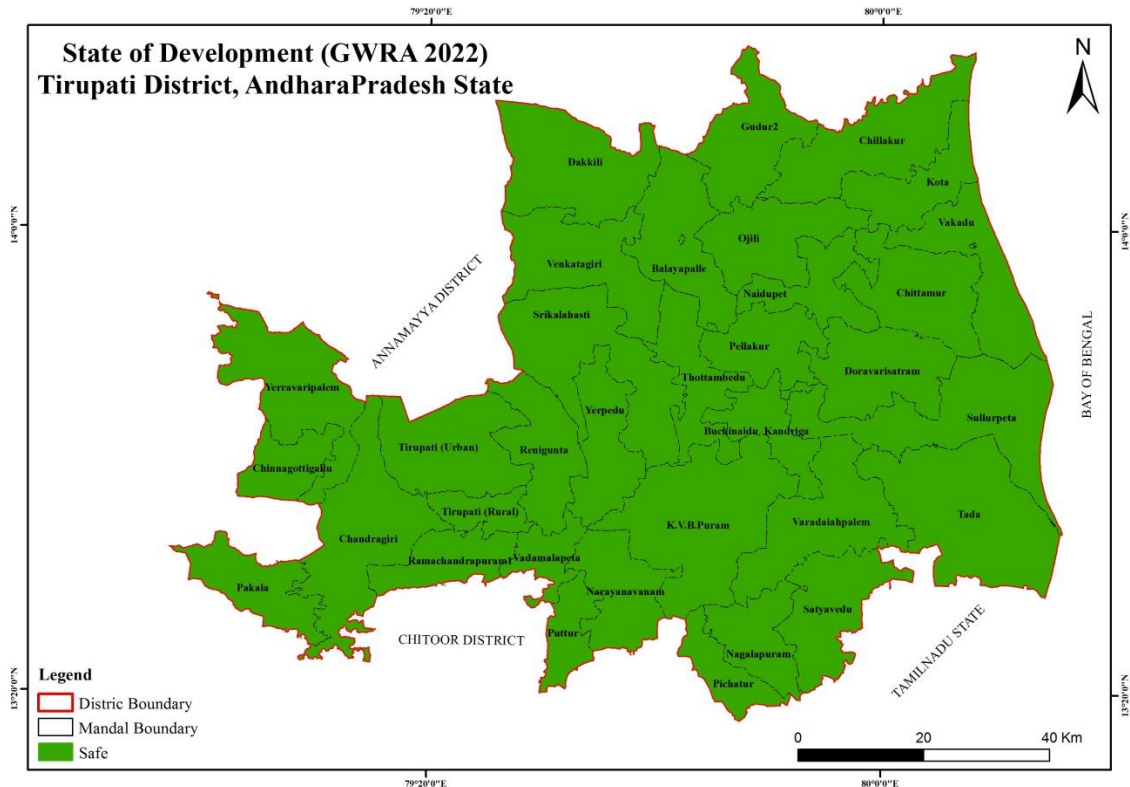


Figure 27. Stage of Ground water Development in Tirupati district

## 5 GROUND WATER RELATED ISSUES

### 5.1 Declining of water level

Due to large scale of Bore wells and shallow tube wells are the reason for declining of water level in the district. The upland mandals particularly Vengatagiri, Dakkili, Satyavedu, Sri kalahasti, Tirupathi Rural, Canagdaragiri Puthur, Yarravaripalam, Chinnagottigallu and Pakla having lack of fracture and less rainfall is the reason for the declining water level. The dug wells and bore wells used for in irrigation purposes in these mandals and this is main reason for decline of water level

### 5.2 Geogenic pollution (Fluoride)

Higher concentration of fluoride i.e. more than 1.50 ppm observed in following mandals, K.V. B Puram, Pellakur, Vadamalapet and ramachandrapuram. The reasons are higher residence time of ground water in deeper aquifer and country rock as having source of fluoride bearing minerals. The maximum fluoride concentration observed at Eguvapundi is 2.69 ppm.

### **5.3 Anthropogenic pollution (Nitrate)**

Higher concentration of Nitrate also observed from the most of mandals particularly V.Yerravaripalem, Balayapalle, Gundur, Dorvarichatram, Kota, Pakala, Srikalahasti, KVB puram Pellakur and Vadamalpet. The reason for high concentration of fluoride is unscientific sewage disposal of treated and untreated effluents in urban and rural areas and use of fertilizers and nitrogen fixation by leguminous crops.

## **6 MANAGEMENT STRATEGIES**

The occurrence of fractures in massive rocks are very limited in extent, as the compression in the rock reduces the opening of fractures at depth and in Tirupati district, the majority of fractures occur within 100m depth (90%). Higher  $\text{NO}_3^-$  concentrations ( $> 45 \text{ mg/l}$ ) in weathered zone is due to sewage contamination and higher concentration of  $\text{F}^-$  ( $>1.5 \text{ mg/l}$ ) in weathered zone and fractured zone is due to geogenic (granite/gneiss rock), high weathering, longer residence time and alkaline nature of groundwater. In general Nitrate and Fluoride contamination is sporadic due to local sewage, agricultural activities and country rocks having the fluoride bearing minerals.

### **6.1 Management plan**

Though all the mandals are categorized as safe, the management strategies are inevitable for this replenishable resource for future developmental activities. The supply side management is not necessary for the present stage of ground water development, in future if failure of monsoon and large scale of extraction for the purpose of agriculture and other industrial activities takes place, the present scenario may change. If 25% of recommended structures can be constructed wherever the development activities have increased this includes both the supply side and demand side. The supply side measure includes the state water resources department's interventions such as construction of different recharge structures and de-silting of available minor irrigation tanks. The proposed artificial recharge structure Location is given in Fig. No 28

The uneven distribution of groundwater availability and its utilization indicates that a single management strategy cannot be adopted and requires integrated hydrogeological aspects along with socio-economic conditions to develop appropriate management strategy.



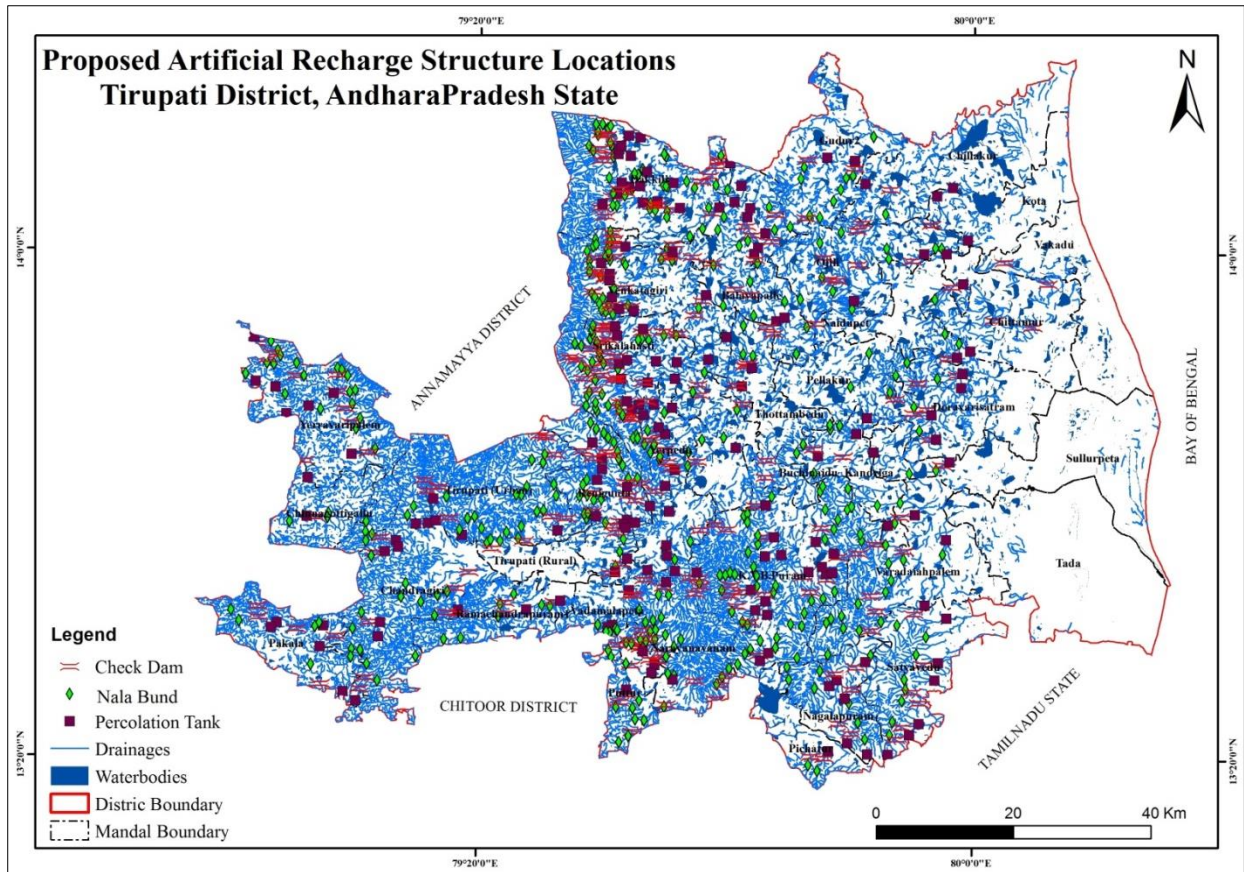


Figure 28. Proposed artificial recharge structure Location

## 6.2 Supply side measures

	Check Dams	Percolation Tanks
Total Numbers	256	17
Total Cost (lakhs)	767	130
Recharge from all CD's (MCM)	15	
Recharge from all percolation Tanks (Mcm)		8
Total Recharge (MCM)	23	
Additional Irrigation Potential likely to be created (ha)	2679	

Supply side Management calculated based on field work carried in the study area. It is found that additional Irrigation potential likely to be created around for 2679 ha. The following table's shows that the type and number of Artificial recharge can be constructed and cost of the structure also calculated based on the study.

### 6.3 Demand side measures

The demand side management calculated based Ground water resource estimation of 2022, it is observed that if the mandals taken in the account of the developments up to 60 %. The following the table are shows that the results of outcome.

GW Resource available for development for up to 60% development (mcm)	535.78
GW Resource to be developed through DW (mcm)	321.47
GW Resource to be developed through BW (mcm)	214.31
No. of DW feasible	119061
No. of BW feasible	39687

## 7 Outcome of NAQUIM

Though all the mandals are categorized as safe as per GWRA 2022 it needs attention keeping view of future ground water development. So following recommendation are suggested

- Supply side recommendation for construction of Check dams 256, Percolation Tanks 17, and renovation of village ponds 1048 considering the future developments.
- Total water can be saved is 23 MCM and total cost of the project is 2811 lakhs
- Additional Irrigation Potential likely to be created 2679 ha with above interventions.
- Demand side recommendation are the mandals which are having the resource available up to 60% developments can be by creating 535 mcm of groundwater .
- It is recommended that to avoid water logged in following mandals Kota, Tada, Sullurpeta, Vakadu, Chillakur and Chittamur mandals may be used for conjunctive use of both Ground water and surface water for irrigation and other purposes.

## Acknowledgment

The author's sincerely thanks to Shri. Sunil Kumar, Chairman, Shri. A.K.Agarwal Member (HQ) and Shri.Sathish, Member (South) of the Central Ground Water Board, Govt. of India. The author extended his sincere thanks to Dr.A. Asokan, Member (North West) Shri M. Siva Kumar, Regional Directors, SECR, Chennai and Shri.J.Siddhardha Kumar, Regional Directors, SR, Hyderabad for their support and encouragement during preparation study and report. The author also thanks to Smt.Rani V.R., Scientist D & Nodal Officers NAQUIM, Sri Vishnu and Sai Mari Young Professional and all the Officers and Staff of Southern Region, Hyderabad for their support and cooperation during study. The author thanks to State Ground Water Department, Rural Water Supply department and Chief Planning officer, Tirupati District, Government of Andhra Pradesh for making available of field data.

## References:

District Statistical Hand book, Tirupati district, Government of Andhra Pradesh, CPO (2014)

### Annexure I Mandal Wise Drinking Water Facilities in Villages, 2019-20

No.	Mandal Name		P.W.S	Bore Wells	Open Wells	Others	Fluoride Villages	Brackish Water
1	Chillakur	28	28	0	0	0	0	0
2	Chittampur	33	12	0	0	23	0	0
3	Gudur	23	19	0	0	0	0	0
4	Kota	19	19	0	0	0	0	0
5	Vakadu	32	30	2	0	1	0	0
6	Balayapalle	46	46	0	0	0	0	0
7	Dakkili	43	43	0	0	0	0	0
8	Venkatagiri	60	55	0	0	0	0	0
9	K.V.B.Puram	38	38	0	0	0	0	0
10	Nagalapuram	12	12	0	0	0	0	0
11	Narayanavanam	16	16	0	0	0	0	0
12	Pichatur	17	17	0	0	0	0	0
13	Renigunta	30	30	0	0	0	0	0

No.	Mandal Name		P.W.S	Bore Wells	Open Wells	Others	Fluoride Villages	Brackish Water
14	Srikalahasti	62	62	0	0	0	0	0
15	Thottambedu	40	40	0	0	0	0	0
16	Yerpedu	32	32	0	0	0	0	0
17	Buchinaidu Kandriga	24	24	0	0	0	0	0
18	Satyavedu	30	30	0	0	0	0	0
19	Varadaiahpalem	29	29	0	0	0	0	0
20	Doravarisatram	42	36	0	0	5	0	0
21	Naidupet	33	29	0	0	0	0	0
22	Ojili	43	44	0	0	0	0	0
23	Pellakur	28	25	0	0	2	0	0
24	Sullurpeta	40	28	0	0	4	0	0
25	Tada	22	21	0	0	1	0	0
26	Chandragiri	23	23	0	0	0	0	0
27	Chinnagottigallu	10	10	0	0	0	0	0
28	Pakala	15	15	0	0	0	0	0
29	Ramachandrapuram	17	17	0	0	0	0	0
30	Tirupati Rural	29	29	0	0	0	0	0
31	Tirupati Urban	2	2	0	0	0	0	0
32	Yerravaripalem	10	10	0	0	0	0	0
33	Puttur	18	18	0	0	0	0	0
34	Vadamalapeta	19	19	0	0	0	0	0
35	Tirupati Urban	5	5	0	0	0	0	0
		148	148	0	0	0	0	0
		970	913	2	0	36	0	0

Annexure II Source wise Irrigation in Tirupati District

No.		Dug well	Shallow Tube well	Medium Tube well	Deep Tube well		S. Flow Scheme			
1	Chillakur	0	0	0	0	0	0	0	0	0
2	Chittampur	0	0	0	0	0	0	0	0	0
3	Gudur	0	0	0	0	0	0	0	0	0
4	Kota	0	0	0	0	0	0	0	0	0
5	Vakadu	0	0	0	0	0	0	0	0	0
6	Balayapalle	1210	679	11	0	1900	79	290	369	2269
7	Dakkili	772	757	1356	0	2885	63	269	332	3217
8	Venkatagiri	287	165	1603	182	2237	98	216	314	2551
9	K.V.B.Puram	1331	1275	278	118	3002	99	0	99	3101
10	Nagalapuram	659	1084	393	0	2136	27	0	27	2163
11	Narayanavanam	488	97	574	192	1351	21	0	21	1372
12	Pichatur	641	380	449	492	1962	35	0	35	1997
13	Renigunta	648	575	196	218	1637	46	0	46	1683
14	Srikalahasti	499	70	3033	56	3658	97	0	97	3755
15	Thottambedu	825	661	722	95	2303	118	0	118	2421
16	Yerpedu	1484	410	2295	633	4822	92	0	92	4914
17	Buchinaidu Kandriga	345	0	1244	37	1626	84	0	84	1710
18	Satyavedu	731	45	316	70	1162	117	0	117	1279
19	Varadaiahpalem	491	543	28	0	1062	80	0	80	1142
20	Doravarisatram	0	0	0	0	0	0	0	0	0
21	Naidupet	0	0	0	0	0	0	0	0	0
22	Ojili	0	0	0	0	0	0	0	0	0
23	Pellakur	0	0	0	0	0	0	0	0	0
24	Sullurpeta	0	0	0	0	0	0	0	0	0
25	Tada	0	0	0	0	0	0	0	0	0
26	Chandragiri	2458	79	137	1032	3706	11	0	11	3717
27	Chinnagottigallu	917	0	9	1326	2252	180	0	180	2432
28	Pakala	2545	3	0	1787	4335	125	0	125	4460
29	Ramachandrapuram	1272	121	897	864	3154	16	0	16	3170
30	Tirupati Rural	1063	1	1297	138	2499	29	0	29	2528
31	Tirupati Urban	105	2	13	4	124	6	0	6	130
32	Yerravaripalem	141	0	2	1030	1173	240	0	240	1413
33	Puttur	1370	140	673	332	2515	31	0	31	2546
34	Vadamalapeta	386	374	980	798	2538	59	0	59	2597
35	Tirupati Urban	85	3	8	2	98	4	0	4	102
		10342	723	4016	7313	22394	701	0	701	23095
		20753	7464	16514	9406	54137	1757	775	2532	56669

**Annexure III Source wise, Mandal wise NET area Irrigated In hectare**

Sl. No	Mandal Name	Canals	Tanks	Tube Wells	Dug Wells	Lift Irrigation	Other Sources	Total	Area irrigated more than once	Gross area Irrigated
1	Chillakur	0	3021	532	149	641	0	4343		
2	Chittampur	1600	4364	2318	286	618	0	9186	82	4425
3	Gudur	870	1721	3597	0	0	0	6188	405	9591
4	Kota	0	2164	2631	185	0	0	4980	0	6188
5	Vakadu	2851	2241	1081	0	0	0	6173	452	5432
6	Balayapalle	0	2307	2533	22	22	0	4884	235	6408
7	Dakkili	202	2850	1737	0	0	0	4789	21	4905
8	Venkatagiri	280	1971	1192	0	0	0	3443	297	5086
9	K.V.B.Puram	235	440	1731	411	0	0	2817		
10	Nagalapuram	30	0	1376	140	0	0	1546	1656	4473
11	Narayanavanam	0	129	1588	176	0	0	1893	750	2296
12	Pichatur	145	52	2107	382	0	0	2686	517	2410
13	Renigunta	422	409	314	130	0	0	1275	754	3440
14	Srikalahasti	0	2915	1695	0	0	0	4610	165	1440
15	Thottambedu	0	2963	1466	248	0	0	4677	1392	6002
16	Yerpedu	448	1505	3254	2	0	0	5209	692	5369
17	Buchinaidu Kandriga	0	3059	1315	196	0	0	4570		
18	Satyavedu	0	944	618	1220	0	0	2782	478	5048
19	Varadaiahpalem	0	3370	1047	410	0	0	4827	762	3544
20	Doravarisatram	0	4634	1614	103	0	0	6351	444	5271
21	Naidupet	0	3091	1120	0	0	0	4211	150	6501
22	Ojili	0	3040	1201	0	0	0	4241	1317	5528
23	Pellakur	2853	2192	1811	0	0	0	6856	68	4309
24	Sullurpeta	0	4515	776	0	0	0	5291	344	7200
25	Tada	0	2201	378	0	208	570	3357	248	5539
26	Chandragiri	0	0	1355	402	0	0	1757		
27	Chinnagottigallu	0	0	2438	0	0	0	2438	831	2588
28	Pakala	0	0	1982	0	0	0	1982	120	2558
29	Ramachandrapuram	0	0	2095	670	0	0	2765	374	2356
30	Tirupati (Rural)	0	0	773	93	0	0	866	1233	3998
31	Tirupati (Urban)	0	0	46	18	0	0	64	204	1070
32	Yerravaripalem	32	84	1034	0	0	0	1150	20	84
33	Puttur	0	45	3234	40	0	0	3319	309	1459
34	Vadamalapeta	0	0	1616	186	0	0	1802	382	3701
35	Tirupati (Urban)	0	0	19	0	0	0	19	365	2167
	Sub-Total	32	129	14592	1409	0	0	16162	5	24
		9968	56227	53624	5469	1489	570	127347	3843	20005
									16516	143863

#### Annexure IV Combined Water level data of Key wells and NHS

Sl. No	Location	Lattitude	Longitude	Pre	Post	Fluctuation
1	Vengateswarapuram (Dakkili Forest))	14.11140	79.50570	1.5	0.3	1.2
2	Mattumudagu (Border Well of Dakilli In Placve of Vardanapalle)	14.03070	79.62310	1.5	0.9	0.6
3	Momidi	14.19480	80.04560	4.35	3.74	0.61
4	Thamminapatnam	14.23110	80.10090	2.14	1.13	1.01
5	Valamedu	14.02390	80.12180	3.01	1.73	1.28
6	Maddali	14.04212	79.95648	2.27	0.32	1.95
7	Mangalapur	14.12111	79.79430	1.79	0.87	0.92
8	Pakapudi (Old)	14.02662	79.69352	1.67	0.55	1.12
9	Kamakuru	13.97014	79.71133	4.49	1.68	2.81
10	Peda Pariya	14.03096	79.87014	6.93	4	2.93
11	Kundam	13.97137	79.78589	3.36	1.83	1.53
12	Jangalapalli (Muddampalle)	13.97183	79.60675	1.38	1.02	0.36
13	Arur (Tadimedu)	13.90955	80.05167	2.14	0.58	1.56
14	Mallam (Devuni Khandrika U.I)	13.95083	80.11099	1.27	0.6	0.67
15	Maneri (Suragunta Tagelu)	13.78568	80.02638	1.97	0.53	1.44
16	Degala Palem	13.70564	80.02892	1.51	1.16	0.35
17	Atakanithippa	13.72261	80.12341	0.7	0.69	0.01
18	Nagiganiapallee	13.60961	79.29813	6.18	4.53	1.65
19	Yeruvripalem	13.70051	79.12398	5.45	1	4.45
20	Mallelavandanapalli	13.70868	79.20506	4.4	2.15	2.25
21	Koraparthivaripalle	13.77633	79.12122	4.38	2.85	1.53
22	Turkapalli	13.78852	79.04530	5.76	2.2	3.56
23	Gundlabailu (Ayyakaripalli)	13.84084	79.10175	2.67	1.3	1.37
24	Kattakiruntghapalle	13.47318	79.04447	2.08	1.67	0.41
25	Mulapalle	13.59806	79.21389	4.17	3.93	0.24
26	Danamurtipalle	13.51970	79.21720	6.03	4.5	1.53
27	Mitta Gadanki	13.45889	79.17020	4.5	3.8	0.7
28	Gandlapalle	13.40517	79.17326	5.28	3.2	2.08
29	Opprapalli(Kannipakam)	13.41955	77.22804	5.71	2.9	2.81
30	Veppakupam ( Katta Veppakuppam)	13.49319	79.31538	4.78	4.6	0.18
31	Kalepalle	13.49949	79.35895	1.85	0.9	0.95
32	Gangireddypalle	13.53928	79.39987	6.81	4.23	2.58
33	Appalayagunta	13.53189	79.48096	6.05	3	3.05
34	Battikandriga	13.51113	79.50646	2.67	0.44	2.23
35	Mantapampalle	13.53319	79.30835	8.07	6.92	1.15
36	Tiruchanur	13.60277	79.45341	2.98	2.8	0.18
37	Padiredu(Mannavaram))	13.55795	79.53724	4.57	3.74	0.83
38	Chinnarajukuppam	13.42712	79.50918	1.86	1.53	0.33
39	Kailasapuram	13.38384	79.56919	2.81	0.75	2.06
40	Kumarbommarajapuram	13.35582	79.51158	7.96	7.68	0.28

Sl. No	Location	Lattitude	Longitude	Pre	Post	Fluctuation
41	Govindappanayudukandriga	13.40669	79.63231	3.09	1.84	1.25
42	Eguvaputturu	13.44125	79.69156	1.95	0.2	1.75
43	Pichchaturu	13.39289	79.73307	0.89	0.68	0.21
44	Eguvapundi	13.57284	79.77732	4.6	0.49	4.11
45	Ragigunta (Kothur))	13.62911	79.72915	6.58	1.15	5.43
46	Khrisnapuram	13.68062	79.55730	5.22	1.15	4.07
47	Diguvavidhi	13.70587	79.66057	5.61	1.5	4.11
48	Mucchavolu	13.80351	79.63450	3.17	0.75	2.42
49	Sirasamambedu	13.85773	79.86211	2.41	1.22	1.19
50	Venad	13.64058	80.13075	2.76	1.56	1.2
51	Kethagonda	13.63398	80.02127	1.57	1.56	0.01
52	Chinnapanduru	13.54196	79.94200	1.68	0.82	0.86
53	Nellathur(Chenchuramasettikandrika)	13.62346	79.96958	2.86	1.65	1.21
54	Santaveluru	13.68031	79.93582	2.02	1.2	0.82
55	Alattur (Basavannagunta)	13.73509	79.80328	3.86	1.9	1.96
56	Peddapalvedu	13.73269	79.85267	1.06	0.82	0.24
57	Anjuru ( Padamaravaturu)	13.65388	79.78488	3.43	1.96	1.47
58	Sivanadapalaem (Parlapalee)	13.71897	79.74401	0.27	0.1	0.17
59	Vallivedu (Manigadaru Khandrika)	13.90749	79.60180	1.2	0.75	0.45
60	Siddagonta(Muddampalle)	13.97140	79.63651	2.59	1.29	1.3
61	Anjaneyapuram RS	13.69844	79.48853	7.36	3.68	3.68
62	Mamanduru	13.74968	79.45850	6.3	3.25	3.05
63	Kukkala Doddi	13.77251	79.42851	8.39	5.87	2.52
64	Ammasi Reddy Kandriga	13.4564	79.9636	2.57	2.83	-0.26
65	Aravapalem	13.8783	80.1564	2.7	1.18	1.52
66	Atkanitipa	13.7239	80.1231	3.05	0.6	2.45
67	Baita Kodiam Bedu	13.3694	79.8142	4.91	4.5	0.41
68	Balijepalli	13.5211	79.3806	3.04	2.39	0.65
69	Brahmana Puduru Agraharam	13.9306	80.0383	1.95	1.86	0.09
71	Chinna Panduru	13.3778	79.9414	2.98	1.87	1.11
72	Chittedu	14.0542	79.9806	3.6	0.98	2.62
73	Durgarajapatnam	13.8783	80.1564	2.17	1.07	1.1
74	Erpedu1	13.6969	79.5939	2.79	0.4	2.39
75	Gollapalli	13.9503	79.5867	6.9	5.63	1.27
76	Gopalpuram	14.0206	79.605	1.95	1.65	0.3
77	Guthuvaripalli(R.P. Agraharam)	13.6514	79.5425	4.53	2.58	1.95
78	Kesavaram	14.0625	79.9597	5.75	3.1	2.65
79	Krishnapuram	13.7811	79.9689	5.2	5.31	-0.11
80	Madam Bedu	13.4111	79.9283	7.83	8.1	-0.27
81	Melchuru	13.8147	79.9478	0.94	1	-0.06
82	Mungilipattu	13.5606	79.2494	3.41	3.33	0.08
83	Naagalapuram (Krishnapuram)	13.3956	79.7769	3.76	2.21	1.55
84	Nilavaai	14.4703	79.9008	2.08	1.35	0.73



<b>Sl. No</b>	<b>Location</b>	<b>Lattitude</b>	<b>Longitude</b>	<b>Pre</b>	<b>Post</b>	<b>Fluctuation</b>
85	Pallem	13.82	79.5844	2.45	1.73	0.72
86	Puttur	13.4447	79.5511	2.46	1.6	0.86
87	Puttur	13.4574	79.54628	2.56	1.11	1.45
88	Ramareddypalem	14.1589	79.3753	1.82	1.28	0.54
89	Satyavedu	13.4256	79.9514	1.08	0.99	0.09
90	Srikalahasti	13.7658	79.7164	4.52	3.35	1.17
91	Suritipalli	13.6733	79.3283	2.62	0.18	2.44
92	Tallampadu	13.7281	79.9503	2.56	-0.8	3.36
93	Tikkavaram	14.1278	79.8617	2.1	3.04	-0.94
94	Tirumala1	13.6847	79.3444	2.61	1.49	1.12
95	Tirupati(U)	13.6422	79.4214	6.13	5.08	1.05
96	Valiveedu-PZ	13.5272	79.0761	1.79	0.55	1.24
97	Venkatagiri	13.95	79.5878	6.02	7.02	-1
98	Vidyanagar-Alt	14.0258	80.0269	4.54	2.48	2.06

### Annexure V Details of Exploratory wells (in house) in Tirupati District

S.No	Block / Mandal	Location	Longitude	Latitude	Depth Drilled (mbgl)	Total Depth (mbgl)	Casing depth (mbgl)	Major Lithology	From	to	From	to	From	to	S.W.L ( m.bgl )	Discharge (lpm)	Drawdown (m)	T	EC ( Micro siemens/cm)
1	Puttur	Puttur	79.550	13.420	200	200	17.5	GRANITE	80.00	80.10	183.00	183.30			8.02	0.00	NA	1.13	1052.00
2	Ramachandrapuram	Kammapalle	79.440	13.550	200	200	24.5	GRANITE	27.00	27.10	103.00	103.50	171.00	171.20	11.50	354.00	10.19	29.21	905.00
3	chinnagottugalu	chinnagottupalle	79.088	13.650	200	200	20.34	GRANITE	16.55	17.55	50.47	51.47			6.85	45.60	17.55	1.48	1201.00
4	Tirupati(U)	Tirupati West Rs	79.399	13.625	200	200	24.58	GRANITE	43.65	44.65					16.15	30.00	13.15	2.48	1688.00
5	Venkatagirikota	Bairupalli	78.507	12.950	140	140	18.28	GRANITE	114.49	115.49	127.49	128.04			15.80	510.00	19.05	23.64	
6	Venkatagirikota	Bairupalli	78.507	12.950	140	140	11.69	GRANITE	40.74	41.74	122.22	123.22	128.04	129.04	15.42	420.00	18.80	26.40	808.00
7	Venkatagirikota	Venkatagirikota	78.483	12.983	200	200	17.79	GRANITE	21.20	22.20					4.64	0.84	NA	1.61	727.00
8	Yerravaripalem	V.R.Agraharam	79.178	13.042	200	200	13.42	GRANITE	42.65	43.65					5.60	30.00	NA	7.03	733.00
9	Tirupati (Rural)	Cherlapalle	79.360	13.590	200	200	29.6	GRANITE	dry						12.21	0.00	NA	1.02	NA
10	Pakala	Gudivaripalli	79.181	13.450	200	200	11.7	GRANITE	18.00	18.50	40.00	40.50			4.85	90.00	9.68	7.92	1023.00
11	Chandragiri	Mungalipattu	79.247	13.559	200	200	29.6	GRANITE	131.00	131.50					12.21	12.96	NA	1.06	1021.00
12	Pakala	Talupula	79.999	13.743	200	200	17.5	GRANITE	dry						6.75	0.00	NA	1.10	NA
13	Tirupati (Rural)	Tummalakunta	79.390	13.610	200	200	45.27	GRANITE	65.00	65.50	86.00	86.50			20.40	270.00	9.23	14.26	986.00
14	Tirupati (Rural)	Tummalakunta	79.320	13.630	200	200	42.2	Granite	61.00	61.50					20.80	45.00	4.63	54.83	987.00

## Annexure VI Interpreted Results of VES in Tirupati District

Sr No.	Block	Village	Longitude	Latitude	Year of Study	R1	H1 (m)	R2	H2 (m)	R3	H3 (m)	R4	H4 (m)	R5	Inferred Lithology	Identified weathered formation (m)		Thickness of weathered formation (m)		Depth of fractures contact (m)	
1	Gudur2	Vinduru	79.8275	14.1793	2021-22	12	3	5	6	4706					Alluvium	3	10	7			
2	Balayapalle	Nindali	79.7061	14.1045	2021-22	13	3.81	2	3	4940					Schist	0	10	10			
3	Dakkili	Sreepuram	79.6372	14.0456	2021-22	6.92	1.18	2.58	3.89	9864					Banded gneissic	0	10	10			
4	Balayapalle	Jangalapalle	79.6161	13.9748	2021-22	91.58	0.95	32.39	2.62	115.5	15.14	1080			Banded gneissic	0	18	18			
5	Venkatagiri	Mokkalapudi	79.5535	13.9617	2021-22	28.7	4.55	12.3	2.13	98.6	33.3	VH			Banded gneissic	4	25	31			
6	Chillakur	Chillakur	79.8769	14.1217	2021-22	31.1	0.65	254	0.52	54	68.4	781			Alluvium	10	35	25	60	70	
7	Chillakur	Kalavakonda	79.9611	14.1201	2021-22	80	1.2	8.56	16.4	28					Schist	3	20	17			
8	Chillakur	Vaddi Kandriga	80.0181	14.1083	2021-22	120	1.15	7.74	1.04	47.6	15	4.83	76.2	139	Laterite	10	45	35			
9	Chillakur	Momidi	80.0517	14.1952	2021-22	475	1.29	19.3	4.78	101	8.32	1.14			Alluvium	0	10	10			
10	Chillakur	Vellapalem	80.0644	14.1082	2021-22	576	5.95	285	0.77	5.17					Alluvium	0	10	10	50	60	
11	Kota	Maddali	79.9528	14.0463	2021-22	21.2	2.71	9.31	32	16.2					Schist	2	34	32			
12	Kota	Kota	80.0482	14.0233	2021-22	18.6	15.5	6.19	83.2	350					Alluvium	16	51	35	100	120	
13	Vakadu	Juvvinattu	80.1143	14.0354	2021-22	NI									Alluvium						
14	Chittampur	Vadlavanipalle	80.1243	13.9662	2021-22	VH	0.3	38	1.37	5.27	24.9	2.89			Alluvium	2	27	25			
15	Chittampur	Eswarawaka	80.0322	13.9592	2021-22	8.00	1.95	2.47	1.57	9.83	42.43	61.72			Alluvium	3	45	42	140	160	
16	Gudur2	Mangalapur	79.7966	14.1300	2021-22	69.2	0.56	403	1.14	17.9	2.82	1010			Schist	0	15	15	30	40	
17	Gudur2	Kandra	79.7977	14.0491	2021-22	263	0.49	19.2	4.35	311	53.1	859			Schist	4	24	20			
18	Ojili	Kundam	79.7886	13.9817	2021-22	28.1	9.56	183	81.8	284					Schist	0	15	15	100	120	
19	Balayapalle	Gottikadu	79.7201	14.0307	2021-22	80.9	0.72	11.4	8.2	93.6	42	7788			Schist	8	40	32	90	100	
20	Ojili	Jarlapadu	79.7089	13.9882	2021-22	31.2	10.1	235	75.9	797					Banded gneissic	0	10	10	45	50	
21	Ojili	Peda Periya	79.8755	14.0229	2021-22	11.2	1.68	39	35.8	7924					Schist	2	33	31	60	70	
22	Ojili	Kothapeta	79.8836	13.9421	2021-22	7.46	1.19	3.17	1.83	10.7	12.8	1064			Alluvium	0	15	15			
23	Pellakur	Palachuru	79.8058	13.8818	2021-22	55.9	1.39	7.73	10.6	542					Banded gneissic	0	13	13			

Sr No.	Block	Village	Longitude	Latitude	Year of Study	R1	H1 (m)	R2	H2 (m)	R3	H3 (m)	R4	H4 (m)	R5	Inferred Lithology	Identified weathered formation (m)		Thickness of weathered formation (m)	Depth of fractures contact (m)										
24	Venkatagiri	Yathaluru	79.6434	13.8922	2021-22	9.47	2.51	52.2	20.3	5365					Banded gneissic	0	12	12											
25	Dakkili	Althurupadu	79.5532	14.0528	2021-22	24.6	0.66	298	1.01	10.2	3.84	604			Banded gneissic	0	7	7											
26	Naidupet	Darakastu Kandriga	79.9248	13.9744	2021-22	11	1.86	7.43	29.6	2921					Alluvium	0	30	30											
27	Pellakur	Kanuru	79.8813	13.8711	2021-22	6.04	0.56	215	0.63	13.4	5.04	1295			Alluvium	0	10	10											
28	Pellakur	Chavali	79.8449	13.8704	2021-22	76.4	1.88	11.7	23.7	332					Schist	2	25	23											
29	Pellakur	Punabaka	79.7935	13.8228	2021-22	4.32	2.7	7.84	10.8	523					Banded gneissic	3	13	10	30	40									
30	Gudur2	Gudur	79.8370	14.1375	2021-22	19.5	9.14	7.47	5.47	7732					Schist														
31	Sullurpeta	Kasvareddypalem	80.0308	13.6948	2021-22	NI-Saline											Alluvium												
32	Sullurpeta	Kudiri	80.0658	13.7042	2021-22																			Alluvium					
33	Sullurpeta	Attakanipeta	80.1208	13.7151	2021-22																			Alluvium					
34	Sullurpeta	Kollapattu	80.1463	13.7759	2021-22																			Alluvium					
35	Tada	Venadu	80.1275	13.6661	2021-22																								
36	Doravarisatram	Mangalampadu	79.9329	13.7313	2021-22	90.5	2.65	18.7	3.21	113	44.5	VH			Banded gneissic	0	15	15											
37	Sullurpeta	Degavari Kandriga	79.8962	13.7335	2021-22	24.2	3.11	9.92	3.67	9806					Banded gneissic	0	7	7											
38	Doravarisatram	Buduru	79.9255	13.7670	2021-22	42.2	1.17	20.9	6.22	72	22.7	VH			Alluvium	7	30	23											
39	Pellakur	Modugul;Apalem	79.8951	13.7813	2021-22	1.34	2.97	3.37	2.69	VH	5.66				Banded gneissic	0	7	7											
40	Doravarisatram	Akkarapaka	79.9602	13.7876	2021-22	24.7	1.52	67.3	1.63	9.79	2.87	676			Schist	0	15	15											
41	Tada	Akkampeta	80.0171	13.6497	2021-22	21	6	2							Laterite	0	6	6											
42	Tada	Tada	80.0350	13.5859	2021-22	40.77	7.852	98.2	6.05	12.01					Laterite	0	20	20											
43	Tada	Konnambattu	79.9805	13.6862	2021-22	9.79	0.89	11.9	9.12	8.18	16.8	332	23.8	1.74	Alluvium	0	27	27											
44	Tada	Vatambedu	80.0505	13.6624	2021-22	NI-Saline											Alluvium												
45	Doravarisatram	Thogaramudi	80.0448	13.7587	2021-22	2.25	0.62	47.3	0.85	2.71	10.5	1.65			Alluvium	0	15	15											
46	Doravarisatram	Kalluru	80.0129	13.7974	2021-22	48.5	0.59	1241	1.21	25	71.6	3096			Schist	2	25	23	60	70, 140									
47	Doravarisatram	Mylangam	79.9660	13.8300	2021-22	41.5	3.58	2.08	3.02	9.5	25.6	8339			Schist	2	26	24	45	60									
48	Chittampur	Chillamuru	80.0253	13.8743	2021-22	191	2	26.5	3.61	5.71	32.7	3108			Schist	6	38	32											

Sr No.	Block	Village	Longitude	Latitude	Year of Study	R1	H1 (m)	R2	H2 (m)	R3	H3 (m)	R4	H4 (m)	R5	Inferred Lithology	Identified weathered formation (m)		Thickness of weathered formation (m)	Depth of fractures contact (m)	
49	Naidupet	Gottiprolu	79.9870	13.9447	2021-22	47.7	1.87	188	2.23	5.66	2.12	95.8			Schist	0	10	10		
50	Chittampur	Burudagalli Kothapalem	80.1221	13.8821	2021-22	10.1	1.74	2.54	3.61	1.33					Alluvium	0	10	10		
51	Chittampur	Gunapadu	79.9679	13.9863	2021-22	89.96	1.20	10.94	6.20	28.47	31.39	630.1			Alluvium	8	39	31		
52	Venkatagiri	Yathaluru	79.6432	13.8865	2021-22	5	0.6	438	0.9	6	2.8	1081			Banded gneissic	0	10	10		
53	Venkatagiri	Yathaluru	79.6442	13.8888	2021-22	137	1.22	11	9.02	262					Banded gneissic	0	11	11		
54	Balayapalle	Gottikadu	79.7109	14.0317	2021-22	35	2.51	4	4.85	729					Schist	0	10	10		
55	Balayapalle	Nindali	79.7065	14.1013	2021-22	35	1.85	20	17.1	1251					Schist	2	19	17	55	60
56	Balayapalle	Kamakuru	79.7092	13.9602	2021-22	27	2.2	6	4.11	1202					Banded gneissic	0	10	10		

### Annexure VII Key wells samples rresults of Chemical Analysis Data of Tirupati district

Sl. No.	Location	pH	E C in □S/cm	TH	Ca	Mg	Na	K	Fe	Cl	SO <sub>4</sub>	NO <sub>3</sub>	F	Alkalinity	Turbidity (NTU)				
																mg/L			
1	Vengateswarapuram (Dakkili Forest))	8.2	120	50	9.018	6.6825	3.91	0.782	N.A.	10.635	5.28	1.44	0.19	37.5	3	0	46	66	1.0
2	MATTUMUDAGU (Border Well Of Dakilli In Placve Of Vardanapalle)	7.43	1540	480	68.136	75.33	118.5	25.02	N.A.	177.25	5.28	65.3	0.74	460	3.9	0	561	878	4.8
3	Kothapatnam	7.6	280	100	32.064	4.86	16.1	3.519	N.A.	31.905	1.92	9.07	0.04	85	3.3	0	104	163	0.3
4	Valamedu	7.25	5170	1600	180.36	279.45	441.6	16.03	N.A.	1418	271.7	1.38	0.14	300	2.7	0	366	2832	35
5	Maddali	7.46	1800	550	72.144	89.91	158.2	4.301	N.A.	326.14	7.68	68.2	0.51	375	4.2	0	458	1006	3.6
6	Mangalapur	7	5030	1375	180.36	224.78	294.4	387.9	N.A.	1028.1	159.8	183	1.19	750	4.1	0	915	3018	24
7	PAKAPUDI (Old)	7.42	870	285	28.056	52.245	65.55	5.474	N.A.	85.08	2.4	3.45	0.56	310	4.9	0	378	474	7.6
8	Kamakuru	7.14	1670	570	72.144	94.77	98.44	39.49	N.A.	177.25	12	90.1	1.25	500	4.1	0	610	958	10
9	Peda Pariya	7.27	1880	480	44.088	89.91	207.2	6.647	N.A.	262.33	7.68	2.7	0.85	560	3.7	0	683	1038	7.9
10	Kundam	7.27	840	320	50.1	47.385	26.22	33.24	N.A.	49.63	8.64	0.92	0.4	340	3.8	0	415	470	2.6

Sl. No.	Location	pH	E C in $\square$ S/cm	TH	Ca	Mg	Na	K	Fe	Cl	SO <sub>4</sub>	NO <sub>3</sub>	F	Alkalinity	Turbidity (NTU)	CO3	HCO3	TDS	Uranium
				mg/L															
11	Jangalapalli (Muddampalle)	7.27	740	265	58.116	29.16	38.41	16.42	N.A.	63.81	14.4	0.15	0.86	265	2.2	0	323	419	1.4
12	Punneppallee (Kothapeta)	7.37	2120	500	72.144	77.76	253	6.256	N.A.	453.76	92.64	4.2	0.36	320	4.2	0	391	1198	12
13	Arur (Tadimedu)	7.56	390	150	22.044	23.085	19.09	2.346	N.A.	56.72	0.48	6.1	0.65	110	3.2	0	134	212	1.0
14	Mallam (Devuni Khandrika U.I)	7.2	2320	460	80.16	63.18	227.7	159.5	N.A.	453.76	179	64.8	0.19	280	2.3	0	342	1437	4.3
15	Maneri (Suragunta Tagelu)	6.82	5410	1500	280.56	194.4	466.9	147	N.A.	1418	235.2	73	0.43	400	2.6	0	488	3113	85
16	Degala Palem	7.25	1620	290	56.112	36.45	223.8	25.42	N.A.	304.87	18.24	1.13	0.66	360	2.1	0	439	935	3.7
17	Atakanithippa	7.23	920	355	50.1	55.89	31.28	28.54	N.A.	106.35	4.32	6.65	0.83	300	2	0	366	507	6.8
18	Nagiganiapallee	7.04	1750	575	112.22	71.685	134.3	5.474	N.A.	269.42	4.32	32.2	0.63	465	2.9	0	567	976	152
19	Yeruvripalem	7.2	930	290	40.08	46.17	76.13	7.038	N.A.	77.99	1.44	4.4	1.02	350	4.3	0	427	515	38
20	Mallelavanandapalli	7.33	560	215	55.11	18.833	28.52	1.955	N.A.	42.54	18.72	0.62	0.36	200	3.1	0	244	316	20
21	Koraparthivaripalle	7.3	830	275	55.11	33.413	62.33	3.128	N.A.	106.35	13.44	0.9	0.56	250	2.2	0	305	461	41
22	Turkapalli	7.26	930	255	50.1	31.59	90.62	9.775	N.A.	99.26	12.96	2.3	1.01	310	4.7	0	378	528	16
23	Gundlabailu (AYYAKARIPALLI)	7.42	2790	500	128.26	43.74	80.96	563	N.A.	340.32	74.88	194	0.55	680	3.4	0	830	1932	569
24	Chinnagollapalli	7.19	1530	270	80.16	17.01	226.6	0.782	N.A.	163.07	12.48	57.7	0.62	475	3.3	0	580	912	39
25	Bodireddigaripalle	7.2	980	250	28.056	43.74	109	1.564	N.A.	60.265	6.24	4.3	0.91	395	4.9	0	482	548	456
26	Yenadisesapuram	7.12	1420	230	46.092	27.945	215.7	7.82	N.A.	106.35	9.6	0.04	1.21	550	2.2	0	671	824	333
27	Kattakiruntghapalle	7.24	950	240	46.092	30.375	106.5	2.346	N.A.	60.265	13.92	0	0.78	375	2.6	0	458	539	9.7
28	Cherlapalle	7.06	2122	620	72.144	106.92	201	1.4	N.A.	326.14	85	19.5	1.05	540	2.6	0	659	1215	116
29	Mulapalle	7.3	551	180	36.072	21.87	37.4	7.1	N.A.	38.995	17.5	0.65	0.95	215	3.5	0	262	321	6.8
30	Danamurtipalle	7.2	996	160	40.08	14.58	143.2	0.8	N.A.	77.99	27	6.3	0.93	360	2.6	0	439	579	42
31	Mitta Gadanki	7	1378	470	120.24	41.31	97.1	5	N.A.	127.62	72.5	42.3	0.57	430	2.9	0	525	827	17
32	Mogarala (Yenumalavaripalle)	6.95	2126	680	88.176	111.78	178	6	N.A.	283.6	160.8	60.5	0.83	500	3	0	610	1262	576
33	Gandlapalle	7.1	930	280	56.112	34.02	76	2.9	N.A.	28.36	15	2.2	0.85	410	2.9	0	500	521	7.0
34	Opprapalli(Kannipakam)	7.05	996	320	60.12	41.31	96	1.5	N.A.	35.45	35	1	1.07	450	2.9	0	549	606	11

Sl. No.	Location	pH	E C in □S/cm	TH	Ca	Mg	Na	K	Fe	Cl	SO <sub>4</sub>	NO <sub>3</sub>	F	Alkalinity	Turbidity (NTU)	CO3	HCO3	TDS	Uranium
				mg/L															
35	Veppakupam (Katta Veppakuppam)	7.2	1100	260	48.096	34.02	133.1	3.2	N.A.	56.72	37	3.1	1.6	450	3.3	0	549	652	27
36	Kalepalle	7.2	1015	280	48.096	38.88	102.1	5.63	N.A.	28.36	40	2	1.15	440	3.7	0	537	594	53
37	Gangireddypalle	7.19	745	280	52.104	36.45	58	2	N.A.	28.36	23.5	7.4	0.66	330	3.9	0	403	454	15
38	Appalayagunta	6.7	755	245	44.088	32.805	64.25	1.38	N.A.	24.815	29.25	3	0.74	315	3.2	0	384	435	3.7
39	Battikandrige	7.1	1450	420	88.176	48.6	119.1	28.5	N.A.	49.63	40	2.2	1.62	630	3	0	769	847	41
40	Sribommarajapuram	7	2287	660	112.22	92.34	192.1	22.37	N.A.	283.6	130	80	0.73	560	2	0	683	1330	134
41	Mantapampalle	7.3	335	125	18.036	19.44	22	0.43	N.A.	17.725	11.75	0.71	0.69	145	2	0	177	199	7.9
42	Tiruchanur	7.2	730	230	40.08	31.59	76.05	7.15	N.A.	77.99	24.5	0.4	0.47	270	2	0	330	459	17
43	Padiredu(Mannavaram)	7.2	1537	560	76.152	89.91	92.7	2.01	N.A.	205.61	92	62	0.51	370	3.9	0	452	896	33
44	Chinnarajukuppam	7.3	710	230	48.096	26.73	65.95	1.67	N.A.	28.36	23.75	0.41	0.52	330	3.9	0	403	441	5.9
45	Kailasapuram	7.36	1155	320	60.12	41.31	109.1	0.27	N.A.	21.27	45	1.1	1.42	500	3.5	0	610	652	7.9
46	Kumarbommarajapuram	7.31	1286	350	64.128	46.17	117.3	0.96	N.A.	70.9	60.5	0.82	0.99	500	2.7	0	610	734	36
47	Govindappanayudukandrige	7.36	1301	380	72.144	48.6	98.5	50.72	N.A.	177.25	103.5	32.4	0.31	260	2.4	0	317	777	12
48	Eguvaputturu	7.4	815	310	44.088	48.6	54.85	2.67	N.A.	141.8	27.75	0.45	0.34	180	4.4	0	220	455	8.8
49	Pichchaturu	7.29	799	300	56.112	38.88	44.45	1.5	N.A.	113.44	41.5	43.75	0.34	170	3.2	0	207	467	3.0
50	Yamalapudi	7.1	1714	570	68.136	97.2	136.2	2.06	N.A.	212.7	111.5	14.1	0.92	450	4.2	0	549	978	59
51	Eguvapundi	7.14	2815	600	112.22	77.76	322.8	28.91	N.A.	524.66	154	82.3	2.69	420	3.8	0	513	1618	85
52	Ragigunta (Kothur)	7.5	1001	390	48.096	65.61	52.3	1.61	N.A.	49.63	39.5	0.8	0.84	380	3.3	0	464	541	23
53	Khrisnapuram	7.8	65	25	4.008	3.645	3.22	1.07	N.A.	7.09	3.3	1.53	0.06	20	4.8	0	24	39	3.7
54	Modugulepalee (Kottavirapuram)	7.1	1242	300	44.088	46.17	158.7	2.19	N.A.	141.8	67	29.9	0.35	340	3.1	0	415	743	32
55	Diguvavidhi	6.9	2338	580	112.22	72.9	212.2	105.7	N.A.	425.4	104.5	60	0.27	480	2.9	0	586	1451	41
56	Mucchavolu	7.33	1408	300	44.088	46.17	181.7	1.53	N.A.	170.16	101	3.2	0.53	370	2	0	452	824	17
57	P.C.T.Khandika	7.29	1360	410	60.12	63.18	111.4	0.95	N.A.	120.53	93.5	2.3	1.8	410	2.5	0	500	759	58
58	Settigunta U.I	7.1	1446	440	112.22	38.88	127.3	2.13	N.A.	155.98	133	49	0.86	350	3.1	0	427	880	14

Sl. No.	Location	pH	E C in □S/cm	TH	Ca	Mg	Na	K	Fe	Cl	SO <sub>4</sub>	NO <sub>3</sub>	F	Alkalinity	Turbidity (NTU)	CO3	HCO3	TDS	Uranium
				mg/L															
59	Sirasamambedu	7.4	1285	210	28.056	34.02	170.3	40.91	N.A.	155.98	89	14	0.65	320	2.4	0	391	771	21
60	Venad	7.25	660	190	40.08	21.87	39.35	44.92	N.A.	77.99	71.25	29.1	0.12	125	2.6	0	153	418	1.3
61	Kethagonda	7.1	1324	240	44.088	31.59	188.8	5.55	N.A.	226.88	97.5	4.1	0.45	240	2.8	0	293	778	2.2
62	Chinnapanduru	7.09	1625	370	84.168	38.88	188.5	28.55	N.A.	290.69	107	0.44	1.3	320	2.7	0	391	978	7.0
63	Aduru	7	920	295	64.128	32.805	73.76	3.519	N.A.	77.99	88.8	7.9	0.6	250	2.4	0	305	536	7.1
64	Nellathur (Chenchuramasettikandrika)	6.9	1330	350	64.128	46.17	98.92	78.2	N.A.	276.51	101.8	22	0.12	150	3	0	183	799	1.3
65	Santaveluru	6.99	2950	600	92.184	89.91	124.8	473.1	N.A.	510.48	147.4	49.8	0.14	560	2.1	0	683	1905	5.2
66	Alattur (Basavannagunta)	7.2	580	180	36.072	21.87	47.33	5.474	N.A.	102.81	23.04	0.81	0.39	120	3.3	0	146	327	1.8
67	Peddapalvedu	7.05	820	300	74.148	27.945	44.14	10.95	N.A.	99.26	33.12	19	0.68	220	3.1	0	268	473	4.6
68	Anjuru ( Padamaravaturu)	7.28	2600	550	112.22	65.61	199.4	247.9	N.A.	340.32	60.96	93.8	0.68	680	3.3	0	830	1627	134
69	Sivanadapalaem (Parlapalee)	7.3	780	275	72.144	23.085	51.93	1.564	N.A.	67.355	29.28	2.25	1.47	262.5	2.7	0	320	444	6.9
70	Vallivedu (Manigadaru Khandrika)	7.14	810	240	80.16	9.72	44.41	53.57	N.A.	63.81	13.44	0.56	0.22	300	2.7	0	366	489	4.6
71	Siddagonta(Muddampalle)	7.41	2630	520	92.184	70.47	176.5	322.2	N.A.	368.68	107	225.8	0.5	500	3.1	0	610	1736	6.7
72	Muddampalle	6.7	4140	1100	400.8	24.3	424.8	35.58	N.A.	1049.3	126.7	45.8	0.24	420	3.3	0	513	2420	124
73	Anjaneyapuram RS	7.5	530	215	32.064	32.805	20.45	4.301	N.A.	49.63	1.44	3.82	0.4	190	2.7	0	232	286	2.2
74	Mamanduru	7.45	400	175	42.084	17.01	9.637	3.128	N.A.	35.45	9.12	0.32	0.25	140	3.9	0	171	221	3.3
75	Kukkala Doddi	7.3	250	105	18.036	14.58	8.717	0.782	N.A.	14.18	4.32	0	0.06	100	2	0	122	135	0.5
76	Santaveluru (Water Supply Well)	7	740	240	42.084	32.805	57.91	3.128	N.A.	92.17	13.44	0.14	0.35	225	2.6	0	275	410	1.4
77	Parlapalle (Canal Sample )	7.23	540	180	28.056	26.73	39.05	3.91	N.A.	60.265	43.2	1.72	0.43	137.5	2.9	0	168	306	2.8



**Annexure VIII Tentative location details of Artificial Recharge Structure to be constructed**

S.No	District	Mandala Name	Structure	Latitude	Longitude
1	Tirupati	Buchinaidu Kandriga	Check Dam	79.79	13.74
2	Tirupati	Buchinaidu Kandriga	Check Dam	79.83	13.73
3	Tirupati	Buchinaidu Kandriga	Nala Bund	79.76	13.74
4	Tirupati	Buchinaidu Kandriga	Nala Bund	79.81	13.77
5	Tirupati	Buchinaidu Kandriga	Nala Bund	79.81	13.77
6	Tirupati	Buchinaidu Kandriga	Nala Bund	79.82	13.77
7	Tirupati	Buchinaidu Kandriga	Nala Bund	79.79	13.71
8	Tirupati	Buchinaidu Kandriga	Nala Bund	79.87	13.67
9	Tirupati	Buchinaidu Kandriga	Nala Bund	79.90	13.65
10	Tirupati	Buchinaidu Kandriga	Nala Bund	79.88	13.64
11	Tirupati	Buchinaidu Kandriga	Percolation Tank	79.79	13.73
12	Tirupati	Buchinaidu Kandriga	Percolation Tank	79.84	13.76
13	Tirupati	Buchinaidu Kandriga	Percolation Tank	79.89	13.64
14	Tirupati	Chandragiri	Check Dam	79.32	13.58
15	Tirupati	Chandragiri	Check Dam	79.20	13.62
16	Tirupati	Chandragiri	Check Dam	79.19	13.60
17	Tirupati	Chandragiri	Check Dam	79.18	13.44
18	Tirupati	Chandragiri	Check Dam	79.18	13.42
19	Tirupati	Chandragiri	Check Dam	79.19	13.51
20	Tirupati	Chandragiri	Check Dam	79.30	13.56
21	Tirupati	Chandragiri	Check Dam	79.29	13.52
22	Tirupati	Chandragiri	Nala Bund	79.29	13.55
23	Tirupati	Chandragiri	Nala Bund	79.18	13.62
24	Tirupati	Chandragiri	Nala Bund	79.19	13.60
25	Tirupati	Chandragiri	Nala Bund	79.16	13.48
26	Tirupati	Chandragiri	Nala Bund	79.18	13.47
27	Tirupati	Chandragiri	Nala Bund	79.19	13.46
28	Tirupati	Chandragiri	Nala Bund	79.20	13.43
29	Tirupati	Chandragiri	Nala Bund	79.18	13.52
30	Tirupati	Chandragiri	Nala Bund	79.17	13.50
31	Tirupati	Chandragiri	Nala Bund	79.24	13.56
32	Tirupati	Chandragiri	Nala Bund	79.23	13.55
33	Tirupati	Chandragiri	Nala Bund	79.26	13.54
34	Tirupati	Chandragiri	Nala Bund	79.28	13.55
35	Tirupati	Chandragiri	Nala Bund	79.28	13.52
36	Tirupati	Chandragiri	Nala Bund	79.25	13.47
37	Tirupati	Chandragiri	Nala Bund	79.25	13.66
38	Tirupati	Chandragiri	Nala Bund	79.25	13.64
39	Tirupati	Chandragiri	Nala Bund	79.24	13.65

<b>S.No</b>	<b>District</b>	<b>Mandala Name</b>	<b>Structure</b>	<b>Latitude</b>	<b>Longitude</b>
40	Tirupati	Chandragiri	Percolation Tank	79.21	13.60
41	Tirupati	Chandragiri	Percolation Tank	79.20	13.51
42	Tirupati	Chandragiri	Percolation Tank	79.20	13.49
43	Tirupati	Chandragiri	Percolation Tank	79.31	13.53
44	Tirupati	Chandragiri	Percolation Tank	79.22	13.62
45	Tirupati	Chandragiri	Percolation Tank	79.23	13.61
46	Tirupati	Chandragiri	Percolation Tank	79.25	13.64
47	Tirupati	Chandragiri	Percolation Tank	79.27	13.64
48	Tirupati	Chinnagottigallu	Check Dam	79.11	13.65
49	Tirupati	Chinnagottigallu	Nala Bund	79.13	13.65
50	Tirupati	Chinnagottigallu	Nala Bund	79.13	13.65
51	Tirupati	Chinnagottigallu	Nala Bund	79.08	13.64
52	Tirupati	Chinnagottigallu	Percolation Tank	79.10	13.65
53	Tirupati	K.V.B.Puram	Check Dam	79.71	13.47
54	Tirupati	K.V.B.Puram	Check Dam	79.70	13.51
55	Tirupati	K.V.B.Puram	Check Dam	79.68	13.54
56	Tirupati	K.V.B.Puram	Check Dam	79.67	13.55
57	Tirupati	K.V.B.Puram	Check Dam	79.69	13.55
58	Tirupati	K.V.B.Puram	Check Dam	79.63	13.56
59	Tirupati	K.V.B.Puram	Check Dam	79.63	13.57
60	Tirupati	K.V.B.Puram	Check Dam	79.62	13.57
61	Tirupati	K.V.B.Puram	Check Dam	79.67	13.56
62	Tirupati	K.V.B.Puram	Check Dam	79.72	13.55
63	Tirupati	K.V.B.Puram	Check Dam	79.67	13.64
64	Tirupati	K.V.B.Puram	Check Dam	79.65	13.64
65	Tirupati	K.V.B.Puram	Check Dam	79.72	13.63
66	Tirupati	K.V.B.Puram	Check Dam	79.80	13.64
67	Tirupati	K.V.B.Puram	Check Dam	79.87	13.62
68	Tirupati	K.V.B.Puram	Check Dam	79.82	13.60
69	Tirupati	K.V.B.Puram	Check Dam	79.78	13.55
70	Tirupati	K.V.B.Puram	Check Dam	79.80	13.57
71	Tirupati	K.V.B.Puram	Check Dam	79.77	13.57
72	Tirupati	K.V.B.Puram	Nala Bund	79.79	13.69
73	Tirupati	K.V.B.Puram	Nala Bund	79.80	13.69
74	Tirupati	K.V.B.Puram	Nala Bund	79.83	13.69
75	Tirupati	K.V.B.Puram	Nala Bund	79.73	13.68
76	Tirupati	K.V.B.Puram	Nala Bund	79.69	13.65
77	Tirupati	K.V.B.Puram	Nala Bund	79.70	13.66
78	Tirupati	K.V.B.Puram	Nala Bund	79.70	13.65
79	Tirupati	K.V.B.Puram	Nala Bund	79.70	13.61
80	Tirupati	K.V.B.Puram	Nala Bund	79.71	13.62

<b>S.No</b>	<b>District</b>	<b>Mandala Name</b>	<b>Structure</b>	<b>Latitude</b>	<b>Longitude</b>
81	Tirupati	K.V.B.Puram	Nala Bund	79.71	13.63
82	Tirupati	K.V.B.Puram	Nala Bund	79.66	13.56
83	Tirupati	K.V.B.Puram	Nala Bund	79.66	13.58
84	Tirupati	K.V.B.Puram	Nala Bund	79.67	13.58
85	Tirupati	K.V.B.Puram	Nala Bund	79.67	13.58
86	Tirupati	K.V.B.Puram	Nala Bund	79.68	13.58
87	Tirupati	K.V.B.Puram	Nala Bund	79.63	13.57
88	Tirupati	K.V.B.Puram	Nala Bund	79.68	13.53
89	Tirupati	K.V.B.Puram	Nala Bund	79.69	13.51
90	Tirupati	K.V.B.Puram	Nala Bund	79.71	13.56
91	Tirupati	K.V.B.Puram	Nala Bund	79.71	13.58
92	Tirupati	K.V.B.Puram	Nala Bund	79.71	13.59
93	Tirupati	K.V.B.Puram	Nala Bund	79.73	13.55
94	Tirupati	K.V.B.Puram	Nala Bund	79.74	13.56
95	Tirupati	K.V.B.Puram	Nala Bund	79.76	13.51
96	Tirupati	K.V.B.Puram	Nala Bund	79.77	13.53
97	Tirupati	K.V.B.Puram	Nala Bund	79.80	13.62
98	Tirupati	K.V.B.Puram	Nala Bund	79.81	13.64
99	Tirupati	K.V.B.Puram	Nala Bund	79.82	13.65
100	Tirupati	K.V.B.Puram	Nala Bund	79.80	13.66
101	Tirupati	K.V.B.Puram	Nala Bund	79.85	13.62
102	Tirupati	K.V.B.Puram	Nala Bund	79.85	13.63
103	Tirupati	K.V.B.Puram	Nala Bund	79.83	13.66
104	Tirupati	K.V.B.Puram	Nala Bund	79.84	13.67
105	Tirupati	K.V.B.Puram	Nala Bund	79.68	13.46
106	Tirupati	K.V.B.Puram	Nala Bund	79.69	13.47
107	Tirupati	K.V.B.Puram	Nala Bund	79.70	13.48
108	Tirupati	K.V.B.Puram	Nala Bund	79.74	13.48
109	Tirupati	K.V.B.Puram	Nala Bund	79.74	13.49
110	Tirupati	K.V.B.Puram	Nala Bund	79.72	13.49
111	Tirupati	K.V.B.Puram	Nala Bund	79.76	13.47
112	Tirupati	K.V.B.Puram	Nala Bund	79.82	13.56
113	Tirupati	K.V.B.Puram	Nala Bund	79.80	13.55
114	Tirupati	K.V.B.Puram	Nala Bund	79.78	13.54
115	Tirupati	K.V.B.Puram	Nala Bund	79.77	13.51
116	Tirupati	K.V.B.Puram	Percolation Tank	79.60	13.58
117	Tirupati	K.V.B.Puram	Percolation Tank	79.71	13.46
118	Tirupati	K.V.B.Puram	Percolation Tank	79.73	13.47
119	Tirupati	K.V.B.Puram	Percolation Tank	79.70	13.56
120	Tirupati	K.V.B.Puram	Percolation Tank	79.71	13.53
121	Tirupati	K.V.B.Puram	Percolation Tank	79.72	13.52

<b>S.No</b>	<b>District</b>	<b>Mandala Name</b>	<b>Structure</b>	<b>Latitude</b>	<b>Longitude</b>
122	Tirupati	K.V.B.Puram	Percolation Tank	79.63	13.58
123	Tirupati	K.V.B.Puram	Percolation Tank	79.72	13.54
124	Tirupati	K.V.B.Puram	Percolation Tank	79.72	13.67
125	Tirupati	K.V.B.Puram	Percolation Tank	79.73	13.63
126	Tirupati	K.V.B.Puram	Percolation Tank	79.81	13.60
127	Tirupati	K.V.B.Puram	Percolation Tank	79.79	13.62
128	Tirupati	K.V.B.Puram	Percolation Tank	79.74	13.60
129	Tirupati	K.V.B.Puram	Percolation Tank	79.72	13.60
130	Tirupati	K.V.B.Puram	Percolation Tank	79.80	13.58
131	Tirupati	K.V.B.Puram	Percolation Tank	79.78	13.58
132	Tirupati	K.V.B.Puram	Percolation Tank	79.81	13.58
133	Tirupati	K.V.B.Puram	Percolation Tank	79.80	13.59
134	Tirupati	Nagalapuram	Check Dam	79.84	13.37
135	Tirupati	Nagalapuram	Check Dam	79.82	13.38
136	Tirupati	Nagalapuram	Check Dam	79.84	13.43
137	Tirupati	Nagalapuram	Check Dam	79.81	13.45
138	Tirupati	Nagalapuram	Check Dam	79.84	13.46
139	Tirupati	Nagalapuram	Nala Bund	79.75	13.46
140	Tirupati	Nagalapuram	Nala Bund	79.75	13.44
141	Tirupati	Nagalapuram	Nala Bund	79.80	13.45
142	Tirupati	Nagalapuram	Nala Bund	79.81	13.47
143	Tirupati	Nagalapuram	Nala Bund	79.79	13.43
144	Tirupati	Nagalapuram	Nala Bund	79.83	13.41
145	Tirupati	Nagalapuram	Nala Bund	79.86	13.47
146	Tirupati	Nagalapuram	Nala Bund	79.85	13.38
147	Tirupati	Nagalapuram	Nala Bund	79.86	13.36
148	Tirupati	Nagalapuram	Percolation Tank	79.83	13.36
149	Tirupati	Nagalapuram	Percolation Tank	79.86	13.34
150	Tirupati	Nagalapuram	Percolation Tank	79.81	13.43
151	Tirupati	Nagalapuram	Percolation Tank	79.82	13.44
152	Tirupati	Nagalapuram	Percolation Tank	79.83	13.41
153	Tirupati	Nagalapuram	Percolation Tank	79.86	13.46
154	Tirupati	Narayanavanam	Check Dam	79.59	13.41
155	Tirupati	Narayanavanam	Check Dam	79.58	13.56
156	Tirupati	Narayanavanam	Check Dam	79.65	13.41
157	Tirupati	Narayanavanam	Check Dam	79.63	13.44
158	Tirupati	Narayanavanam	Check Dam	79.67	13.44
159	Tirupati	Narayanavanam	Check Dam	79.67	13.43
160	Tirupati	Narayanavanam	Check Dam	79.63	13.55
161	Tirupati	Narayanavanam	Nala Bund	79.57	13.49
162	Tirupati	Narayanavanam	Nala Bund	79.58	13.52

<b>S.No</b>	<b>District</b>	<b>Mandala Name</b>	<b>Structure</b>	<b>Latitude</b>	<b>Longitude</b>
163	Tirupati	Narayanavanam	Nala Bund	79.56	13.51
164	Tirupati	Narayanavanam	Nala Bund	79.57	13.52
165	Tirupati	Narayanavanam	Nala Bund	79.55	13.53
166	Tirupati	Narayanavanam	Nala Bund	79.59	13.50
167	Tirupati	Narayanavanam	Nala Bund	79.60	13.48
168	Tirupati	Narayanavanam	Nala Bund	79.60	13.44
169	Tirupati	Narayanavanam	Nala Bund	79.59	13.40
170	Tirupati	Narayanavanam	Nala Bund	79.61	13.49
171	Tirupati	Narayanavanam	Nala Bund	79.70	13.51
172	Tirupati	Narayanavanam	Nala Bund	79.66	13.43
173	Tirupati	Narayanavanam	Nala Bund	79.66	13.44
174	Tirupati	Narayanavanam	Nala Bund	79.67	13.45
175	Tirupati	Narayanavanam	Nala Bund	79.59	13.45
176	Tirupati	Narayanavanam	Nala Bund	79.57	13.50
177	Tirupati	Narayanavanam	Nala Bund	79.57	13.50
178	Tirupati	Narayanavanam	Nala Bund	79.58	13.55
179	Tirupati	Narayanavanam	Nala Bund	79.59	13.55
180	Tirupati	Narayanavanam	Percolation Tank	79.60	13.44
181	Tirupati	Narayanavanam	Percolation Tank	79.59	13.57
182	Tirupati	Pakala	Check Dam	79.09	13.50
183	Tirupati	Pakala	Check Dam	79.14	13.49
184	Tirupati	Pakala	Check Dam	79.12	13.43
185	Tirupati	Pakala	Check Dam	79.04	13.53
186	Tirupati	Pakala	Check Dam	79.04	13.52
187	Tirupati	Pakala	Nala Bund	79.12	13.51
188	Tirupati	Pakala	Nala Bund	79.12	13.51
189	Tirupati	Pakala	Nala Bund	79.11	13.46
190	Tirupati	Pakala	Nala Bund	79.16	13.47
191	Tirupati	Pakala	Nala Bund	79.00	13.53
192	Tirupati	Pakala	Nala Bund	79.01	13.51
193	Tirupati	Pakala	Percolation Tank	79.13	13.51
194	Tirupati	Pakala	Percolation Tank	79.12	13.48
195	Tirupati	Pakala	Percolation Tank	79.15	13.42
196	Tirupati	Pakala	Percolation Tank	79.17	13.41
197	Tirupati	Pakala	Percolation Tank	79.06	13.51
198	Tirupati	Pakala	Percolation Tank	79.06	13.50
199	Tirupati	Pichatur	Check Dam	79.80	13.34
200	Tirupati	Pichatur	Check Dam	79.78	13.34
201	Tirupati	Pichatur	Nala Bund	79.78	13.33
202	Tirupati	Pichatur	Nala Bund	79.79	13.32
203	Tirupati	Pichatur	Percolation Tank	79.81	13.34

<b>S.No</b>	<b>District</b>	<b>Mandala Name</b>	<b>Structure</b>	<b>Latitude</b>	<b>Longitude</b>
204	Tirupati	Puttur	Check Dam	79.58	13.47
205	Tirupati	Puttur	Check Dam	79.58	13.46
206	Tirupati	Puttur	Check Dam	79.57	13.46
207	Tirupati	Puttur	Check Dam	79.54	13.46
208	Tirupati	Puttur	Check Dam	79.54	13.37
209	Tirupati	Puttur	Check Dam	79.53	13.41
210	Tirupati	Puttur	Check Dam	79.53	13.42
211	Tirupati	Puttur	Check Dam	79.55	13.48
212	Tirupati	Puttur	Check Dam	79.55	13.48
213	Tirupati	Puttur	Check Dam	79.56	13.49
214	Tirupati	Puttur	Check Dam	79.54	13.49
215	Tirupati	Puttur	Check Dam	79.56	13.50
216	Tirupati	Puttur	Nala Bund	79.53	13.46
217	Tirupati	Puttur	Nala Bund	79.56	13.38
218	Tirupati	Puttur	Nala Bund	79.52	13.40
219	Tirupati	Puttur	Nala Bund	79.54	13.40
220	Tirupati	Puttur	Nala Bund	79.59	13.47
221	Tirupati	Puttur	Nala Bund	79.53	13.36
222	Tirupati	Puttur	Nala Bund	79.54	13.36
223	Tirupati	Puttur	Nala Bund	79.55	13.39
224	Tirupati	Puttur	Nala Bund	79.55	13.41
225	Tirupati	Puttur	Nala Bund	79.55	13.49
226	Tirupati	Puttur	Nala Bund	79.56	13.49
227	Tirupati	Puttur	Nala Bund	79.54	13.49
228	Tirupati	Puttur	Nala Bund	79.54	13.49
229	Tirupati	Puttur	Percolation Tank	79.57	13.46
230	Tirupati	Puttur	Percolation Tank	79.57	13.45
231	Tirupati	Puttur	Percolation Tank	79.53	13.42
232	Tirupati	Puttur	Percolation Tank	79.56	13.48
233	Tirupati	Ramachandrapuram I	Check Dam	79.37	13.54
234	Tirupati	Ramachandrapuram I	Check Dam	79.37	13.52
235	Tirupati	Ramachandrapuram I	Check Dam	79.44	13.54
236	Tirupati	Ramachandrapuram I	Check Dam	79.31	13.52
237	Tirupati	Ramachandrapuram I	Nala Bund	79.36	13.52
238	Tirupati	Ramachandrapuram I	Nala Bund	79.36	13.54
239	Tirupati	Ramachandrapuram I	Nala Bund	79.38	13.55
240	Tirupati	Ramachandrapuram I	Nala Bund	79.43	13.53
241	Tirupati	Ramachandrapuram I	Nala Bund	79.42	13.54
242	Tirupati	Ramachandrapuram I	Nala Bund	79.29	13.49
243	Tirupati	Ramachandrapuram I	Nala Bund	79.31	13.49
244	Tirupati	Ramachandrapuram I	Percolation Tank	79.45	13.54

<b>S.No</b>	<b>District</b>	<b>Mandala Name</b>	<b>Structure</b>	<b>Latitude</b>	<b>Longitude</b>
245	Tirupati	Ramachandrapuram I	Percolation Tank	79.40	13.53
246	Tirupati	Renigunta	Check Dam	79.47	13.74
247	Tirupati	Renigunta	Check Dam	79.51	13.73
248	Tirupati	Renigunta	Check Dam	79.53	13.70
249	Tirupati	Renigunta	Check Dam	79.55	13.70
250	Tirupati	Renigunta	Check Dam	79.49	13.73
251	Tirupati	Renigunta	Check Dam	79.54	13.68
252	Tirupati	Renigunta	Check Dam	79.55	13.67
253	Tirupati	Renigunta	Check Dam	79.49	13.68
254	Tirupati	Renigunta	Check Dam	79.49	13.66
255	Tirupati	Renigunta	Check Dam	79.52	13.64
256	Tirupati	Renigunta	Check Dam	79.52	13.63
257	Tirupati	Renigunta	Check Dam	79.52	13.65
258	Tirupati	Renigunta	Check Dam	79.53	13.59
259	Tirupati	Renigunta	Check Dam	79.51	13.58
260	Tirupati	Renigunta	Check Dam	79.50	13.74
261	Tirupati	Renigunta	Nala Bund	79.47	13.69
262	Tirupati	Renigunta	Nala Bund	79.48	13.70
263	Tirupati	Renigunta	Nala Bund	79.49	13.77
264	Tirupati	Renigunta	Nala Bund	79.48	13.78
265	Tirupati	Renigunta	Nala Bund	79.50	13.76
266	Tirupati	Renigunta	Nala Bund	79.51	13.76
267	Tirupati	Renigunta	Nala Bund	79.52	13.75
268	Tirupati	Renigunta	Nala Bund	79.52	13.74
269	Tirupati	Renigunta	Nala Bund	79.52	13.73
270	Tirupati	Renigunta	Nala Bund	79.53	13.72
271	Tirupati	Renigunta	Nala Bund	79.54	13.70
272	Tirupati	Renigunta	Nala Bund	79.55	13.70
273	Tirupati	Renigunta	Nala Bund	79.51	13.64
274	Tirupati	Renigunta	Nala Bund	79.53	13.61
275	Tirupati	Renigunta	Nala Bund	79.49	13.67
276	Tirupati	Renigunta	Nala Bund	79.48	13.68
277	Tirupati	Renigunta	Nala Bund	79.50	13.68
278	Tirupati	Renigunta	Nala Bund	79.53	13.62
279	Tirupati	Renigunta	Nala Bund	79.52	13.59
280	Tirupati	Renigunta	Nala Bund	79.47	13.68
281	Tirupati	Renigunta	Nala Bund	79.44	13.69
282	Tirupati	Renigunta	Percolation Tank	79.53	13.69
283	Tirupati	Renigunta	Percolation Tank	79.49	13.70
284	Tirupati	Renigunta	Percolation Tank	79.50	13.71
285	Tirupati	Renigunta	Percolation Tank	79.50	13.73

<b>S.No</b>	<b>District</b>	<b>Mandala Name</b>	<b>Structure</b>	<b>Latitude</b>	<b>Longitude</b>
286	Tirupati	Renigunta	Percolation Tank	79.49	13.75
287	Tirupati	Renigunta	Percolation Tank	79.53	13.65
288	Tirupati	Renigunta	Percolation Tank	79.53	13.64
289	Tirupati	Renigunta	Percolation Tank	79.53	13.64
290	Tirupati	Renigunta	Percolation Tank	79.49	13.65
291	Tirupati	Renigunta	Percolation Tank	79.52	13.58
292	Tirupati	Satyavedu	Check Dam	79.91	13.38
293	Tirupati	Satyavedu	Check Dam	79.90	13.36
294	Tirupati	Satyavedu	Check Dam	79.93	13.41
295	Tirupati	Satyavedu	Check Dam	79.92	13.42
296	Tirupati	Satyavedu	Check Dam	79.93	13.46
297	Tirupati	Satyavedu	Check Dam	79.92	13.53
298	Tirupati	Satyavedu	Check Dam	79.86	13.50
299	Tirupati	Satyavedu	Nala Bund	79.90	13.51
300	Tirupati	Satyavedu	Nala Bund	79.94	13.50
301	Tirupati	Satyavedu	Nala Bund	79.88	13.52
302	Tirupati	Satyavedu	Nala Bund	79.91	13.43
303	Tirupati	Satyavedu	Nala Bund	79.91	13.44
304	Tirupati	Satyavedu	Nala Bund	79.93	13.47
305	Tirupati	Satyavedu	Nala Bund	79.89	13.38
306	Tirupati	Satyavedu	Nala Bund	79.89	13.37
307	Tirupati	Satyavedu	Nala Bund	79.91	13.41
308	Tirupati	Satyavedu	Percolation Tank	79.92	13.37
309	Tirupati	Satyavedu	Percolation Tank	79.93	13.38
310	Tirupati	Satyavedu	Percolation Tank	79.89	13.34
311	Tirupati	Satyavedu	Percolation Tank	79.95	13.44
312	Tirupati	Satyavedu	Percolation Tank	79.95	13.46
313	Tirupati	Satyavedu	Percolation Tank	79.97	13.52
314	Tirupati	Srikalahasti	Check Dam	79.50	13.90
315	Tirupati	Srikalahasti	Check Dam	79.50	13.90
316	Tirupati	Srikalahasti	Check Dam	79.50	13.88
317	Tirupati	Srikalahasti	Check Dam	79.55	13.90
318	Tirupati	Srikalahasti	Check Dam	79.58	13.90
319	Tirupati	Srikalahasti	Check Dam	79.51	13.90
320	Tirupati	Srikalahasti	Check Dam	79.51	13.90
321	Tirupati	Srikalahasti	Check Dam	79.51	13.88
322	Tirupati	Srikalahasti	Check Dam	79.53	13.79
323	Tirupati	Srikalahasti	Check Dam	79.53	13.78
324	Tirupati	Srikalahasti	Check Dam	79.52	13.83
325	Tirupati	Srikalahasti	Check Dam	79.52	13.83
326	Tirupati	Srikalahasti	Check Dam	79.56	13.83



<b>S.No</b>	<b>District</b>	<b>Mandala Name</b>	<b>Structure</b>	<b>Latitude</b>	<b>Longitude</b>
327	Tirupati	Srikalahasti	Check Dam	79.50	13.84
328	Tirupati	Srikalahasti	Check Dam	79.49	13.85
329	Tirupati	Srikalahasti	Check Dam	79.50	13.86
330	Tirupati	Srikalahasti	Check Dam	79.52	13.85
331	Tirupati	Srikalahasti	Check Dam	79.50	13.87
332	Tirupati	Srikalahasti	Check Dam	79.52	13.86
333	Tirupati	Srikalahasti	Check Dam	79.49	13.87
334	Tirupati	Srikalahasti	Check Dam	79.49	13.82
335	Tirupati	Srikalahasti	Check Dam	79.47	13.83
336	Tirupati	Srikalahasti	Check Dam	79.47	13.86
337	Tirupati	Srikalahasti	Check Dam	79.46	13.86
338	Tirupati	Srikalahasti	Check Dam	79.52	13.80
339	Tirupati	Srikalahasti	Check Dam	79.53	13.80
340	Tirupati	Srikalahasti	Check Dam	79.54	13.78
341	Tirupati	Srikalahasti	Check Dam	79.63	13.83
342	Tirupati	Srikalahasti	Check Dam	79.69	13.80
343	Tirupati	Srikalahasti	Check Dam	79.63	13.81
344	Tirupati	Srikalahasti	Check Dam	79.63	13.73
345	Tirupati	Srikalahasti	Nala Bund	79.48	13.89
346	Tirupati	Srikalahasti	Nala Bund	79.49	13.88
347	Tirupati	Srikalahasti	Nala Bund	79.49	13.89
348	Tirupati	Srikalahasti	Nala Bund	79.49	13.90
349	Tirupati	Srikalahasti	Nala Bund	79.49	13.90
350	Tirupati	Srikalahasti	Nala Bund	79.55	13.89
351	Tirupati	Srikalahasti	Nala Bund	79.55	13.89
352	Tirupati	Srikalahasti	Nala Bund	79.56	13.88
353	Tirupati	Srikalahasti	Nala Bund	79.58	13.89
354	Tirupati	Srikalahasti	Nala Bund	79.49	13.86
355	Tirupati	Srikalahasti	Nala Bund	79.50	13.86
356	Tirupati	Srikalahasti	Nala Bund	79.50	13.87
357	Tirupati	Srikalahasti	Nala Bund	79.47	13.88
358	Tirupati	Srikalahasti	Nala Bund	79.46	13.88
359	Tirupati	Srikalahasti	Nala Bund	79.49	13.83
360	Tirupati	Srikalahasti	Nala Bund	79.48	13.84
361	Tirupati	Srikalahasti	Nala Bund	79.47	13.85
362	Tirupati	Srikalahasti	Nala Bund	79.50	13.85
363	Tirupati	Srikalahasti	Nala Bund	79.52	13.85
364	Tirupati	Srikalahasti	Nala Bund	79.50	13.81
365	Tirupati	Srikalahasti	Nala Bund	79.52	13.80
366	Tirupati	Srikalahasti	Nala Bund	79.52	13.79
367	Tirupati	Srikalahasti	Nala Bund	79.55	13.76

<b>S.No</b>	<b>District</b>	<b>Mandala Name</b>	<b>Structure</b>	<b>Latitude</b>	<b>Longitude</b>
368	Tirupati	Srikalahasti	Nala Bund	79.54	13.76
369	Tirupati	Srikalahasti	Nala Bund	79.55	13.76
370	Tirupati	Srikalahasti	Nala Bund	79.53	13.79
371	Tirupati	Srikalahasti	Nala Bund	79.51	13.80
372	Tirupati	Srikalahasti	Nala Bund	79.49	13.79
373	Tirupati	Srikalahasti	Nala Bund	79.49	13.80
374	Tirupati	Srikalahasti	Nala Bund	79.48	13.80
375	Tirupati	Srikalahasti	Nala Bund	79.49	13.80
376	Tirupati	Srikalahasti	Nala Bund	79.48	13.81
377	Tirupati	Srikalahasti	Nala Bund	79.48	13.82
378	Tirupati	Srikalahasti	Nala Bund	79.64	13.84
379	Tirupati	Srikalahasti	Nala Bund	79.68	13.79
380	Tirupati	Srikalahasti	Nala Bund	79.66	13.76
381	Tirupati	Srikalahasti	Nala Bund	79.63	13.75
382	Tirupati	Srikalahasti	Nala Bund	79.62	13.82
383	Tirupati	Srikalahasti	Percolation Tank	79.52	13.90
384	Tirupati	Srikalahasti	Percolation Tank	79.52	13.89
385	Tirupati	Srikalahasti	Percolation Tank	79.55	13.90
386	Tirupati	Srikalahasti	Percolation Tank	79.55	13.80
387	Tirupati	Srikalahasti	Percolation Tank	79.54	13.79
388	Tirupati	Srikalahasti	Percolation Tank	79.56	13.83
389	Tirupati	Srikalahasti	Percolation Tank	79.53	13.83
390	Tirupati	Srikalahasti	Percolation Tank	79.57	13.86
391	Tirupati	Srikalahasti	Percolation Tank	79.52	13.85
392	Tirupati	Srikalahasti	Percolation Tank	79.53	13.80
393	Tirupati	Srikalahasti	Percolation Tank	79.60	13.86
394	Tirupati	Srikalahasti	Percolation Tank	79.53	13.86
395	Tirupati	Srikalahasti	Percolation Tank	79.68	13.74
396	Tirupati	Thottambedu	Check Dam	79.72	13.90
397	Tirupati	Thottambedu	Check Dam	79.73	13.89
398	Tirupati	Thottambedu	Check Dam	79.70	13.85
399	Tirupati	Thottambedu	Check Dam	79.69	13.85
400	Tirupati	Thottambedu	Check Dam	79.68	13.83
401	Tirupati	Thottambedu	Check Dam	79.71	13.67
402	Tirupati	Thottambedu	Check Dam	79.72	13.70
403	Tirupati	Thottambedu	Check Dam	79.72	13.73
404	Tirupati	Thottambedu	Nala Bund	79.77	13.75
405	Tirupati	Thottambedu	Nala Bund	79.69	13.90
406	Tirupati	Thottambedu	Nala Bund	79.69	13.87
407	Tirupati	Thottambedu	Nala Bund	79.70	13.87
408	Tirupati	Thottambedu	Percolation Tank	79.70	13.85

<b>S.No</b>	<b>District</b>	<b>Mandala Name</b>	<b>Structure</b>	<b>Latitude</b>	<b>Longitude</b>
409	Tirupati	Thottambedu	Percolation Tank	79.69	13.82
410	Tirupati	Tirupati (Rural)	Check Dam	79.35	13.61
411	Tirupati	Tirupati (Rural)	Nala Bund	79.36	13.62
412	Tirupati	Tirupati (Rural)	Nala Bund	79.35	13.62
413	Tirupati	Tirupati (Urban)	Check Dam	79.40	13.62
414	Tirupati	Tirupati (Urban)	Check Dam	79.43	13.65
415	Tirupati	Tirupati (Urban)	Check Dam	79.45	13.65
416	Tirupati	Tirupati (Urban)	Check Dam	79.44	13.73
417	Tirupati	Tirupati (Urban)	Check Dam	79.43	13.76
418	Tirupati	Tirupati (Urban)	Check Dam	79.42	13.76
419	Tirupati	Tirupati (Urban)	Check Dam	79.26	13.68
420	Tirupati	Tirupati (Urban)	Check Dam	79.26	13.70
421	Tirupati	Tirupati (Urban)	Check Dam	79.28	13.69
422	Tirupati	Tirupati (Urban)	Check Dam	79.29	13.65
423	Tirupati	Tirupati (Urban)	Nala Bund	79.48	13.65
424	Tirupati	Tirupati (Urban)	Nala Bund	79.48	13.65
425	Tirupati	Tirupati (Urban)	Nala Bund	79.48	13.66
426	Tirupati	Tirupati (Urban)	Nala Bund	79.48	13.66
427	Tirupati	Tirupati (Urban)	Nala Bund	79.37	13.63
428	Tirupati	Tirupati (Urban)	Nala Bund	79.39	13.62
429	Tirupati	Tirupati (Urban)	Nala Bund	79.39	13.64
430	Tirupati	Tirupati (Urban)	Nala Bund	79.41	13.66
431	Tirupati	Tirupati (Urban)	Nala Bund	79.42	13.66
432	Tirupati	Tirupati (Urban)	Nala Bund	79.44	13.68
433	Tirupati	Tirupati (Urban)	Nala Bund	79.39	13.68
434	Tirupati	Tirupati (Urban)	Nala Bund	79.39	13.68
435	Tirupati	Tirupati (Urban)	Nala Bund	79.40	13.69
436	Tirupati	Tirupati (Urban)	Nala Bund	79.42	13.72
437	Tirupati	Tirupati (Urban)	Nala Bund	79.41	13.73
438	Tirupati	Tirupati (Urban)	Nala Bund	79.42	13.73
439	Tirupati	Tirupati (Urban)	Nala Bund	79.32	13.65
440	Tirupati	Tirupati (Urban)	Nala Bund	79.33	13.65
441	Tirupati	Tirupati (Urban)	Nala Bund	79.31	13.63
442	Tirupati	Tirupati (Urban)	Nala Bund	79.29	13.68
443	Tirupati	Tirupati (Urban)	Nala Bund	79.34	13.64
444	Tirupati	Tirupati (Urban)	Percolation Tank	79.44	13.63
445	Tirupati	Tirupati (Urban)	Percolation Tank	79.28	13.65
446	Tirupati	Tirupati (Urban)	Percolation Tank	79.31	13.63
447	Tirupati	Tirupati (Urban)	Percolation Tank	79.27	13.67
448	Tirupati	Vadamalapeta	Check Dam	79.54	13.55
449	Tirupati	Vadamalapeta	Check Dam	79.54	13.55

<b>S.No</b>	<b>District</b>	<b>Mandala Name</b>	<b>Structure</b>	<b>Latitude</b>	<b>Longitude</b>
450	Tirupati	Vadamalapeta	Check Dam	79.56	13.57
451	Tirupati	Vadamalapeta	Check Dam	79.52	13.48
452	Tirupati	Vadamalapeta	Nala Bund	79.51	13.50
453	Tirupati	Vadamalapeta	Nala Bund	79.51	13.50
454	Tirupati	Vadamalapeta	Nala Bund	79.52	13.50
455	Tirupati	Vadamalapeta	Nala Bund	79.52	13.50
456	Tirupati	Vadamalapeta	Nala Bund	79.50	13.51
457	Tirupati	Vadamalapeta	Nala Bund	79.51	13.48
458	Tirupati	Vadamalapeta	Nala Bund	79.51	13.47
459	Tirupati	Vadamalapeta	Percolation Tank	79.52	13.51
460	Tirupati	Vadamalapeta	Percolation Tank	79.51	13.51
461	Tirupati	Vadamalapeta	Percolation Tank	79.54	13.56
462	Tirupati	Varadaiahpalem	Check Dam	79.91	13.61
463	Tirupati	Varadaiahpalem	Check Dam	79.90	13.65
464	Tirupati	Varadaiahpalem	Check Dam	79.85	13.61
465	Tirupati	Varadaiahpalem	Check Dam	79.86	13.55
466	Tirupati	Varadaiahpalem	Check Dam	79.87	13.53
467	Tirupati	Varadaiahpalem	Nala Bund	79.81	13.52
468	Tirupati	Varadaiahpalem	Nala Bund	79.83	13.51
469	Tirupati	Varadaiahpalem	Nala Bund	79.85	13.54
470	Tirupati	Varadaiahpalem	Nala Bund	79.90	13.67
471	Tirupati	Varadaiahpalem	Nala Bund	79.89	13.59
472	Tirupati	Varadaiahpalem	Nala Bund	79.91	13.60
473	Tirupati	Varadaiahpalem	Nala Bund	79.96	13.60
474	Tirupati	Varadaiahpalem	Nala Bund	79.88	13.55
475	Tirupati	Varadaiahpalem	Nala Bund	79.89	13.57
476	Tirupati	Varadaiahpalem	Nala Bund	79.80	13.51
477	Tirupati	Varadaiahpalem	Nala Bund	79.82	13.52
478	Tirupati	Varadaiahpalem	Nala Bund	79.85	13.50
479	Tirupati	Varadaiahpalem	Percolation Tank	79.94	13.54
480	Tirupati	Varadaiahpalem	Percolation Tank	79.96	13.62
481	Tirupati	Varadaiahpalem	Percolation Tank	79.92	13.66
482	Tirupati	Yerpedu	Check Dam	79.56	13.80
483	Tirupati	Yerpedu	Check Dam	79.57	13.75
484	Tirupati	Yerpedu	Check Dam	79.58	13.76
485	Tirupati	Yerpedu	Check Dam	79.58	13.74
486	Tirupati	Yerpedu	Check Dam	79.59	13.72
487	Tirupati	Yerpedu	Check Dam	79.57	13.69
488	Tirupati	Yerpedu	Check Dam	79.59	13.72
489	Tirupati	Yerpedu	Check Dam	79.63	13.64
490	Tirupati	Yerpedu	Nala Bund	79.58	13.79

<b>S.No</b>	<b>District</b>	<b>Mandala Name</b>	<b>Structure</b>	<b>Latitude</b>	<b>Longitude</b>
491	Tirupati	Yerpedu	Nala Bund	79.56	13.77
492	Tirupati	Yerpedu	Nala Bund	79.58	13.73
493	Tirupati	Yerpedu	Nala Bund	79.58	13.73
494	Tirupati	Yerpedu	Nala Bund	79.57	13.74
495	Tirupati	Yerpedu	Nala Bund	79.57	13.75
496	Tirupati	Yerpedu	Nala Bund	79.56	13.75
497	Tirupati	Yerpedu	Nala Bund	79.59	13.61
498	Tirupati	Yerpedu	Nala Bund	79.60	13.60
499	Tirupati	Yerpedu	Nala Bund	79.62	13.72
500	Tirupati	Yerpedu	Nala Bund	79.62	13.74
501	Tirupati	Yerpedu	Nala Bund	79.62	13.62
502	Tirupati	Yerpedu	Percolation Tank	79.57	13.80
503	Tirupati	Yerpedu	Percolation Tank	79.56	13.79
504	Tirupati	Yerpedu	Percolation Tank	79.60	13.83
505	Tirupati	Yerpedu	Percolation Tank	79.59	13.76
506	Tirupati	Yerpedu	Percolation Tank	79.58	13.77
507	Tirupati	Yerpedu	Percolation Tank	79.60	13.71
508	Tirupati	Yerpedu	Percolation Tank	79.59	13.66
509	Tirupati	Yerpedu	Percolation Tank	79.59	13.61
510	Tirupati	Yerpedu	Percolation Tank	79.59	13.60
511	Tirupati	Yerpedu	Percolation Tank	79.56	13.58
512	Tirupati	Yerpedu	Percolation Tank	79.55	13.64
513	Tirupati	Yerpedu	Percolation Tank	79.59	13.69
514	Tirupati	Yerravaripalem	Check Dam	79.06	13.86
515	Tirupati	Yerravaripalem	Check Dam	79.03	13.88
516	Tirupati	Yerravaripalem	Check Dam	79.05	13.86
517	Tirupati	Yerravaripalem	Check Dam	79.09	13.84
518	Tirupati	Yerravaripalem	Check Dam	79.14	13.84
519	Tirupati	Yerravaripalem	Check Dam	79.14	13.81
520	Tirupati	Yerravaripalem	Check Dam	79.15	13.79
521	Tirupati	Yerravaripalem	Check Dam	79.16	13.77
522	Tirupati	Yerravaripalem	Check Dam	79.19	13.73
523	Tirupati	Yerravaripalem	Check Dam	79.10	13.72
524	Tirupati	Yerravaripalem	Nala Bund	79.06	13.87
525	Tirupati	Yerravaripalem	Nala Bund	79.07	13.86
526	Tirupati	Yerravaripalem	Nala Bund	79.05	13.88
527	Tirupati	Yerravaripalem	Nala Bund	79.05	13.85
528	Tirupati	Yerravaripalem	Nala Bund	79.06	13.85
529	Tirupati	Yerravaripalem	Nala Bund	79.02	13.84
530	Tirupati	Yerravaripalem	Nala Bund	79.09	13.85
531	Tirupati	Yerravaripalem	Nala Bund	79.10	13.84

<b>S.No</b>	<b>District</b>	<b>Mandala Name</b>	<b>Structure</b>	<b>Latitude</b>	<b>Longitude</b>
532	Tirupati	Yerravaripalem	Nala Bund	79.07	13.81
533	Tirupati	Yerravaripalem	Nala Bund	79.14	13.85
534	Tirupati	Yerravaripalem	Nala Bund	79.15	13.84
535	Tirupati	Yerravaripalem	Nala Bund	79.16	13.84
536	Tirupati	Yerravaripalem	Nala Bund	79.17	13.82
537	Tirupati	Yerravaripalem	Nala Bund	79.16	13.81
538	Tirupati	Yerravaripalem	Nala Bund	79.12	13.79
539	Tirupati	Yerravaripalem	Nala Bund	79.16	13.80
540	Tirupati	Yerravaripalem	Nala Bund	79.17	13.77
541	Tirupati	Yerravaripalem	Nala Bund	79.17	13.78
542	Tirupati	Yerravaripalem	Nala Bund	79.19	13.74
543	Tirupati	Yerravaripalem	Nala Bund	79.19	13.63
544	Tirupati	Yerravaripalem	Nala Bund	79.18	13.64
545	Tirupati	Yerravaripalem	Nala Bund	79.18	13.63
546	Tirupati	Yerravaripalem	Percolation Tank	79.03	13.89
547	Tirupati	Yerravaripalem	Percolation Tank	79.03	13.83
548	Tirupati	Yerravaripalem	Percolation Tank	79.06	13.82
549	Tirupati	Yerravaripalem	Percolation Tank	79.07	13.78
550	Tirupati	Yerravaripalem	Percolation Tank	79.14	13.81
551	Tirupati	Yerravaripalem	Percolation Tank	79.10	13.80
552	Tirupati	Yerravaripalem	Percolation Tank	79.16	13.73
553	Tirupati	Yerravaripalem	Percolation Tank	79.10	13.70
554	Tirupati	Balayapalle	Check Dam	79.70	14.02
555	Tirupati	Balayapalle	Check Dam	79.69	14.04
556	Tirupati	Balayapalle	Check Dam	79.73	14.05
557	Tirupati	Balayapalle	Check Dam	79.73	14.02
558	Tirupati	Balayapalle	Check Dam	79.65	13.99
559	Tirupati	Balayapalle	Check Dam	79.70	13.95
560	Tirupati	Balayapalle	Check Dam	79.68	13.95
561	Tirupati	Balayapalle	Nala Bund	79.65	14.03
562	Tirupati	Balayapalle	Nala Bund	79.66	14.05
563	Tirupati	Balayapalle	Nala Bund	79.65	13.98
564	Tirupati	Balayapalle	Nala Bund	79.68	14.01
565	Tirupati	Balayapalle	Nala Bund	79.73	14.03
566	Tirupati	Balayapalle	Nala Bund	79.72	14.06
567	Tirupati	Balayapalle	Nala Bund	79.75	13.94
568	Tirupati	Balayapalle	Nala Bund	79.78	13.90
569	Tirupati	Balayapalle	Nala Bund	79.70	13.96
570	Tirupati	Balayapalle	Nala Bund	79.76	13.87
571	Tirupati	Balayapalle	Nala Bund	79.67	14.08
572	Tirupati	Balayapalle	Nala Bund	79.70	14.02

<b>S.No</b>	<b>District</b>	<b>Mandala Name</b>	<b>Structure</b>	<b>Latitude</b>	<b>Longitude</b>
573	Tirupati	Balayapalle	Nala Bund	79.66	13.93
574	Tirupati	Balayapalle	Nala Bund	79.70	13.92
575	Tirupati	Balayapalle	Percolation Tank	79.66	14.06
576	Tirupati	Balayapalle	Percolation Tank	79.68	14.07
577	Tirupati	Balayapalle	Percolation Tank	79.69	14.05
578	Tirupati	Balayapalle	Percolation Tank	79.72	14.03
579	Tirupati	Balayapalle	Percolation Tank	79.69	14.09
580	Tirupati	Balayapalle	Percolation Tank	79.70	14.06
581	Tirupati	Balayapalle	Percolation Tank	79.71	14.01
582	Tirupati	Balayapalle	Percolation Tank	79.70	14.00
583	Tirupati	Balayapalle	Percolation Tank	79.73	13.91
584	Tirupati	Balayapalle	Percolation Tank	79.75	13.92
585	Tirupati	Chillakur	Check Dam	79.89	14.08
586	Tirupati	Chillakur	Nala Bund	79.88	14.05
587	Tirupati	Chillakur	Percolation Tank	79.85	14.09
588	Tirupati	Chillakur	Percolation Tank	79.97	14.09
589	Tirupati	Chittampur	Check Dam	80.08	13.90
590	Tirupati	Chittampur	Check Dam	80.03	13.91
591	Tirupati	Chittampur	Check Dam	80.10	13.96
592	Tirupati	Chittampur	Nala Bund	79.95	13.94
593	Tirupati	Chittampur	Percolation Tank	79.96	14.00
594	Tirupati	Chittampur	Percolation Tank	79.99	13.96
595	Tirupati	Chittampur	Percolation Tank	80.00	13.87
596	Tirupati	Dakkili	Check Dam	79.49	14.14
597	Tirupati	Dakkili	Check Dam	79.50	14.13
598	Tirupati	Dakkili	Check Dam	79.50	14.12
599	Tirupati	Dakkili	Check Dam	79.50	14.15
600	Tirupati	Dakkili	Check Dam	79.50	14.16
601	Tirupati	Dakkili	Check Dam	79.52	14.14
602	Tirupati	Dakkili	Check Dam	79.51	14.13
603	Tirupati	Dakkili	Check Dam	79.53	14.08
604	Tirupati	Dakkili	Check Dam	79.51	14.07
605	Tirupati	Dakkili	Check Dam	79.52	14.08
606	Tirupati	Dakkili	Check Dam	79.50	14.05
607	Tirupati	Dakkili	Check Dam	79.50	14.06
608	Tirupati	Dakkili	Check Dam	79.57	14.06
609	Tirupati	Dakkili	Check Dam	79.57	14.06
610	Tirupati	Dakkili	Check Dam	79.60	14.06
611	Tirupati	Dakkili	Check Dam	79.63	14.09
612	Tirupati	Dakkili	Check Dam	79.64	14.10
613	Tirupati	Dakkili	Check Dam	79.65	14.11

<b>S.No</b>	<b>District</b>	<b>Mandala Name</b>	<b>Structure</b>	<b>Latitude</b>	<b>Longitude</b>
614	Tirupati	Dakkili	Check Dam	79.66	14.12
615	Tirupati	Dakkili	Check Dam	79.65	14.05
616	Tirupati	Dakkili	Check Dam	79.65	14.12
617	Tirupati	Dakkili	Nala Bund	79.50	14.17
618	Tirupati	Dakkili	Nala Bund	79.51	14.16
619	Tirupati	Dakkili	Nala Bund	79.51	14.17
620	Tirupati	Dakkili	Nala Bund	79.48	14.14
621	Tirupati	Dakkili	Nala Bund	79.49	14.13
622	Tirupati	Dakkili	Nala Bund	79.51	14.14
623	Tirupati	Dakkili	Nala Bund	79.51	14.14
624	Tirupati	Dakkili	Nala Bund	79.49	14.16
625	Tirupati	Dakkili	Nala Bund	79.49	14.16
626	Tirupati	Dakkili	Nala Bund	79.49	14.17
627	Tirupati	Dakkili	Nala Bund	79.51	14.13
628	Tirupati	Dakkili	Nala Bund	79.51	14.10
629	Tirupati	Dakkili	Nala Bund	79.53	14.08
630	Tirupati	Dakkili	Nala Bund	79.54	14.08
631	Tirupati	Dakkili	Nala Bund	79.55	14.10
632	Tirupati	Dakkili	Nala Bund	79.54	14.10
633	Tirupati	Dakkili	Nala Bund	79.55	14.11
634	Tirupati	Dakkili	Nala Bund	79.58	14.13
635	Tirupati	Dakkili	Nala Bund	79.58	14.13
636	Tirupati	Dakkili	Nala Bund	79.59	14.09
637	Tirupati	Dakkili	Nala Bund	79.59	14.09
638	Tirupati	Dakkili	Nala Bund	79.58	14.09
639	Tirupati	Dakkili	Nala Bund	79.58	14.09
640	Tirupati	Dakkili	Nala Bund	79.52	14.06
641	Tirupati	Dakkili	Nala Bund	79.51	14.06
642	Tirupati	Dakkili	Nala Bund	79.56	14.06
643	Tirupati	Dakkili	Nala Bund	79.56	14.06
644	Tirupati	Dakkili	Nala Bund	79.57	14.06
645	Tirupati	Dakkili	Nala Bund	79.57	14.06
646	Tirupati	Dakkili	Nala Bund	79.59	14.05
647	Tirupati	Dakkili	Nala Bund	79.59	14.05
648	Tirupati	Dakkili	Nala Bund	79.51	14.08
649	Tirupati	Dakkili	Nala Bund	79.62	14.09
650	Tirupati	Dakkili	Nala Bund	79.61	14.09
651	Tirupati	Dakkili	Nala Bund	79.66	14.13
652	Tirupati	Dakkili	Nala Bund	79.62	14.02
653	Tirupati	Dakkili	Nala Bund	79.65	14.09
654	Tirupati	Dakkili	Nala Bund	79.64	14.06



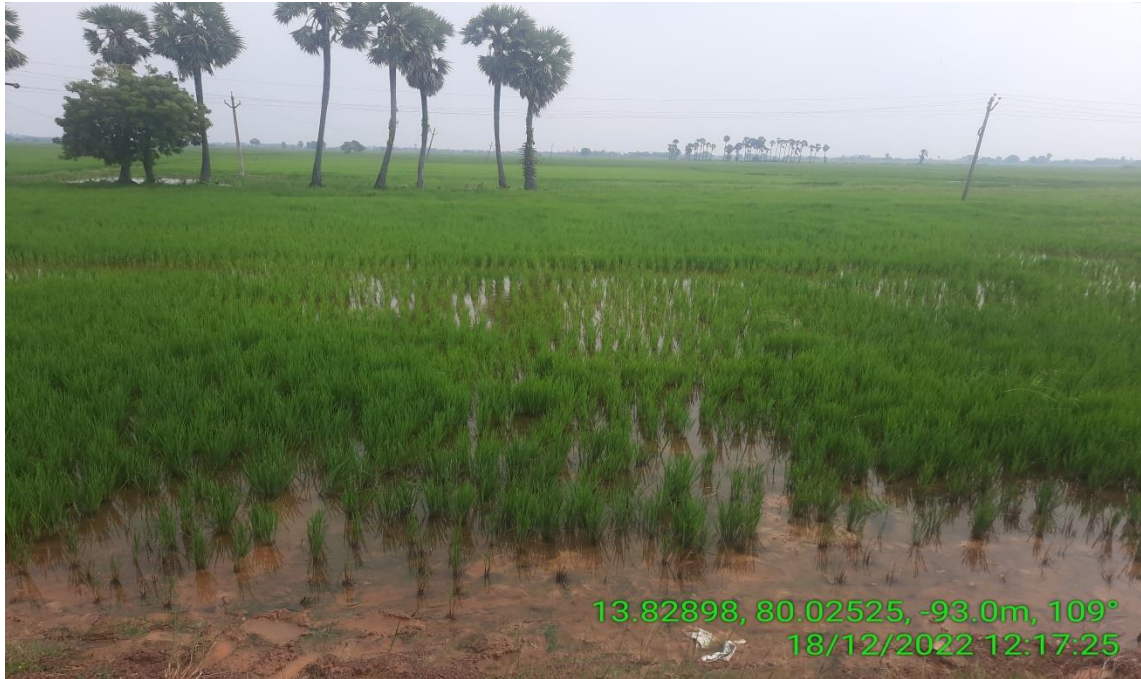
<b>S.No</b>	<b>District</b>	<b>Mandala Name</b>	<b>Structure</b>	<b>Latitude</b>	<b>Longitude</b>
655	Tirupati	Dakkili	Percolation Tank	79.52	14.13
656	Tirupati	Dakkili	Percolation Tank	79.52	14.14
657	Tirupati	Dakkili	Percolation Tank	79.52	14.14
658	Tirupati	Dakkili	Percolation Tank	79.53	14.15
659	Tirupati	Dakkili	Percolation Tank	79.55	14.15
660	Tirupati	Dakkili	Percolation Tank	79.54	14.13
661	Tirupati	Dakkili	Percolation Tank	79.56	14.11
662	Tirupati	Dakkili	Percolation Tank	79.53	14.09
663	Tirupati	Dakkili	Percolation Tank	79.55	14.09
664	Tirupati	Dakkili	Percolation Tank	79.59	14.09
665	Tirupati	Dakkili	Percolation Tank	79.52	14.08
666	Tirupati	Dakkili	Percolation Tank	79.52	14.09
667	Tirupati	Dakkili	Percolation Tank	79.50	14.06
668	Tirupati	Dakkili	Percolation Tank	79.55	14.07
669	Tirupati	Dakkili	Percolation Tank	79.57	14.07
670	Tirupati	Dakkili	Percolation Tank	79.60	14.06
671	Tirupati	Doravarisatram	Check Dam	79.94	13.76
672	Tirupati	Doravarisatram	Check Dam	79.89	13.81
673	Tirupati	Doravarisatram	Check Dam	79.92	13.79
674	Tirupati	Doravarisatram	Check Dam	79.94	13.79
675	Tirupati	Doravarisatram	Check Dam	79.93	13.83
676	Tirupati	Doravarisatram	Check Dam	79.98	13.84
677	Tirupati	Doravarisatram	Nala Bund	79.95	13.84
678	Tirupati	Doravarisatram	Nala Bund	79.92	13.80
679	Tirupati	Doravarisatram	Nala Bund	79.93	13.77
680	Tirupati	Doravarisatram	Percolation Tank	79.95	13.76
681	Tirupati	Doravarisatram	Percolation Tank	79.94	13.79
682	Tirupati	Doravarisatram	Percolation Tank	79.99	13.84
683	Tirupati	Doravarisatram	Percolation Tank	79.98	13.82
684	Tirupati	Gudur2	Check Dam	79.78	14.12
685	Tirupati	Gudur2	Check Dam	79.84	14.11
686	Tirupati	Gudur2	Check Dam	79.77	14.05
687	Tirupati	Gudur2	Nala Bund	79.77	14.10
688	Tirupati	Gudur2	Nala Bund	79.77	14.11
689	Tirupati	Gudur2	Nala Bund	79.83	14.10
690	Tirupati	Gudur2	Nala Bund	79.84	14.10
691	Tirupati	Gudur2	Nala Bund	79.75	14.04
692	Tirupati	Gudur2	Nala Bund	79.79	14.05
693	Tirupati	Gudur2	Nala Bund	79.78	14.05
694	Tirupati	Gudur2	Nala Bund	79.81	14.07
695	Tirupati	Gudur2	Nala Bund	79.82	14.08

<b>S.No</b>	<b>District</b>	<b>Mandala Name</b>	<b>Structure</b>	<b>Latitude</b>	<b>Longitude</b>
696	Tirupati	Gudur2	Nala Bund	79.86	14.15
697	Tirupati	Gudur2	Percolation Tank	79.84	14.12
698	Tirupati	Gudur2	Percolation Tank	79.80	14.13
699	Tirupati	Kota	Percolation Tank	79.95	14.08
700	Tirupati	Kota	Percolation Tank	79.99	14.02
701	Tirupati	Naidupet	Check Dam	79.97	13.86
702	Tirupati	Naidupet	Check Dam	79.97	13.96
703	Tirupati	Naidupet	Check Dam	79.79	13.91
704	Tirupati	Naidupet	Nala Bund	79.96	13.90
705	Tirupati	Naidupet	Nala Bund	79.98	13.88
706	Tirupati	Naidupet	Nala Bund	79.84	13.93
707	Tirupati	Naidupet	Percolation Tank	79.98	13.86
708	Tirupati	Ojili	Check Dam	79.80	13.99
709	Tirupati	Ojili	Check Dam	79.84	14.03
710	Tirupati	Ojili	Check Dam	79.85	14.04
711	Tirupati	Ojili	Check Dam	79.94	14.04
712	Tirupati	Ojili	Check Dam	79.71	13.99
713	Tirupati	Ojili	Check Dam	79.92	13.99
714	Tirupati	Ojili	Check Dam	79.84	13.99
715	Tirupati	Ojili	Check Dam	79.80	13.97
716	Tirupati	Ojili	Check Dam	79.82	13.96
717	Tirupati	Ojili	Nala Bund	79.71	13.99
718	Tirupati	Ojili	Nala Bund	79.79	14.01
719	Tirupati	Ojili	Nala Bund	79.82	14.03
720	Tirupati	Ojili	Nala Bund	79.89	13.99
721	Tirupati	Ojili	Nala Bund	79.88	14.01
722	Tirupati	Ojili	Nala Bund	79.96	14.01
723	Tirupati	Ojili	Nala Bund	79.95	14.01
724	Tirupati	Ojili	Nala Bund	79.77	13.94
725	Tirupati	Ojili	Nala Bund	79.81	13.95
726	Tirupati	Ojili	Nala Bund	79.80	13.97
727	Tirupati	Ojili	Percolation Tank	79.84	13.94
728	Tirupati	Ojili	Percolation Tank	79.93	14.00
729	Tirupati	Pellakur	Nala Bund	79.84	13.83
730	Tirupati	Pellakur	Nala Bund	79.89	13.82
731	Tirupati	Pellakur	Nala Bund	79.90	13.84
732	Tirupati	Pellakur	Nala Bund	79.91	13.86
733	Tirupati	Pellakur	Nala Bund	79.86	13.87
734	Tirupati	Pellakur	Percolation Tank	79.86	13.78
735	Tirupati	Sullurpeta	Check Dam	79.96	13.72
736	Tirupati	Sullurpeta	Nala Bund	79.91	13.71

<b>S.No</b>	<b>District</b>	<b>Mandala Name</b>	<b>Structure</b>	<b>Latitude</b>	<b>Longitude</b>
737	Tirupati	Sullurpeta	Nala Bund	79.95	13.72
738	Tirupati	Sullurpeta	Percolation Tank	79.97	13.73
739	Tirupati	Sullurpeta	Percolation Tank	79.87	13.74
740	Tirupati	Vakadu	Check Dam	80.04	13.99
741	Tirupati	Venkatagiri	Check Dam	79.49	13.99
742	Tirupati	Venkatagiri	Check Dam	79.49	13.97
743	Tirupati	Venkatagiri	Check Dam	79.50	13.97
744	Tirupati	Venkatagiri	Check Dam	79.52	13.99
745	Tirupati	Venkatagiri	Check Dam	79.51	14.01
746	Tirupati	Venkatagiri	Check Dam	79.52	14.01
747	Tirupati	Venkatagiri	Check Dam	79.51	14.02
748	Tirupati	Venkatagiri	Check Dam	79.51	14.03
749	Tirupati	Venkatagiri	Check Dam	79.59	13.99
750	Tirupati	Venkatagiri	Check Dam	79.59	14.00
751	Tirupati	Venkatagiri	Check Dam	79.59	14.01
752	Tirupati	Venkatagiri	Check Dam	79.49	13.95
753	Tirupati	Venkatagiri	Check Dam	79.50	13.97
754	Tirupati	Venkatagiri	Check Dam	79.50	13.97
755	Tirupati	Venkatagiri	Check Dam	79.53	13.95
756	Tirupati	Venkatagiri	Check Dam	79.51	13.93
757	Tirupati	Venkatagiri	Check Dam	79.54	13.93
758	Tirupati	Venkatagiri	Check Dam	79.51	13.93
759	Tirupati	Venkatagiri	Check Dam	79.60	13.89
760	Tirupati	Venkatagiri	Check Dam	79.62	13.99
761	Tirupati	Venkatagiri	Check Dam	79.63	13.94
762	Tirupati	Venkatagiri	Check Dam	79.62	13.92
763	Tirupati	Venkatagiri	Nala Bund	79.51	13.99
764	Tirupati	Venkatagiri	Nala Bund	79.53	13.99
765	Tirupati	Venkatagiri	Nala Bund	79.53	13.98
766	Tirupati	Venkatagiri	Nala Bund	79.51	14.02
767	Tirupati	Venkatagiri	Nala Bund	79.51	14.01
768	Tirupati	Venkatagiri	Nala Bund	79.51	14.03
769	Tirupati	Venkatagiri	Nala Bund	79.49	14.02
770	Tirupati	Venkatagiri	Nala Bund	79.49	14.01
771	Tirupati	Venkatagiri	Nala Bund	79.49	14.01
772	Tirupati	Venkatagiri	Nala Bund	79.48	13.99
773	Tirupati	Venkatagiri	Nala Bund	79.48	13.98
774	Tirupati	Venkatagiri	Nala Bund	79.48	13.97
775	Tirupati	Venkatagiri	Nala Bund	79.48	14.00
776	Tirupati	Venkatagiri	Nala Bund	79.50	13.99
777	Tirupati	Venkatagiri	Nala Bund	79.51	14.00

<b>S.No</b>	<b>District</b>	<b>Mandala Name</b>	<b>Structure</b>	<b>Latitude</b>	<b>Longitude</b>
778	Tirupati	Venkatagiri	Nala Bund	79.51	14.00
779	Tirupati	Venkatagiri	Nala Bund	79.51	14.00
780	Tirupati	Venkatagiri	Nala Bund	79.58	13.99
781	Tirupati	Venkatagiri	Nala Bund	79.59	13.99
782	Tirupati	Venkatagiri	Nala Bund	79.59	14.01
783	Tirupati	Venkatagiri	Nala Bund	79.49	13.95
784	Tirupati	Venkatagiri	Nala Bund	79.49	13.94
785	Tirupati	Venkatagiri	Nala Bund	79.50	13.94
786	Tirupati	Venkatagiri	Nala Bund	79.51	13.93
787	Tirupati	Venkatagiri	Nala Bund	79.50	13.93
788	Tirupati	Venkatagiri	Nala Bund	79.50	13.92
789	Tirupati	Venkatagiri	Nala Bund	79.50	13.92
790	Tirupati	Venkatagiri	Nala Bund	79.51	13.92
791	Tirupati	Venkatagiri	Nala Bund	79.53	13.93
792	Tirupati	Venkatagiri	Nala Bund	79.52	13.95
793	Tirupati	Venkatagiri	Nala Bund	79.50	13.97
794	Tirupati	Venkatagiri	Nala Bund	79.60	13.89
795	Tirupati	Venkatagiri	Nala Bund	79.63	14.03
796	Tirupati	Venkatagiri	Nala Bund	79.63	13.93
797	Tirupati	Venkatagiri	Nala Bund	79.66	13.89
798	Tirupati	Venkatagiri	Percolation Tank	79.51	13.97
799	Tirupati	Venkatagiri	Percolation Tank	79.53	14.01
800	Tirupati	Venkatagiri	Percolation Tank	79.59	14.00
801	Tirupati	Venkatagiri	Percolation Tank	79.50	13.99
802	Tirupati	Venkatagiri	Percolation Tank	79.51	13.96
803	Tirupati	Venkatagiri	Percolation Tank	79.51	13.94
804	Tirupati	Venkatagiri	Percolation Tank	79.54	13.92
805	Tirupati	Venkatagiri	Percolation Tank	79.52	13.93
806	Tirupati	Venkatagiri	Percolation Tank	79.64	13.94
807	Tirupati	Venkatagiri	Percolation Tank	79.67	13.89
808	Tirupati	Venkatagiri	Percolation Tank	79.64	13.86

**Field Photos:**



Filed Photos 1 paddy a major crops cultivated around 79 % of total area of the district



Filed Photos 2 Sand dunes are converted as cultivated land, large scale of Ground nuts cultivated around Kothapatnam, Kota Mandal



Filed Photos 3 Canal irrigation practices most of the area



Filed Photos 4 Large Diameter dug wells used for Irrigation purposes



Filed Photos 5 Bore well / Tube wells are common irrigation practices in most of the mandals.



Filed Photos 6 Around Hundred years old dug well being used in Venad Island (Tada Mandal)