1. Salient Features of West Godavari District

West Godavari District is carved out of old Godavari District as it is the western delta of the River Godavari. It was appropriately named as West Godavari with Headquarters at Eluru and came to existence in the year 1925. It lies between 16º 15' 00" and 17º 30' 00" of the North latitude and 80º 50' 00" and 81º 55' 00" of East longitude which extends over an area of 8506 Sq. Kms with a coastline of around 23.00 Kms. It was surrounded on the east by River Godavari and East Godavari District, on south by Krishna District and the Bay of Bengal on the west by Krishna District and on north by Khammam District of Telangana State. The District can be divided into three physiographic divisions. The southern part is represented by the delta of Krishna and Godavari rivers. The central part is an undulating terrain interspersed with low hills covering parts of Tadepalligudem and Eluru taluks, and the north is covered by Papikonda hill ranges of Eastern Ghats.

1.1 Administrative Setup

The District comprises five Revenue divisions viz., Eluru, Kovvur, Narasapuram, Jangareddigudem and Kukkunoor with 16 Mandals, 12 Mandals, 12 Mandals 6 and 2 Mandals, respectively. The Kukkunoor division was newly formed after bifurcation of state from Telangana State with two mandals i. Kukkunoor and Velaipadu. Total 48 Mandals covered in the district, separately for Revenue and Panchayat Raj with effect from 25-05-1985 in place of 12 erstwhile taluks and 16 Panchayat samithies with the objective of bringing the administration to the doorsteps of the people. They started functioning from 15-01-1987. Besides, 7 Municipalities,1 Nagara Panchayat and 1 Corporation are in existence.

- ✓ Municipal Corporation: Eluru
- ✓ Municipalities : Tadepalligudem, Kovvur, Nidadavole, Tanuku, Narasapuram, Bhimavaram and Palacole,

- ✓ Nagara Panchayat: Jangareddigudem

There are 928 Revenue villages that exist in the District, of which 886 villages are inhabited while the remaining 42 are uninhabited. The upland consists of an undulating broken terrain by low ranges of Eastern Ghats. The main sources of Irrigation in upland are tanks. The delta land is being irrigated by canals of river Godavari.

Fig.1 Administrative Boundaries of West Godavari District, Andhra Pradesh

1.2 Drainage

The District is mainly drained by the Godavari, Yerrakalava, Tammileru and Ramileru rivers. River Godavari enters the District near the north eastern corner and after flowing a distance of 72 km, the river bifurcates into Gautami and Vasishta rivers at Vijeshwaram. The Gautami River which marks the District boundary debouches into the Bay of Bengal at Antervedi, draining about 20% of the District area. The other prominent rivers/streams in the District are Yerrakalava, Tammileru, Ramileru, and Guvvaleru. Yerrakalava which is the main tributary of Godavari River while Tammileru and Guvvaleru join Kolleru lake. Kolleru Lake, the biggest fresh water lake in the country, is situated in the south western part of the District. The total area of the lake is 16,914 Hectares out of which West Godavari area covered in 10,596 hectares. It acts as a reservoir for drainage water of surrounding delta areas during monsoon and it dries up in summer. In recent years, the aquaculture tanks encroached in all directions of the lake which has an area of 6339 ha resulting in the reduction of the original size of the lake. The drainage in the District is mainly dendritic in the northern part of the District and appears to be controlled by structure. Drainage density is more in the northern part and is sparse in the southern part. The delta area is served by the Godavari canal system and numerous other drains.

1.2a.Kolleru Lake- A eco-sensitive zone

Kolleru Lake is one of the largest freshwater lakes in the country. This lake is located between the Krishna and Godavari river deltas. Administratively, the Kolleru is covered in Krishna and West Godavari Districts. Pedapadu, Eluru, Bhimadole, Nidamarru, and Akiveedu Mandals in West Godavari District are important tourist destinations as the Kolleru Lake is situated within these mandals of the District. Guvaleru and Tammileru are the major streams that join the lake. In addition to this, the lake is fed by irrigation canals/ drains. The only outlet of the lake is river Upputeru. The lake was declared as a wildlife sanctuary under India's Wildlife Protection Act of 1972, and designated as a wetland of international importance in Ramsar Convention of 1971. The lake up to +5ft

contour level covering 308.55 sq.km has been notified as Wildlife sanctuary by the State Govt in October, 1999.

The remote sensing based study indicates that the Kolleru Lake and its environs are being disturbed with the construction of aquaculture ponds. Significant parts of fertile agriculture lands are converted into the aquaculture. Major part of the lake is infested with weeds like elephant grass and water hyacinth. Rich in flora and fauna, it attracts migratory birds between October and March. This lake is a major tourist attraction. The sanctuary attracts tourists for sighting the birds. A variety of waterfowls can be seen at Atapaka which is about 1.5 km from Kaikaluru. The sanctuary is approachable from all four sides of the lake by road. The lake is under stress mainly due to encroachment, aquaculture activities, pollution from industrial and domestic sources and prolific growth of weeds. Problems of encroachment have also resulted in deterioration of this water body.

In order to restore the ecological characteristics of the lake and its biodiversity, about 2421 fish tanks extending over 23,487 acres have been demolished in the sanctuary area during June, 2006. Various conservation activities like removal and carting the soil from demolished fish tanks, removal of weeds, construction of boundary pillars, survey & demarcation, education and awareness etc. have been undertaken for conservation of Kolleru lake.

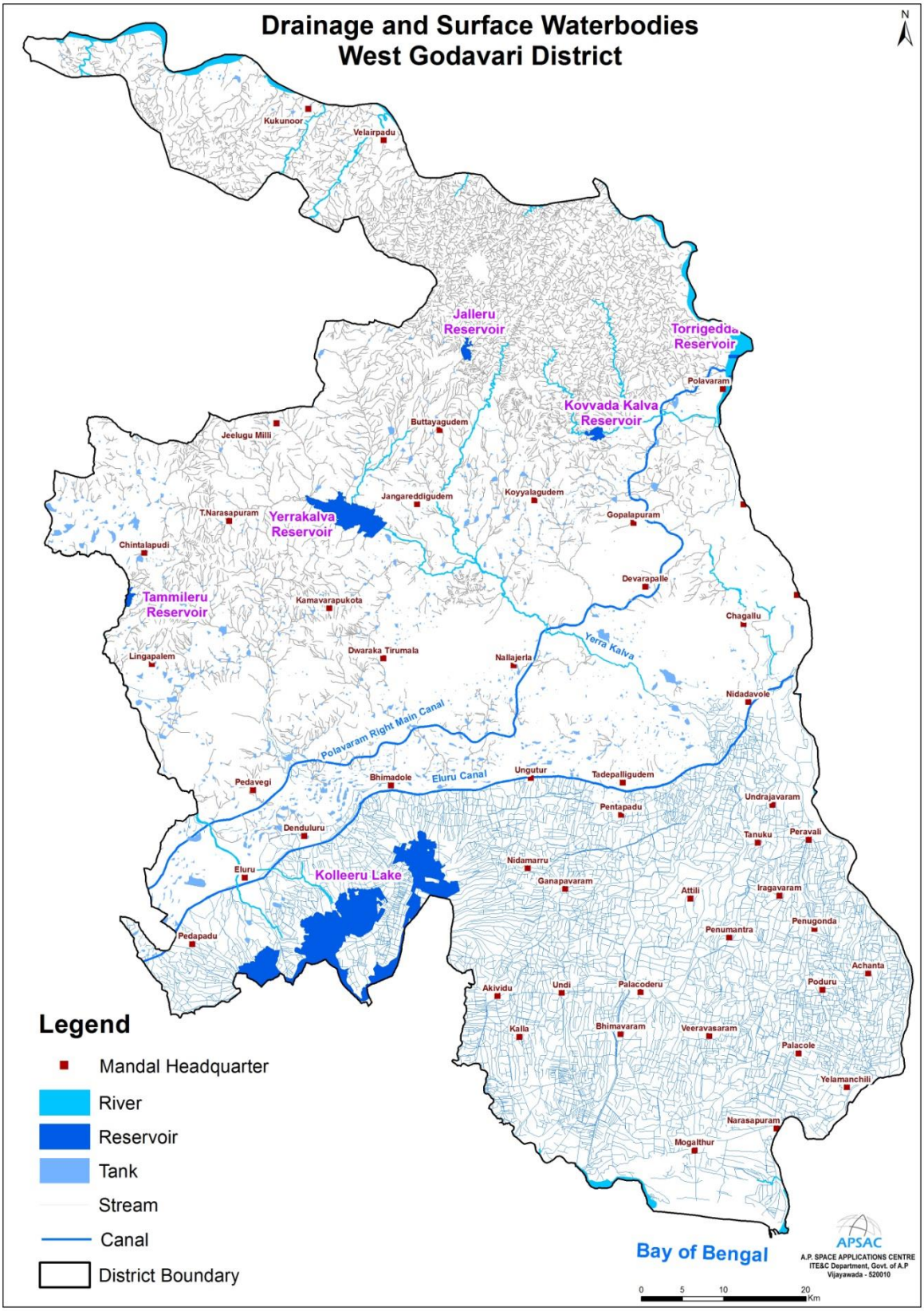


Fig. 2 Drainage and Surface Water bodies of the West Godavari District

1.3 Climate and Rainfall

Tropical climate conditions with extreme hot summer and cold winter prevail in this District. April to June is the hottest period with high temperature in May. The climate of the District is moderate and characterized by tropical rainy climate with aggressive summer. The period from December to middle of February is generally the season of fine weather. The summer season is from March to May. Almost in each and every mandal , Automatic weather stations (AWS) are established by A.P. State Developmental Planning Society (APSDPS), Planning Department, Govt. of A.P. (Fig.3) at each mandal headquarter and the data from these stations is received by central server on hourly basis every day. Mandal wise and year wise rainfall data is appended in Table-1.The average annual rain fall monthly mandal wise was collected. As per the analysis northern part of the mandals i.e Polavaram and Buttayagudem mandals received good rainfall and also Narsapuram mandal received the good rainfall as the mandal is near the coast. The month wise annual rain fall receives August fallowed by July and September months.

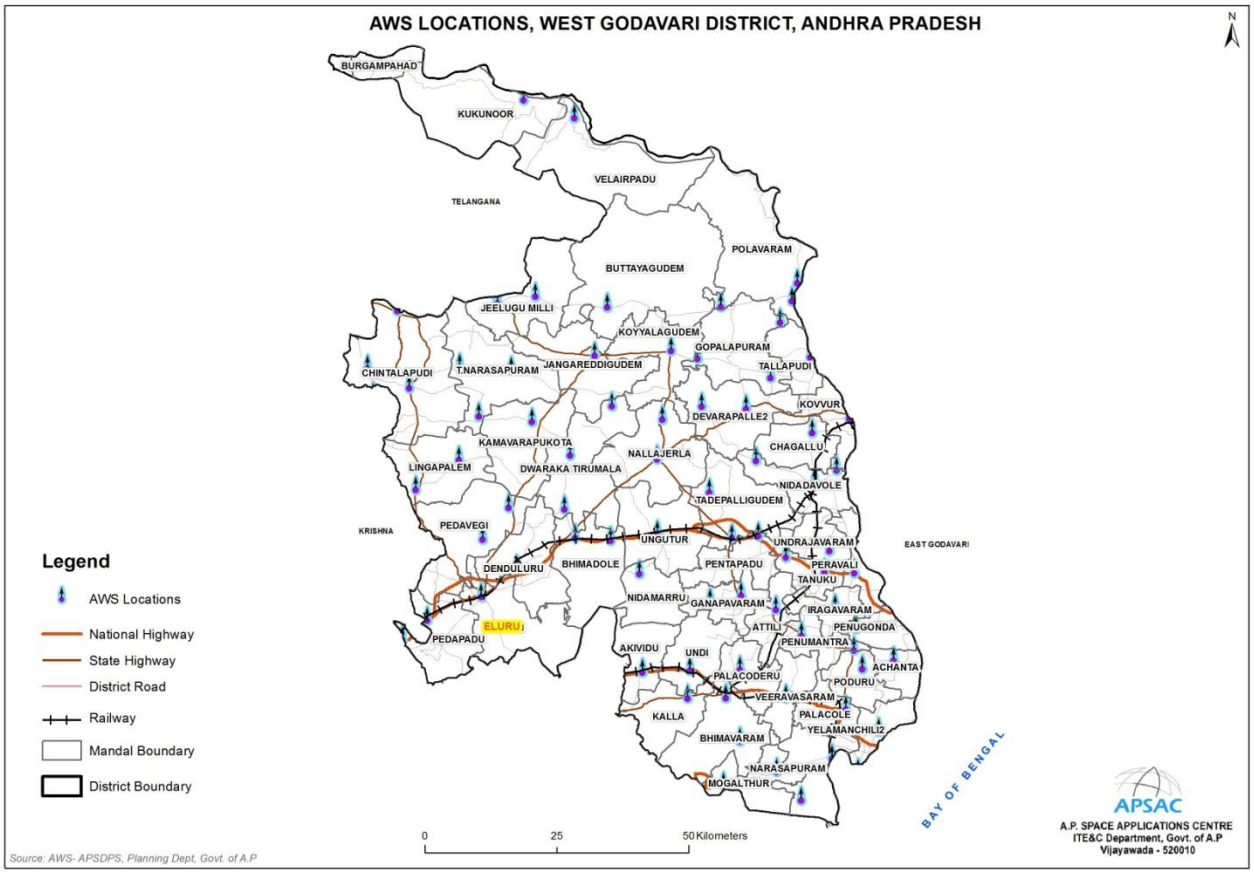


Fig.3. Distribution of automatic weather stations (AWS) in West Godavari District, Andhra Pradesh

Table:1.Mandal Wise Average Annual Rainfall (mm)														
S No	Mandal Name	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	TOTAL
1	Achanta	3.63	6.65	11.28	12.63	58.11	116.46	207.13	205.17	187.86	189.89	90.86	18.23	1107.91
2	Akiveedu	3.76	7.67	14.56	15.16	44.11	110.71	215.10	212.00	156.37	148.66	61.31	13.91	1003.32
3	Attili	3.84	6.69	11.99	13.40	63.92	113.05	221.99	236.54	181.65	154.16	69.90	12.84	1089.96
4	Bhimavaram	4.93	5.49	9.06	13.52	46.28	116.17	200.82	218.13	172.49	172.45	90.34	16.34	1066.02
5	Bhimadole	3.88	7.35	12.69	14.36	44.18	107.81	206.11	208.91	171.50	128.56	40.84	11.46	957.64
6	Buttayagudem	6.24	13.06	18.05	19.72	84.41	205.14	382.78	406.81	266.27	195.41	51.28	19.58	1668.74
7	Chagallu	4.59	7.95	13.38	17.42	58.36	112.46	196.45	221.76	190.95	137.64	60.99	11.01	1032.96
8	Chintalapudi	7.56	7.73	13.09	23.33	50.85	136.87	249.16	241.95	161.52	125.01	38.59	9.43	1065.10
9	Denduluru	4.44	5.78	8.30	14.87	36.03	112.15	193.56	199.92	149.13	93.42	58.69	16.02	892.31
10	Devarapalle	4.03	5.79	14.20	9.96	45.61	108.82	198.85	197.78	157.54	128.54	40.32	13.50	924.96
11	Dwaraka Tirumala	6.70	5.95	22.60	10.34	55.51	119.65	215.47	239.62	177.66	109.57	40.48	13.66	1017.20
12	Eluru	7.20	6.75	13.51	20.06	45.33	120.91	201.88	205.96	172.41	129.08	52.01	12.62	987.72
13	Ganapavaram	4.01	7.13	11.40	10.93	57.22	108.38	214.94	242.59	174.15	132.01	63.30	9.89	1035.94
14	Gopalapuram	8.46	6.36	11.13	15.49	56.17	117.86	227.55	236.91	166.10	135.10	37.86	12.69	1031.68
15	Iragavaram	2.19	4.12	12.09	12.90	41.87	98.00	193.23	203.44	197.12	120.14	70.40	12.71	968.20
16	Jangareddigudem	4.68	6.35	13.22	18.75	50.73	142.83	240.39	248.20	176.29	135.31	38.76	11.63	1087.14
17	Jeelugumilli	7.09	6.66	14.75	14.84	55.43	134.02	239.47	274.02	167.48	114.07	34.88	10.92	1073.63
18	Kalla	4.98	9.31	11.26	15.83	55.96	115.36	209.19	210.14	167.34	166.09	78.51	16.86	1060.83
19	Kamavarapukota	6.49	7.91	20.72	9.32	60.14	122.19	214.38	247.44	182.25	120.52	34.65	10.19	1036.20
20	Kovvur	9.83	10.18	15.14	24.01	57.74	122.99	213.01	214.24	159.31	148.18	51.31	8.23	1034.17
21	Koyyalagudem	9.19	8.47	13.49	9.74	53.53	137.80	246.33	249.26	191.78	135.85	42.20	10.87	1108.51
22	Lingapalem	7.43	8.69	14.41	12.83	47.41	118.23	193.48	197.61	163.65	119.23	38.81	12.29	934.05
23	Mogalthur	8.72	3.38	6.91	14.33	50.73	110.69	187.94	207.48	196.74	207.29	96.55	21.36	1112.11
24	Nallajerla	6.52	4.74	12.00	11.22	58.59	120.80	213.52	235.78	174.07	136.27	36.18	11.81	1021.53
25	Narasapuram	7.21	10.49	10.37	10.81	53.74	123.00	206.24	209.36	189.17	215.71	109.89	17.54	1163.52
26	Nidadavole	2.19	4.99	11.09	25.14	42.49	123.85	176.34	211.58	190.20	126.40	64.41	16.31	994.97
27	Nidamarru	4.65	7.69	10.91	10.22	49.90	104.34	195.06	243.23	163.38	138.12	61.29	9.27	998.07

28	Padavegi	6.00	11.37	12.74	13.45	48.26	106.33	187.62	207.19	159.26	123.26	33.30	14.16	922.95
29	Palacole	3.66	4.56	7.61	14.02	35.54	131.49	206.39	225.92	220.86	193.95	89.36	18.74	1152.06
30	Palakoderu	4.13	4.76	12.51	10.40	56.91	115.96	225.81	239.10	183.23	159.79	85.33	14.99	1112.93
31	Pedapadu	8.66	12.11	15.44	11.15	44.25	115.57	186.47	206.03	181.21	113.03	54.02	14.70	962.65
32	Pentapadu	2.34	5.84	5.94	13.17	51.22	123.91	214.18	222.43	183.14	129.66	84.95	11.48	1048.25
33	Penugonda	3.62	6.45	9.23	7.99	50.02	109.18	196.03	207.56	166.90	165.43	78.23	11.90	1012.55
34	Penumantra	1.93	7.36	9.89	10.38	61.83	110.64	210.76	227.63	187.80	156.71	73.22	14.83	1072.99
35	Peravali	3.48	4.23	8.03	11.32	64.86	103.95	209.34	230.09	196.19	152.86	69.58	9.61	1063.53
36	Poduru	4.73	6.16	11.14	13.26	48.79	123.01	221.35	233.01	193.65	190.94	85.62	15.81	1147.45
37	Polavaram	4.95	14.27	12.43	37.18	80.84	141.54	241.70	259.17	200.67	146.54	47.08	11.66	1198.03
38	T Narasapuram	6.45	8.06	12.86	16.65	53.75	118.24	211.82	239.43	146.41	104.28	31.09	10.86	959.89
39	Tadepalligudem	4.51	5.33	10.22	15.71	59.17	121.43	215.57	229.58	161.85	148.65	66.41	10.72	1049.14
40	Tanuku	4.41	5.86	7.96	16.50	59.32	121.88	215.96	224.68	177.25	154.66	72.50	11.65	1072.63
41	Thallapudi	4.91	5.92	11.84	16.86	69.09	134.68	196.34	216.22	163.04	115.56	40.11	9.81	984.38
42	Undi	9.29	3.61	7.42	16.78	43.64	120.06	237.91	233.21	193.48	143.88	79.71	14.76	1103.75
43	Undrajavaram	1.16	4.99	5.07	25.88	54.29	128.63	208.99	222.08	191.29	132.25	62.94	13.89	1051.48
44	Unguturu	2.41	7.04	13.90	10.04	56.33	103.19	205.30	223.25	167.93	146.64	51.30	9.65	996.97
45	Veeravasaram	0.78	1.60	6.58	15.59	43.42	122.02	214.70	240.15	181.73	169.19	82.66	18.24	1096.64
46	Yelamanchili	5.01	8.90	7.68	9.95	50.62	104.77	182.66	193.68	182.50	182.46	94.59	14.83	1037.66
Total		**5.15**	**7.00**	**11.74**	**14.94**	**53.40**	**120.37**	**214.11**	**228.40**	**179.19**	**145.49**	**61.66**	**13.34**	**1054.79**

The District enjoys tropical humid type of climate with oppressive summer season and good seasonal rainfall. The summer season extends from March to May followed by southwest monsoon season, which lasts till September. October and November constitute the post monsoon or retreating monsoon season. December to February months experience cold weather conditions. This is followed by monsoon period from June to September, the post monsoon from October to December and the winter season from January to February. The monsoon usually breaks in the middle of June and brings good rains up to middle of October. The average annual rainfall of the District is 1055 mm, which ranges from nil rainfall in January to March. The mean seasonal rainfall distribution is 835 mm in southwest monsoon (June- September), 307 mm in northeast monsoon (Oct-Dec). In general, the amount of rainfall increases from west to east. The distribution of rainfall in West Godavari District is shown in the form of isohyets (Fig.4).The mean daily maximum temperature in the District is about 38°C in May and the mean daily minimum temperature is about 20°C in December/ January. Temperature in the District begins to rise from the middle of February till May. With the onset of southwest monsoon in June, the temperature decreases to about 20°C and is more or less uniform during the monsoon period. The relative humidity in the District is of the order of 80% in the mornings throughout the year, whereas in the evenings the relative humidity varies from about 70 to more than 80% (CGWB, 2013).

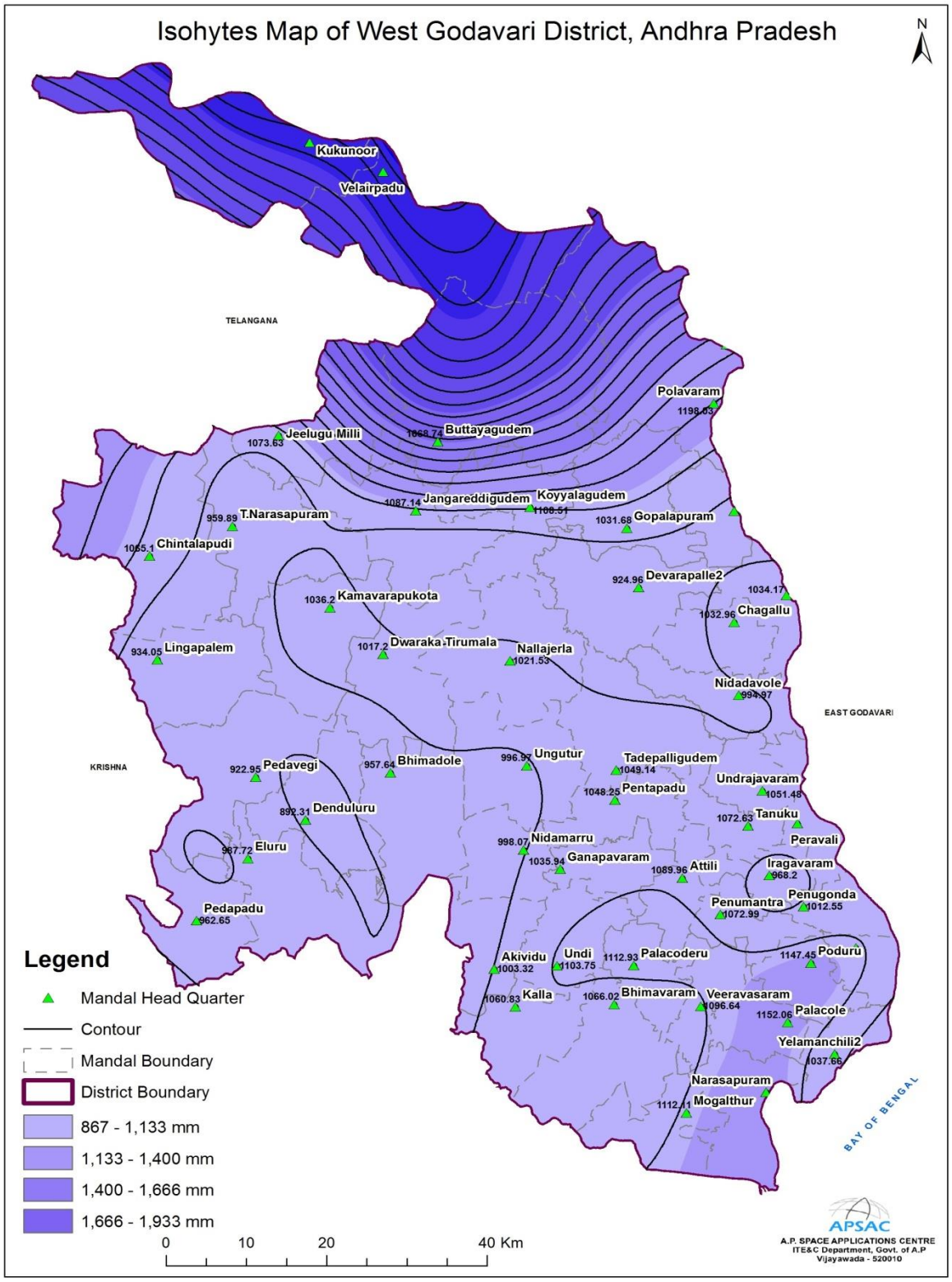


Fig. 4 Distribution of Rainfall in West Godavari District, Andhra Pradesh

1.4 Transport and Communications

The District is well served by roads and railways. 928 villages (including some of the major hamlets) have been connected with transport facilities of which Most of the villages are connected by A.P.S.R.T.C. The total of core road network of the District is 1224km. It includes 523 km of existing and proposed length of 700 km. of which 198 km are National highways (NH16 and NH214A) and 280km of State Highways. The Chennai-Howrah national highway and broad-gauge railway line pass through this District. The network of National highways, State highways, District roads and Panchayat roads is shown in Fig.5. Eluru Town is about 40 km to Gannavaram Airport. APSAC carried out detailed mapping of Panchayat raj roads using high resolution satellite data and developed a web application (APSAC, 2017a). The total number of PR roads are 1,823 with the spatial length of 4,078 km. Out of the total length, 1,431 km is under BT, 268 km CC, 705 km WBM, 1,104 km Gravel and 570 km under Earthen surface with the total habitations of 2,326.

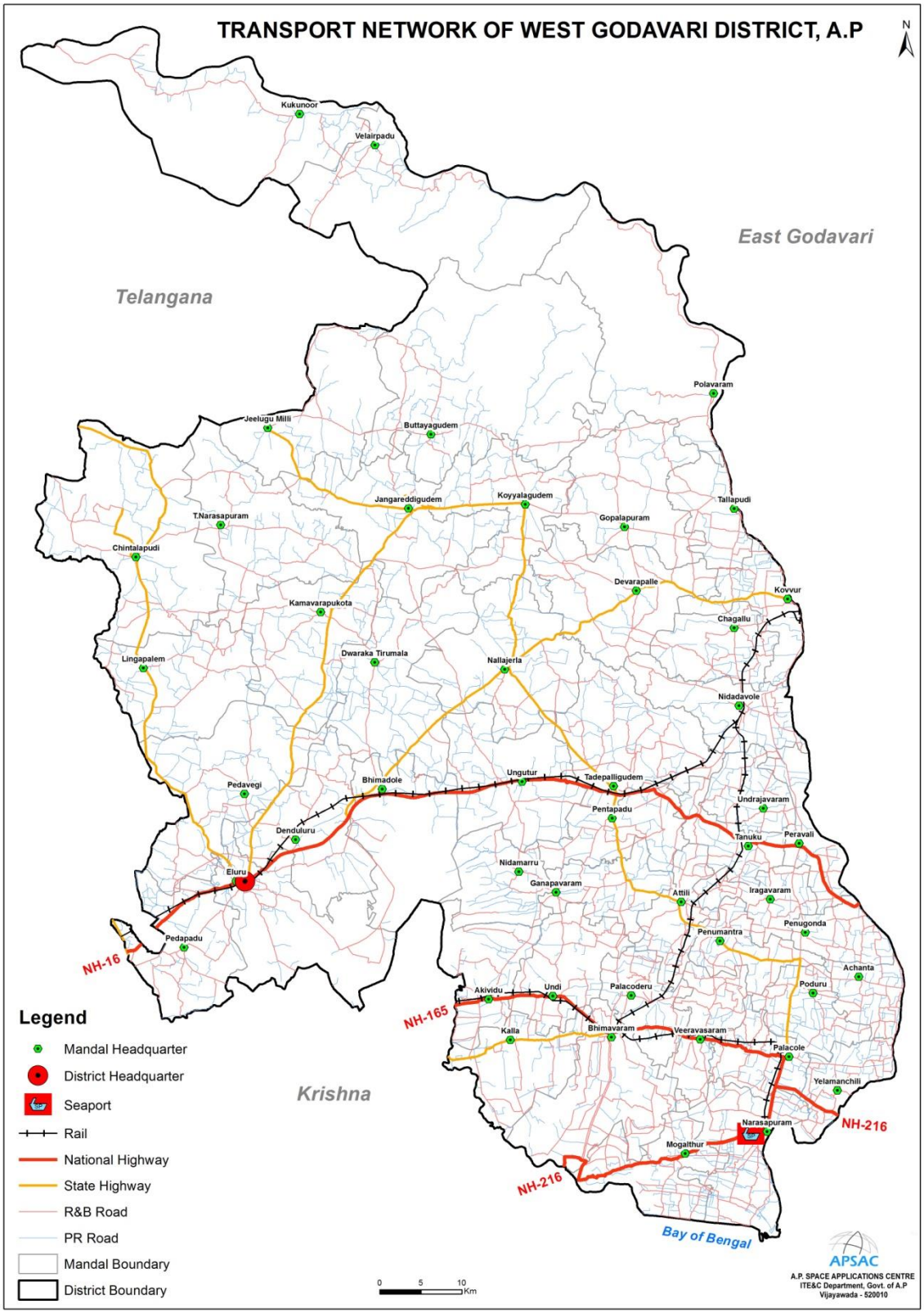


Fig. 5. Transport Network of West Godavari District, Andhra Pradesh

1.5 Population and Literacy

The population of the District is 39,95,742 comprising with a decennial growth of 8.06%. The District has 886 inhabited and 42 uninhabited villages. The population density is 470 per Sq.Km. West Godavari District has recorded a literacy of 74.30 as per 2011 census, which is higher than the State literacy rate of 67.35%. This District is much advanced in the field of education. Almost all the villages in the District have primary schools. There are 4,408 schools in the District. In addition, the Prestigious National Institute of Technology, and Y. S.R. Horticulture University were established in Tadepalligudem. In terms of scheduled caste population, there are 823545 males and females. Mandal-wise spatial distribution of schedule caste population and types of SC student hostels and residential schools in West Godavari District, Andhra Pradesh is shown in Fig.6.

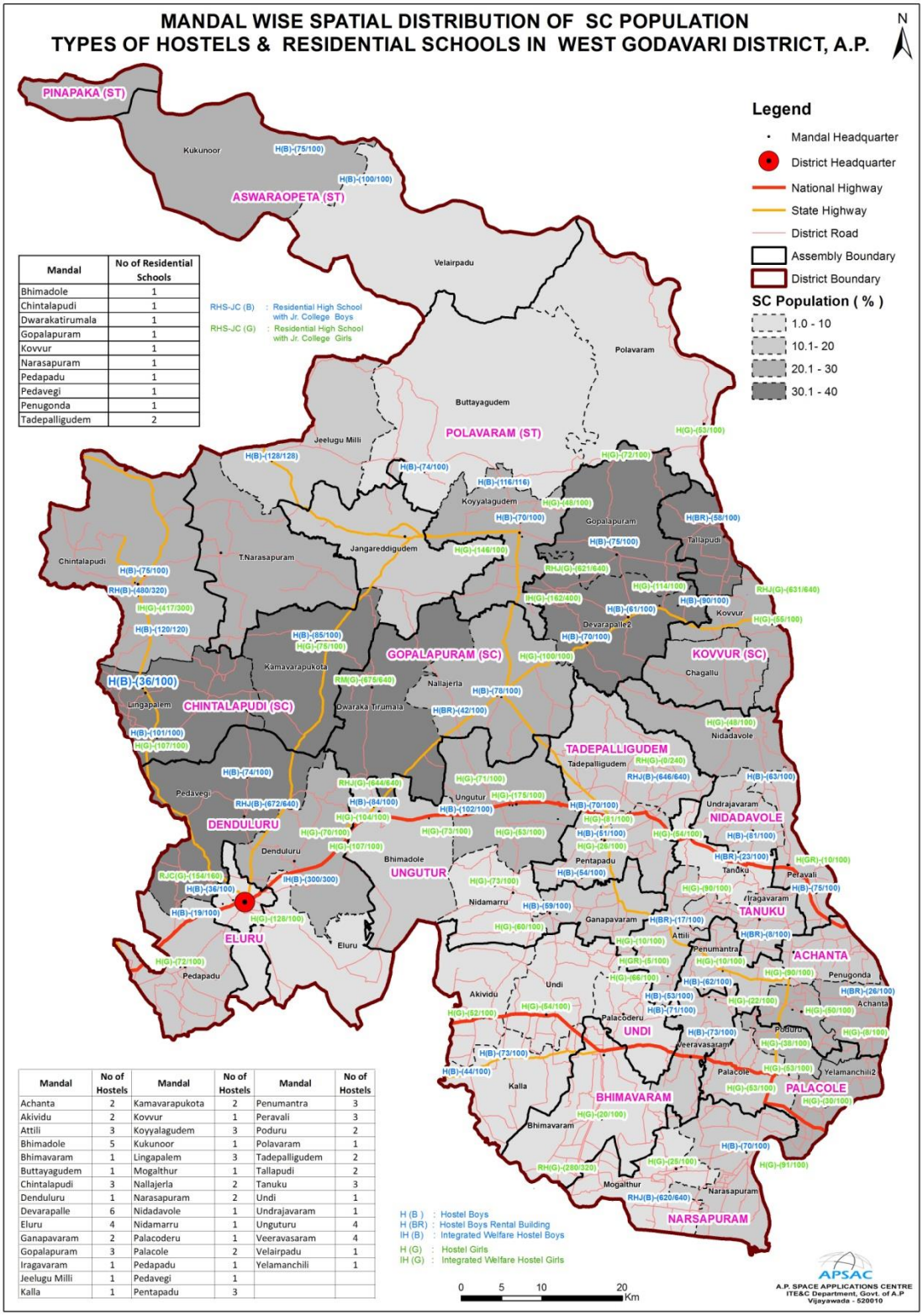


Fig.6. Mandal wise Distribution of Schedule Caste Population and Types of Hostels and Residential Schools in West Godavari District, Andhra Pradesh

1.6 Important Tourist Places

1.6a Places of Tourist Interest

There is enormous potential for Tourism in West Godavari District, because of the presence of religious Monuments/Temples, and the district is endowed with rich historical or archaeological heritage. The places of religious temples/institutions and historical / archaeological significance in the District are presented briefly hereunder. All efforts are afoot by the District Authorities for bringing about overall tourism development in the District in view of its vast potentiality and ample scope in this regard.

1.Bhimavaram :

Bhimavaram is a Mandal Hqs. The place is noted for a big Naturopathic Hospital located in an extensive garden. Of the several temples at the place, Bhimeswara and Someswara are important. The Sivalingam in the temple of Bhimeswara is said to be Swayambhu Lingam (Self manifested). The Sivalingam in Gunupudi Someswara temple is also said to be a Swayambhu. The place is one of the five Aramas (Pancharamas), the other four being Amaravathi (Gunturu), Bheemarama near Samarlakota and Draksharamam both in East Godavari and Kshira Ramalingeswara of Palacole in this District.

2. **Dwaraka Tirumala** :

This is a place of Hindu religious importance owing to the temple of Lord Venkateswara which also locally known as “CHINA TIRUPATHI” at a distance of 40 Kms from Eluru.

3. **Palacole** :

Palacole formerly known as Palakota and Palakolanu is situated at a distance of 10 Kms from Narasapur. The most important item of interest in this town is the Kshira Ramalingeswara Temple which is one of the Pancharamas.

4. **Pattisam**:

Pattisam is situated at a distance of 25 Kms from Kovvuru Railway Station. It is one of the ancient and sacred places in South India. The religious importance is due to the shrines of Veerabhadra and Bhavanarayana situated on the Devakuta Parvatam overlooking the Papi Hills in the heart of River Gowthami, a branch of River Godavari.

5. **Juttiga and Natta Rameswaram (Dakshina Kasi)** :

Juttiga & Natta Rameswaram are twin Villages assumed religious importance on account of the temples of Swayambhulingam known as Sri Uma Vasuki Ravi Someswara Swamy at Juttiga Village and the lingam which is made of shells and cones named as Natta Ramalingeswara Swamy at Natta Rameswaram Village. Every “SIVARATHRI” Festival day “Edurukolotsavam” is being celebrated at the border point of two villages. Thousands of Pilgrims attend the celebrations. It is one of the important pilgrim centres in the District.

6. **Penugonda**:

It is a Mandal Headquarter. The place acquired importance as it is believed that this is the birth place of Kanyakaparameswari, the goddess of the Vaisyas. The temple of Kanyakaparameswari is the most important religious institution in the town.

7. **Pedavegi** :

Pedavegi was originally known as Vengi, It was the Capital of the Salankayanas, Vishnukundins and the East Chalukyas, and was a flourishing city at the time of Satavahanas. It is a petty village now with a few visible landmarks.

8. **Khandavalli**:

This village is situated at a distance of 12 Kms from Tanuku. It is a very ancient village situated on the banks of Vasista Godavari. This village is also known as panchalingakshetram owing to the existence of five Sivalingams in the temple of Markandeswara-Mrukandeswara. This strange phenomenon of five lingams in a temple is found only at Varanasi and Rajahmundry. Hence, this place is considered to be of religious importance.

9. **Tanuku** :

Tanuku is the Headquarters of the Mandal and it is said to be the birth place of Adikavi Nannaya Bhattaraka, who undertook the translation of the Mahabharata written in Sanskrit by Sage Vedavyasa into Telugu.

10. **Kolleru Lake** :

Kolllru Lake is one of the naturally formed fresh water lakes in the country which is partly located in West Godavari District and partly in Krishna District. Four decades back, Kolleru Lake used to be very colourful with 193 varieties of Birds, which migrate every year from October and return during March- April. Most of the birds visit Kolleru lake flying from distant countries like Egypt , Siberia , Philippines , Arabia, Australia , China, etc. and return to their Native countries with their Offspring. Now most of the birds are not coming to Kolleru Lake due to polluted waters and also from shrinkage of water bed area. Out of the above birds, Guda konga is the familiar one which is locally known as Kolleti konga . It is one of the most beautiful tourist places and a Bird sanctuary in the District.

The Supreme Court has ordered for restoration of Kolleru lake area removing all the encroachments and making the lake the habitat for Birds. Now the Kolleru lake is seen busy with colourful feathers and Chirping birds.

1.6b Places of Religious and Cultural importance

a) **Jainism** :

The Temple of Pradhama Teerthankara, named as Adhinadhudu of Jainism at Pedamiram Village near Bhimavaram Town and on a big stone image of sitting posture statue of a Jaina Tirthankara at Penumanchili of Achanta Mandal are samples of existence of Jainism in West Godavari District. Every year Aniversal day of Adhinadhudu at Pedamiram Village is being celebrated on Karthika Poornima day in a grandeur manner.

b) **Buddhism**:

The remains of ancient 'Sangharam' at Jeelakarragudem, H/o Guntupalli Village of Kamavarapukota Mandal, include a group of Rock-cut Chambers i.e. Caves, remains of a Brick-built Chaitya Hall and many "Sthupas" in different sizes, mostly rock-cut and a few structures reveals that Buddhism existed here some centuries ago. This place is picturesquely situated amidst hills of scenic beauty. The history of Guntupalli caves dated back to 200 B.C. Thousands of people still visit this historical place. It is believed that the entire development and extension of its growth was during the centuries of 2nd B.C. to 3rd A.D. In the entire Sangharam of this place, either in rock-cuts or in structures, Gowtama Buddha picture impressions are not found. So, it is evident that "Heenayanam" Buddhist culture i.e. early ages of Buddhist culture prevailed in this place

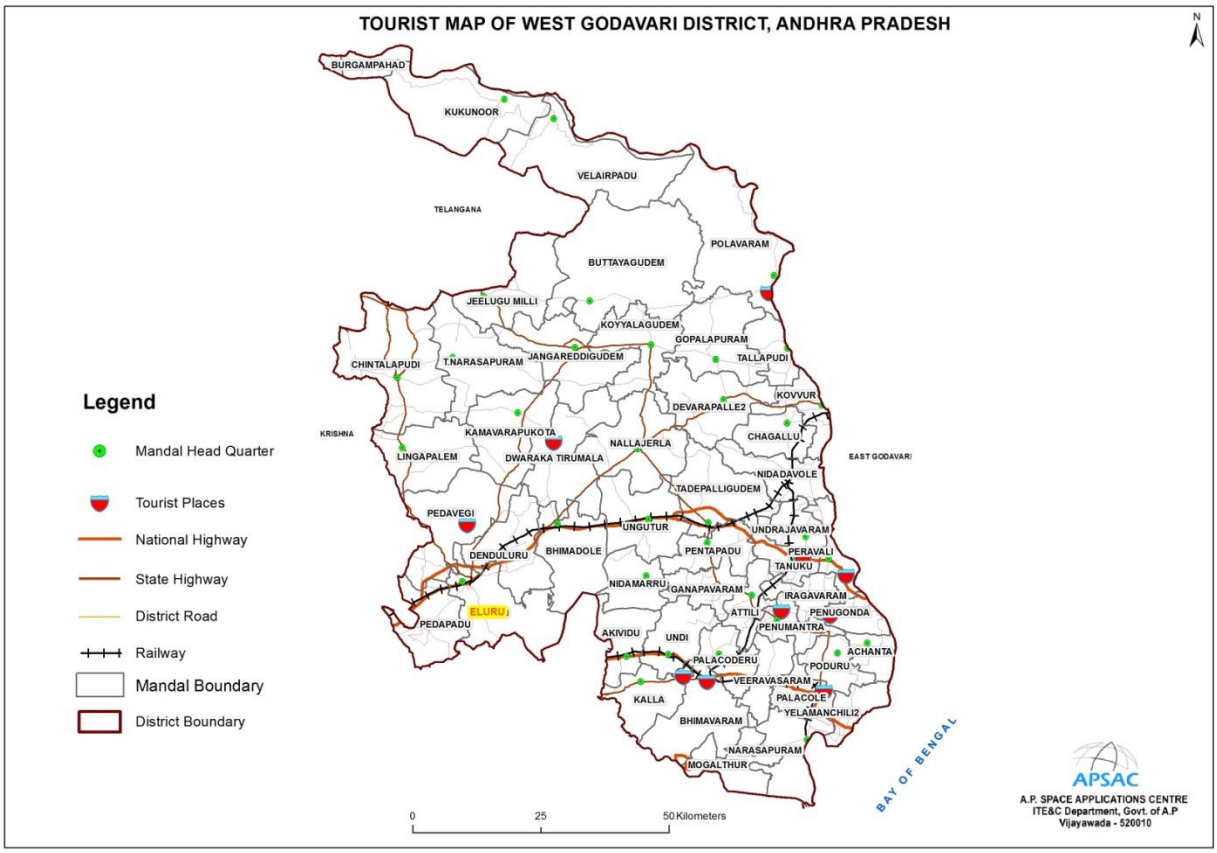


Fig.7 Some Important Tourist Places in West Godavari District, Andhra Pradesh

2. Land Utilization, Forest and Slope in the District

The Land Use / Land Cover (LULC) pattern of any region is an outcome of various physical and cultural factors and their utilization by man in time and space. Land use refers to the type of utilization to which man has put the land. It also refers to the evaluation of the land with respect to various natural characteristics. But land cover describes the vegetal attributes of land. Land use/land cover data is essential for planners, decision makers and those concerned with land resources management. For the proper understanding of the influence of the various human-induced land use practices with regard to the environmental change, it is essential to help simulate the land use changes. Remote sensing technology is considered the most effective as it provides timely and authentic information about the spatial distribution of land use/land cover, while Geographical Information System (GIS) provides a flexible digital environment for collecting, storing, visualizing and analyzing the spatial data. Remote sensing as a vital tool helps for rapid assessment and monitoring of a natural resource. When combined with GIS, it makes it possible to map land use/cover phenomena in detail for further planning, development, and decision-making, which is essential for meeting the increasing demands and welfare of the ever-growing population.

2.1 Land Use / Land Cover Classification

Various land use/land cover categories have been delineated by using 3 seasons (Kharif, Rabi & Zaid) satellite data under level-3 classification. For on-screen digitization, visual image interpretation techniques (size, shape, color, tone, texture, association and pattern) have been used for classifying the land use/land cover map (NRSA, 2006). This information is used for general planning purposes at

District/mandal level. The broad categories are built-up, agricultural, forest, wastelands, wetlands and water bodies

West Godavari is famous for its intensive agriculture and it is known as "Annapurna" meaning rice bowl of Andhra Pradesh. River Godavari irrigates a large part of the District. Paddy is the main food crop cultivated in the District. The other predominant crops raised in this District are Banana, Sugarcane, Chillies, Coconut, Maize, Tobacco and Oil palm.

The comparative area distribution of different land use categories and change are shown in the Figure 9 &Table-15. The major land use/land cover categories (2015 - 16) that have been identified in the District are Built-Up land (533.43Sq.Km.), Agricultural land (6166.56Sq.Km), Forest (1354.41Sq.Km), Wastelands (86.43Sq.Km.), Wetlands (160.59Sq.Km) and Water Bodies (310.75Sq.Km)

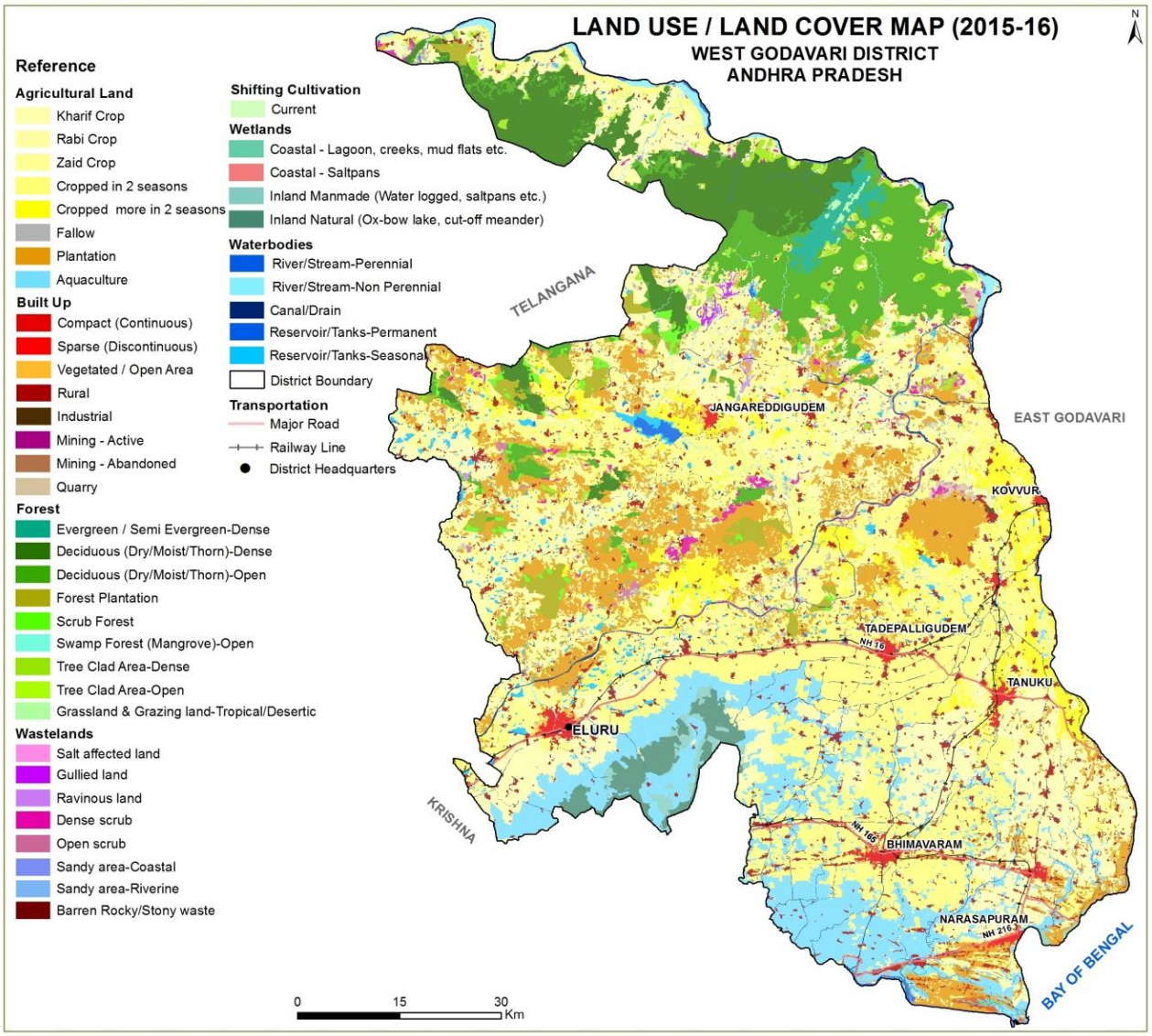


Figure 8. land use / land cover map of West Godavari District 2015-2016

Table-2.1 Category-wise Distributions of Land use/Land Cover during 2015-16

S. No	Land Use Categories Year 2015-16	Area in sq.km.	%
Built-Up Land		**533.43**	**6.11**
1	Compact (Continuous)	**67.68**	**0.80**
2	Sparse (Discontinuous)	**10.91**	**0.13**
3	Vegetated / Open Area	17.23	0.20
4	Rural	305.52	3.59
5	Industrial	9.33	0.11
6	Mining - Active	0.35	0.00
7	Mining - Abandoned	0.93	0.01
8	Quarry	16.05	0.19
Agricultural Land		**6166.56**	**5.03**
9	Kharif Crop	1330.30	15.64
10	Rabi Crop	450.98	5.30
11	Zaid Crop	1.13	0.01
12	Cropped in 2 seasons	2346.04	27.58
13	Cropped more in 2 seasons	354.44	4.17
14	Fallow	84.61	0.99
15	Plantation	898.59	10.56
16	Aquaculture	700.46	8.23
Forest		**1354.41**	**15.92**
18	Deciduous (Dry/Moist/Thorn)-Dense	64.55	0.76
19	Deciduous (Dry/Moist/Thorn)-Open	478.58	5.63
20	Forest Plantation	511.93	6.02
21	Scrub Forest	143.83	1.69
22	Swamp Forest (Mangrove)-Open	3.20	0.04
23	Tree Clad Area-Dense	84.54	0.99

S. No	Land Use Categories Year 2015-16	Area in sq.km.	%
24	Tree Clad Area-Open	17.24	0.20
25	Grass & Grazing land-Tropical/Desertic	6.69	0.08
Wastelands		**86.43**	**1.02**
26	Gullied land	7.07	0.08
27	Ravinous land	4.51	0.05
28	Dense scrub	42.47	0.50
29	Open scrub	29.08	0.34
30	Coastal	2.98	0.04
31	Riverine	0.05	0.00
32	Barren Rocky/Stony waste	0.29	0.00
Wetlands		**251.43**	**2.88**
33	Inland Natural (Ox-bow lake, waterlogged etc.)	107.32	1.26
34	Inland Manmade (Water logged, saltpans	45.56	0.54
35	Coastal - Lagoon, creeks, mudflats etc.	3.18	0.04
36	Coastal - Saltpans	4.54	0.05
Water bodies		**310.75**	**3.65**
37	River/Stream-Perennial	40.38	0.47
38	River/Stream-Non Perennial	68.14	0.80
39	Canal/Drain	74.40	0.87
40	Reservoir/Tanks-Permanent	32.28	0.38
41	Reservoir/Tanks-Seasonal	95.55	1.12
42	Shifting cultivation-Current	0.11	0.00
Total		**8506.86**	**100.00**

Built-Up

These are the areas of human habitation that has a cover of buildings, transport and communication, utilities in association with water, vegetation and vacant lands. It consists of built-up (Compact & Sparse), Vegetated / Open Area, Rural, Industrial and Mining/Quarry. It occupies an area of 533.43 sq. km, which is about 6% of the total geographical area of the District. Of which, rural area contributes 3.65% which is more than 50% of the built-up category.

Built up - Compact (Continuous)

Most of the land is covered by buildings, roads, and artificially surfaced area and cover almost all the ground. The built-up - compact class is assigned when the urban structures and transport network (i.e. impermeable surfaces) occupy more than 80 % of the surface area. This category is occupied **67.68** sq. km, which are found in urban areas.

Built up - Sparse (Discontinuous)

Most of the land is covered by the structures like buildings, roads and artificially surfaced areas associated with vegetated areas and bare soil, which occupy discontinuous but significant surfaces. Between 30 and 80 % of the total surface should be impermeable. Scattered blocks of residential flats, hamlets and small villages are delineated under this category. It contributes an area of **10.91**sq. km, which are found in peri-urban areas.

Vegetated / Open Area

These are vegetated areas within urban agglomeration (situated within or in contact with urban areas). Vegetation cover of trees, shrubs, and herbs covers at least 5% of the total surface area, which has been delineated. Parks, sport and leisure facilities, camping grounds, sports grounds, leisure parks, golf courses,

race courses, including formal parks etc are considered in this category. This category occupies an area of 17.23 sq. km.

Built-Up – Rural

These are the lands used for the human settlement of size comparatively less than the urban settlements of which more than 80% of the people are involved in the primary activity of agriculture and associated with non-commercial and with allied classes are identified as built up (rural) category. The rural area contributed is about 305.52 sq. km.

Industrial

Non-linear impervious surfaces are included in this class which is related to trade, manufacturing, distribution and commerce. These are areas where the human activity is observed in the form of manufacturing along with other supporting establishments for maintenance. The industrial area occupies an area of 9.33 sq. km.

Mining – Active

Mining areas encompass area under surface operations. The recognizable impacts of these activities on the landscape are unmistakable giant pit mines covering vast areas. The active mining areas are presently large-scale surface operations of removal of economically important ores and presently going on. The active mining area contributes an area of 0.35 sq. km.

Mining – Abandoned

These are the areas where large-scale surface operations of removal of economically important ores are carried out in the past, but presently kept abandoned due to various reasons like economic, operational, viability, disturbances etc. Only 0.93 sq. km has been contributed under this category.

Quarry

These are manifestations of surface mining operations wherein small-scale excavation of land surface for sand, gravel, clay-phosphate mines, limestone quarries etc. are taking place. They are mostly characterized by their nearness to urban areas. It contributes an area is about 16.05 sq.km.

Agricultural Land

The land use category primarily used for the production of food, fiber, and other commercial and horticultural crops. It includes land under crops namely cropland, fallow land, agricultural plantation and aquaculture. The agricultural category is found as the major category covering **6166.56** sq. km (76.27%) during 2015-16. It is also found that double-cropped area is about 32% of the District total.

Kharif Crop

Agricultural area cultivated between June/July to September/ October coinciding with SW monsoon season is considered Kharif crop. It is associated with rain-fed crops under dryland farming with limited or no irrigation and areas of rain-fed paddy and other dry crops. Kharif is found to be the second major agricultural category with an extension of 1330.30 sq. km (15.64%).

Rabi Crop

These areas are cultivated between November/December to February/March. It is associated with areas under assured irrigation irrespective of the source of irrigation. However, rabi cropped areas also occur in rain-fed regions, under residual soil moisture conditions especially in black soil areas with high rainfall during Kharif season. The extent of rabi cropped area is about 450.98 sq. km.

Zaid Crop

These are the areas that are cropped during summer (April – May) which are mostly associated with irrigated areas with fertile soils, confined to plains/delta areas. The areas are found in 1.13 sq. km during 2015-16.

Cropped in two seasons

These are the areas that are cropped during two cropping seasons that are often seen associated with irrigated areas. Three combinations are possible in this category viz., - Kharif + Rabi, Kharif + Zaid and Rabi + Zaid. It is found that this is the major agricultural category with an extent of 2346.04 sq. km.

Cropped in more than two seasons

These are the areas which are cropped in more than two cropping seasons. It includes triple cropped areas (Kharif, Rabi and Zaid), areas under multiple cropping. Long duration crops like sugarcane, cotton, banana, pineapple, etc., are considered under this category. It contributes an area of 101.37 sq. km (1.16%).

Fallow land

The agricultural land which is being used for cultivation but is temporarily allowed to rest or un-cropped for one or more seasons, but not less than a year and for not more than five years is referred to as fallow land. The fallow land occupies an area of 84.61 sq. km.

Agricultural Plantation

These are the areas under agricultural tree crops planted adopting agricultural management techniques. These also include the areas of land use systems and practices wherein cultivation of herbs, shrubs, and vegetable crops are deliberately integrated with agricultural crops mostly in irrigated conditions for ecological and economic reasons. These areas are separable from cropland, especially with the data acquired during rabi/zaid season. Plantations appear in

dark-red to red tone of different sizes with regular and sharp edges indicating the presence of a fence around it. It is found that 898.59 Sq.km. of the land is under plantation crops during 2015-16.

Aquaculture

These are the areas where fish and shrimps are bred and reared for commercial purposes. Aquaculture ponds are located mostly the inland, along coast or in lakes, river and estuaries. This category is mostly found along the coast with an area of 700.46 sq. km.

Forest

The term forest is used to refer to land with a tree canopy cover of more than 10 percent and area of more than 0.5 ha. Forest is determined both by the presence of trees and the absence of other predominant land uses within the notified forest boundaries. The trees should be able to reach a minimum height of 5 m within the notified forest boundaries. The forest cover occupied about **1354.41**Sq.km..

Deciduous (Dry/Moist/Thorn)-Dense

This category is predominantly composed of species, which shed their leaves once a year, especially during summer. These are mostly broad-leaved tropical forests with a tendency to shed their leaves annually. This category includes all the areas where the canopy cover/density is more than 40 % and contributed 64.55 sq. km.

Deciduous (Dry/Moist/Thorn)-Open

This category is predominantly composed of species, which shed their leaves once a year, especially during summer. These are mostly broad-leaved tropical forests with a tendency to shed their leaves annually. This category includes all the

forest areas where the canopy cover/density ranges between 10 and 40 percent. An area of 478.58 sq. km is attributed to this category.

Forest Plantation

These are the areas of tree species of forestry importance, raised and managed especially in notified forest areas. Most of these are located in uplands, coastal areas within notified areas. Many of these can be identified based on the sharp boundary exhibited by them. The distribution of forest plantation is 511.93 sq. km.

Scrub Forest

These are the forest areas which are generally seen at the fringes of dense forest cover and settlements, where there is biotic and abiotic interference. Most times, they are located closer to habitations. Forest blanks which are the openings amidst forest areas, devoid of tree cover, observed as openings of assorted size and shapes as manifested on the imagery are also included in this category. It is attributed an area of 143.83 sq. km.

Swamp Forest (Mangrove)-Open

These are the areas with the plants evergreen in nature, halophytic, dense or woody in nature, occurring along tidal waters/creeks, estuaries and along the delta in coastal areas. They are densely colonized in coastal on tidal flats, estuaries salt marshes etc. This category includes all the forest areas where the canopy cover/density ranges between 10 and 40 percent. It is found that 3.20 sq. km area is under this category.

Tree Clad Area-Dense

Areas with tree cover lying outside the notified forest area with a woody perennial plant with a single, well-defined stem carrying a more-or-less-defined crown and being at least 3 m tall. Plants essentially herbaceous but with a woody appearance

(e.g. bamboos and ferns) are also classified as trees if the height is more than 5 m and as shrubs, if the height is less than 5 m. This category includes all the areas where the canopy cover/density is more than 40%. It occupied an area of 84.54 sq. km.

Tree Clad Area-Open

Areas with tree cover lying outside the notified forest area with a woody perennial plant with a single, well-defined stem carrying a more-or-less-defined crown and being at least 3 m tall. Plants essentially herbaceous but with a woody appearance (e.g. bamboos and ferns) are also classified as trees if the height is more than 5 m and as shrubs, if the height is less than 5 m. This category includes all the forest areas where the canopy cover/density ranges between 10 and 40 per cent. It is attributed to an area of 17.24 sq. km.

Wastelands

Wasteland is described as degraded land which can be brought under vegetative cover with reasonable effort and which is currently underutilized and land which is deteriorating for lack of appropriate water and soil management or on account of natural causes. Wastelands can result from inherent/imposed disabilities such as by location, environment, chemical and physical properties of the soil or financial or management constraints. The area under this category is **86.43** sq. km.

Salt-affected land

These lands are containing an excessive concentration of salts (soluble salts or exchangeable saline or both). Salinization can result from improper management of canal irrigation water resulting in the rise of the water table and consequent accumulation of salts in the root zone in arid, semi-arid and sub-humid (dry) conditions and ingress of sea water in coastal regions and/or use of high-salt containing ground water. They also become saline when soils have developed on

salt containing parent materials or have saline ground water. Coastal saline soils may be with or without ingress or inundation by sea water. These lands accounted 0.26 sq. km only.

Dense scrub

The scrub is usually confined to topographically elevated areas, on the hill slopes generally surrounded by agricultural lands. These areas possess shallow and skeletal soils, at times chemically degraded, extremes of slopes, severely eroded and lands subjected to excessive aridity with scrubs dominating the landscape. It is found with varying sizes of small to large areas having a contiguous or dispersed pattern. The dense scrub is mostly identified on the hills and occupied an area of 42.47 sq. km.

Open scrub

This category has a similar description as mentioned in the dense scrub excepting that they possess sparse vegetation or devoid of scrub and have a thin soil cover. The open scrub is found at foothills surrounded by agricultural lands with an account of 29.08 sq. km.

Coastal Sand

Coastal sands are the sands that are accumulated as a strip along the sea-coast. Very high reflectance exhibited by this category especially in the NIR region of the spectrum enable their separation with the salt-affected land. It is found along the coast and occupied an area of 2.98 sq. km.

Riverine sand

Riverine sands are those that are seen as accumulations in the flood plain as sheets which are the resultant phenomena of river flooding. The sandy areas occurring within or in continuity to river course are to be excluded from this

category. These are found along the Godavari River and attributed only 0.05 sq. km.

Barren Rocky/Stony waste

The barren rock exposures are especially confined to hilly terrain with down slope with rock outcrops, stony waste and fragments. The area under this category is 0.29 sq. km.

Wetlands

All submerged or water-saturated lands, natural or man-made, inland or coastal, permanent or temporary, static or dynamic which necessarily have a land-water interface, are defined as wetlands. The wetlands category is found having 251.43 sq. km with four sub categories.

Wetland - Inland - Natural

These are the areas that include ox-bow lakes, cut-off meanders, playas, swamp, marsh, peat bogs etc (with vegetation). This category contributed 107.32 sq. km of the District total.

Wetland - Inland- Manmade

Waterlogged areas (seasonal and perennial) created due to the negative effect of human management practices and are present with vegetation. This is attributed to an area of 45.56 sq, km.

Wetland – Coastal

These include estuaries, lagoons, creek, backwater, bay tidal flat/mud flat, mangrove, salt marsh/marsh with vegetation and other hydrophytic vegetation. It contributed an area of 3.18 sq. km

Coastal - Saltpans

Saltpans are flat expanses of areas covered with salt usually white under this Saltpans are manmade saline ecosystem from which crude salt is extracted during summer. These are un-drained, usually small and shallow, natural depression or hollow in which brackish water accumulates and evaporates leaving behind salt deposits. The area attributed under this category is 4.54 sq, km.

Water Bodies

This category comprises areas with surface water, either impounded in the form of ponds, lakes and reservoirs or flowing as streams, rivers, canals etc. These are seen clearly on the satellite image in blue to dark blue or cyan color depending on the depth of water. Waterbody category occupies an area about **310.75** sq. km.

River/Stream-Perennial

Rivers/streams are the natural course of water flowing on the land surface along a definite channel/slope regularly or intermittently towards a sea in most cases or a lake or an inland basin in desert areas or a marsh or another river. The rivers/streams that flow continuously throughout the year are considered perennial. It contributes an area of 40.38 sq. km.

River/Stream-Non Perennial

When the water covers the surface for less than nine months in each year, it is considered non perennial. This also includes the dry part of river generally characterized by the presence of sand or exposed rocks. It is found that most of the streams fall under non perennial category and contributes an area of 68.14 sq. km.

Canal/Drain

Canals and drains are artificial watercourse constructed for irrigation, navigation or to drain out excess water from agricultural lands. It is found mostly in coastal plains with an area of 74.40 sq. km.

Reservoir/Tanks-Permanent

The reservoir is an artificial lake created by the construction of a dam across the river specifically for hydel power generation, irrigation, and water supply for domestic/ industrial needs, flood control, either singly or in combination. Tanks are small lakes of impounded waterways constructed on land surface for irrigation. They are associated with croplands, low lands and reservoirs surrounded by hills without vegetation. This includes all reservoirs/tanks with water spread seen at least during one season in a year is considered under the permanent category. This category occupies an area of 32.28 sq. km.

Reservoir/Tanks-Seasonal

Dry reservoirs/tanks are those, which do not have water spread throughout the year are considered seasonal. It is found that many of the tanks are under seasonal category with an area of 95.55 sq. km.

2.2 Slope Map of the District

The concept of measuring slope from a topographic map is a familiar one for most professionals in the natural resources and landscape planning / management and surveying professions. Slope is a measurement of how steep the ground surface is. Steeper the ground surface, greater the slope is. Slope is measured by calculating the tangent of the surface. The tangent is calculated by dividing the vertical change in elevation by the horizontal distance. Slope is normally expressed in planning as a percent slope which is the tangent (slope) multiplied by 100. Percent Slope = Height / Base * 100

Reliable estimation of the stability of slopes and foundations is very demanding because it is important for terrain analysis to understand the natural process in the disciplines of topography, geology, soils, hydro-geology, infrastructure planning, hazard management both at surface and subsurface. In view of this, slope plays an important role while doing decentralized planning at grassroots level. Traditionally contours information from 1:50,000 or 1:25,000 topographic maps are used for preparation of slope by manual procedures based contour value difference for unit horizontal distance. The emergence of remote sensing & GIS systems and the availability of topographic data in DEM or TIN formats, slope maps can be generated using image processing and GIS methods. Representation of slope in percentage is an understandable rationale for the resource mapping and planning. Slope information is one of the GIS layers that play an important role in natural resources and District planning process. It is proposed to generate the necessary slope layer from the available digital topographic data such as Carto DEM and open source Digital Elevation Model data (NRSC, 2009).

From Fig. 9, it is observed that Southern part of the District is covered with level to nearly level slope which includes deltaic mandals. Moderately sloping areas are observed in upper parts of the District area. Strongly sloping is observed in the central parts of the District.

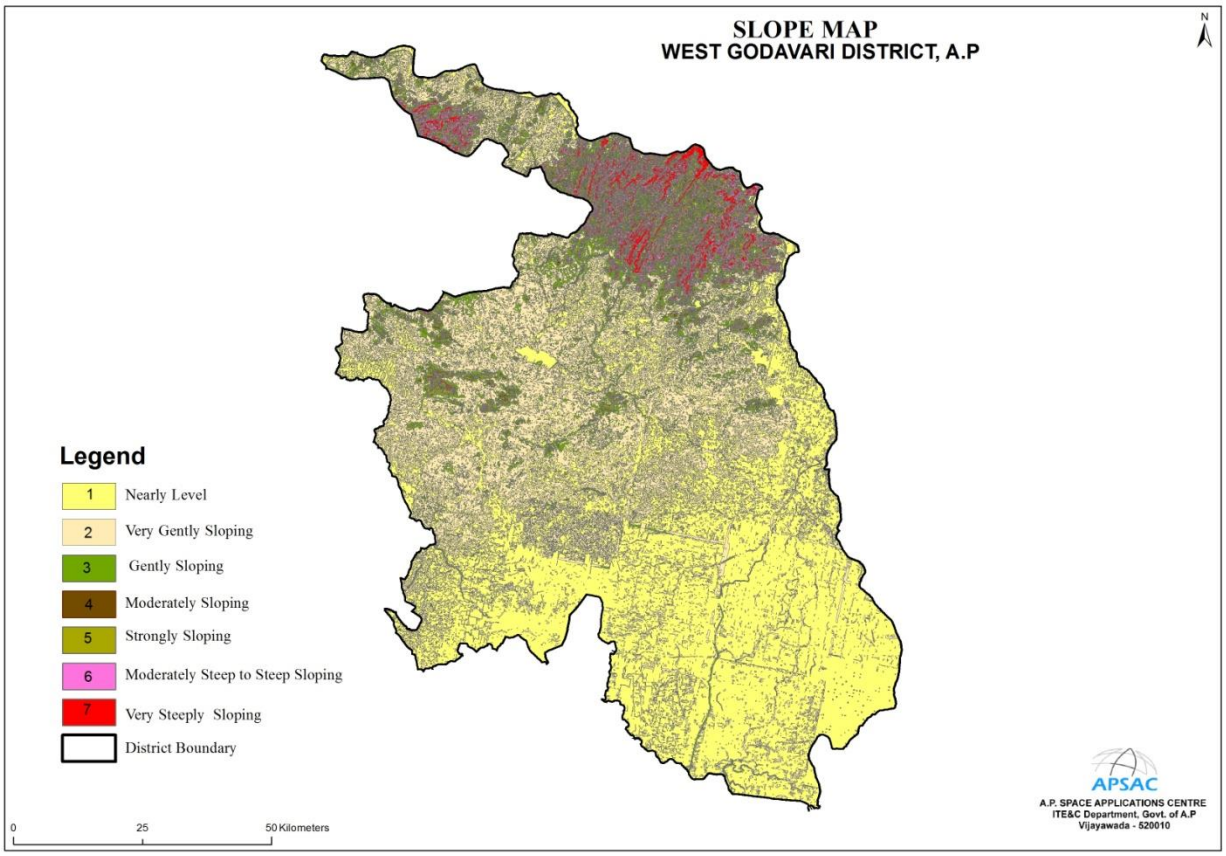


Fig. 9. General Slope of West Godavari District, Andhra Pradesh

Slope data generated from DEM using GIS techniques produces triangular nature slope polygon. To generate meaningful slope layer, it is suggested to aggregate slope polygons by using manual procedures. However, the slope generated from GIS analysis can be used directly for any decision-making planning purpose. The accuracy of the slope is dependent on accuracy of the DEM used for slope generation. The DEM should a bare earth and should not have spikes or dips which are common in automatic DEM generation. Therefore, to use Carto DEM, conversion to bare earth DEM has to be carried out before slope layer generation

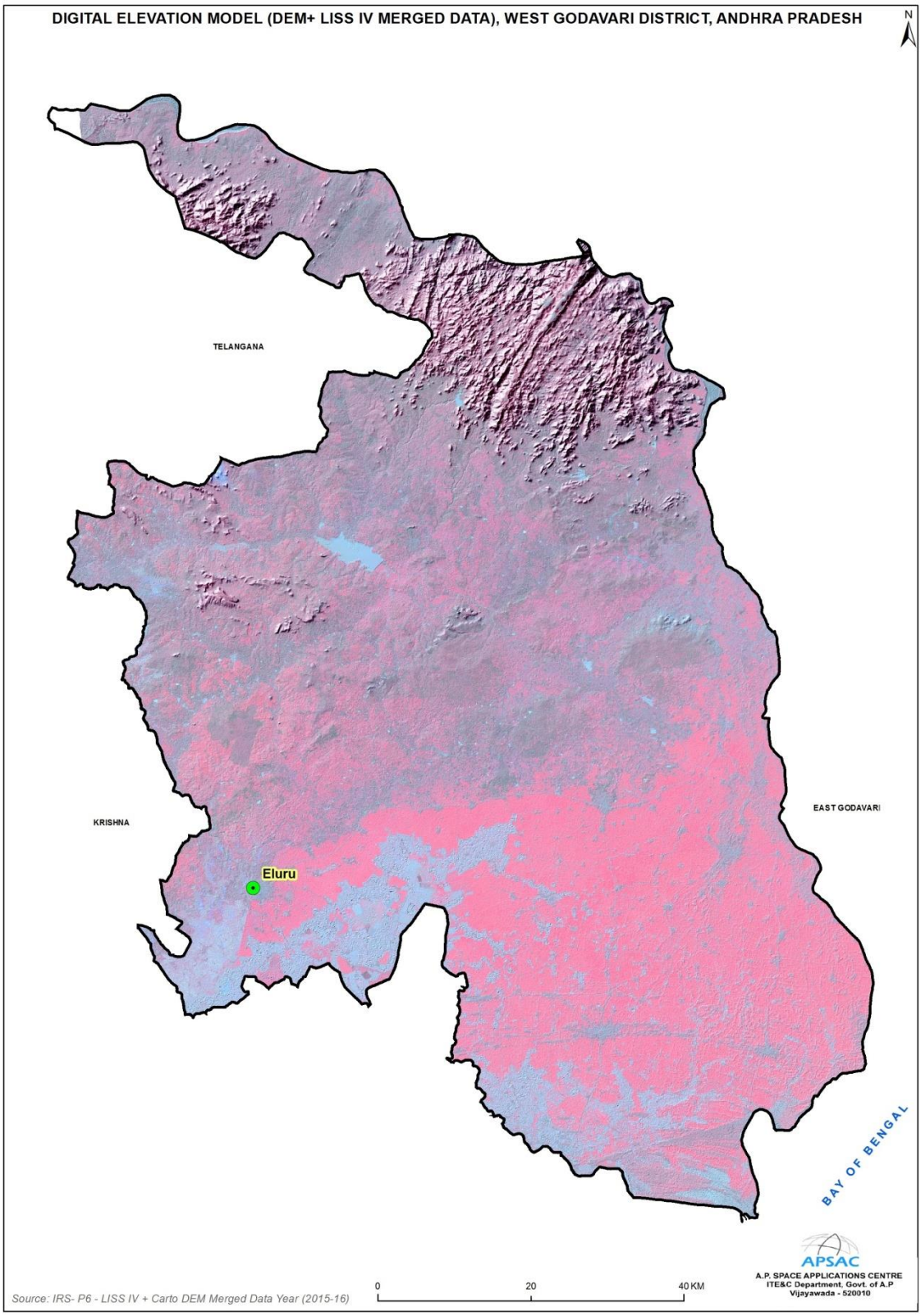


Fig. 10. Digital Elevation Model of West Godavari District

2.3 Forest Cover Distribution

The forest cover in the District based on the interpretation of IRS R2 LISS III data (2015-16) is **1375.11**sq. km which is **16.17** % of the total geographical area (TGA) of the District. As per the land use manual (NRSC, 2016), the forests of the District can be classified into 9 forest classes and class-wise areas are presented in Table-2.2. The spatial distribution of forest cover in the District is shown in Figure-11.

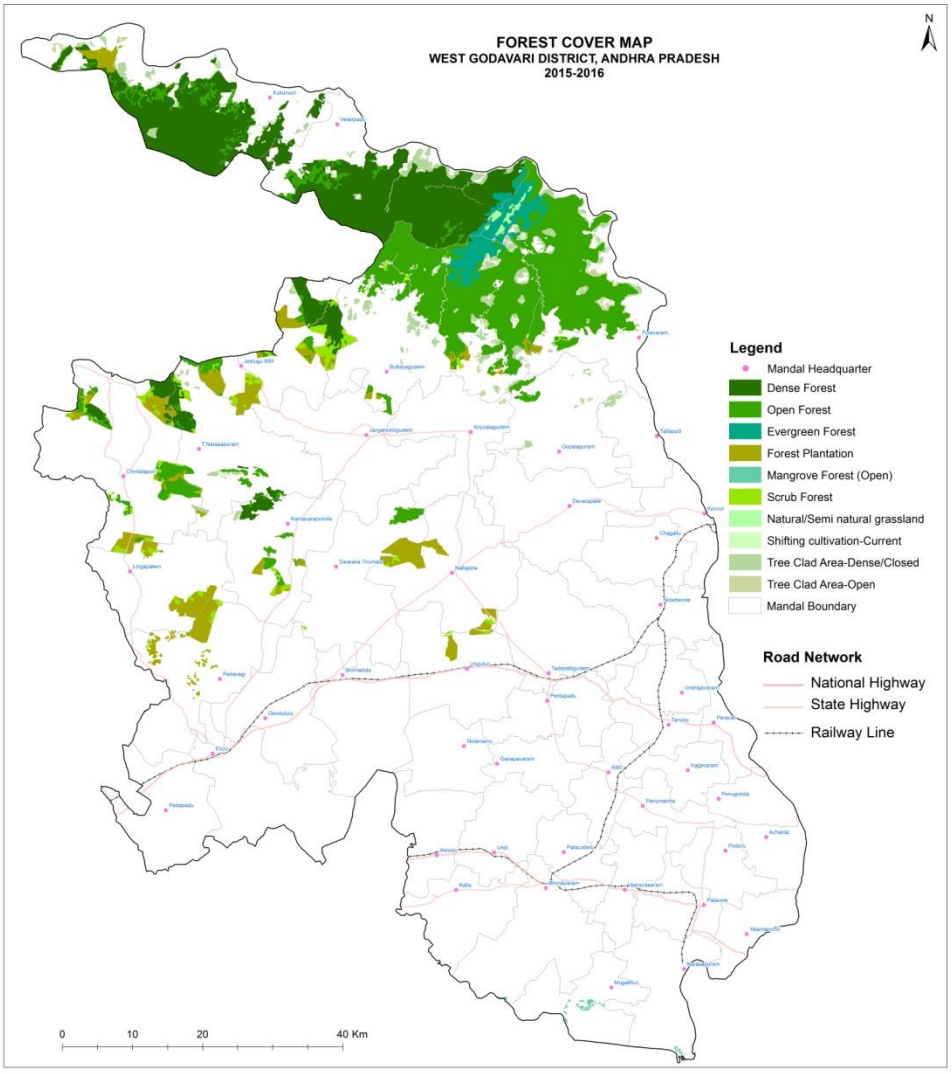


Fig.11 Forest cover map of West Godavari District during 2015-16

Table-2.2 Forest Cover Distribution of West Godavari District

S. No	Forest Category	Area in sq. km.	% TGA
1	Evergreen / Semi Evergreen-Dense	64.55	0.76
2	Deciduous (Dry/Moist/Thorn)-Dense	64.55	0.76
3	Deciduous (Dry/Moist/Thorn)-Open	478.58	5.63
4	Forest Plantation	511.93	6.02
5	Scrub Forest	143.83	1.69
6	Swamp Forest (Mangrove)-Open	3.20	0.04
7	Tree Clad Area-Dense	84.54	0.99
8	Tree Clad Area-Open	17.24	0.20
9	Grass & Grazing land-Tropical/Desertic	6.69	0.08
	Total Forest	**1375.11**	**16.17**

3. Agriculture and Soils

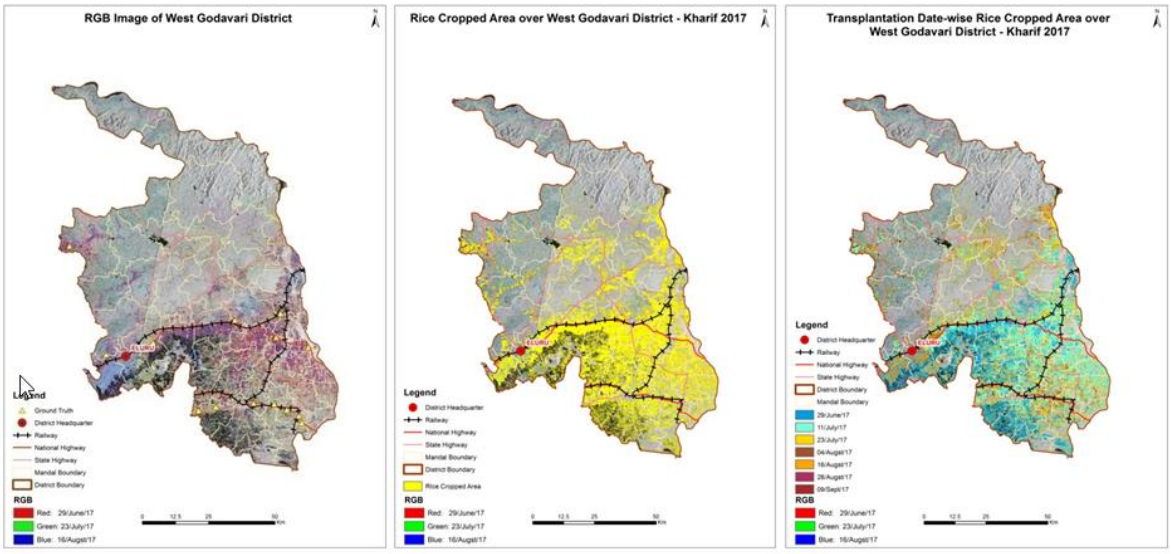
The net area cultivated forms about 89.80 % of the total geographical area of the District. Out of the net area sown, a large portion of the area is irrigated by the network of irrigation canals. River Godavari irrigates all the mandals in Delta region, whereas Pendyala, Gutala, Vegeswarapuram pumping scheme irrigates some parts of Kovvur, Nidadavole, Tallapudi, Polavaram, Gopalapuram Mandals. River Krishna irrigates the entire portion of Eluru, Pedapadu mandals and parts of the area in Denduluru and Bhimadole mandals. In upland tracks, there are irrigation tanks fed by the Hill streams besides other number of Tube wells, Dug wells and M.I. Schemes which supplement the irrigation sources. On par with East Godavari and Krishna Districts, West Godavari District has the distinction of being the Rice Granary of Andhra Pradesh with Paddy farming 60% to 65% of the total area sown with an average yield of 3,597Kgs / Hect. in the District. The other predominant crops also raised in this District are Banana, Sugarcane, Chillies, Coconut, Maize and Tobacco. Oil palm crop area is also increasing day by day due to fulfilling the requirement of "Oil production factory" established in Pedavegi Mandal.

Remote sensing technology has been successfully used by APSAC during the last two decades in the areas of agriculture both in spatial and temporal domains under various projects. APSAC carried out in-season forecasting of acreage for major crops i.e. Kharif rice, Rabi rice, cotton, groundnut etc, at state/ District level for the last two decades in Andhra Pradesh to enable the administrators and planners to take strategic decisions on import-export policy matters and trade negotiations. Rice and Cotton are the most dominant crops in Andhra Pradesh in both Kharif seasons. In this connection, Department of Agriculture and Directorate of Economics & Statistics are generating data on conventional methods for estimation of crop

area and production. In this regard, satellite remote sensing plays a pivotal role with limited field visits for timely for estimation and monitoring the crops.

3.1 Crop Acreage Estimation

The major crops cultivated in the West Godavari District are paddy, sugarcane, maize, chillies and pulses. Other crops such as banana, turmeric and mango are also cultivated in some of the mandals. In addition to Kharif rice, Chillies and Rabi Rice are also estimated using optical remote sensing and Microwave data in the West Godavari District.



(a) (b) (c)

Fig:12(a) Ground truth data overlaid on multi-temporal RGB image, (b) Rice cropped area and (c) Transplantation date-wise rice cropped area over West Godavari District.

3.2 Kharif Rice Estimation

Andhra Pradesh Space Applications Centre (APSAC) has carried out *Kharif* rice crop acreage estimation over West Godavari District using Microwave Remote Sensing (Sentinel-1A) data under FASAL project. Sentinel-1A Synthetic Aperture Radar (SAR) VV polarization data (Spatial Resolution 20m) is used for the analysis. The rice acreage using Sentinel-1 microwave remote sensing data for West Godavari District was estimated as 2,29,136 ha.

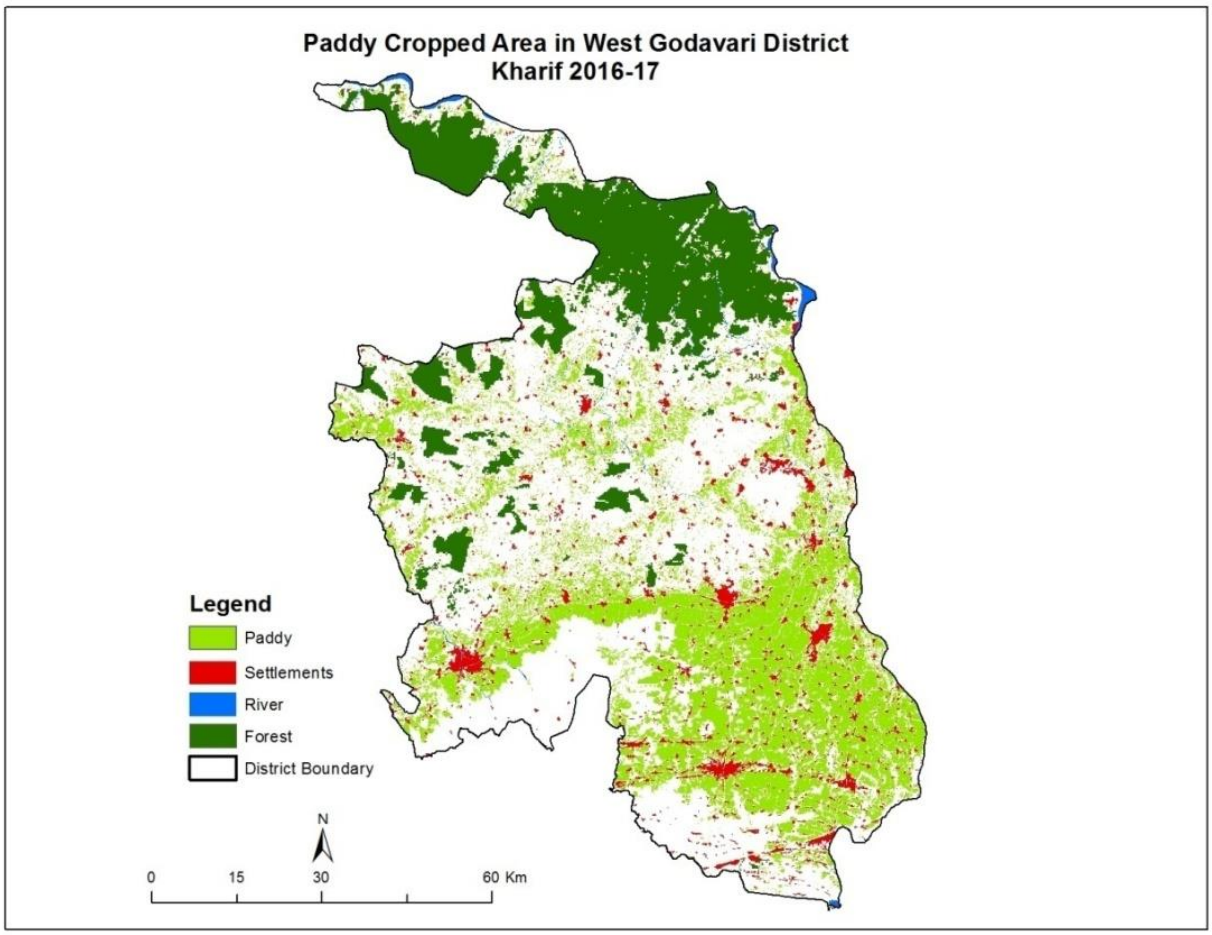


Fig:13. Kharif Rice and Cotton acreage estimation for Kharif 2016-17

SNo.	District	Kharif Paddy acreage (ha.) using optical RS data
1	West Godavari	218836

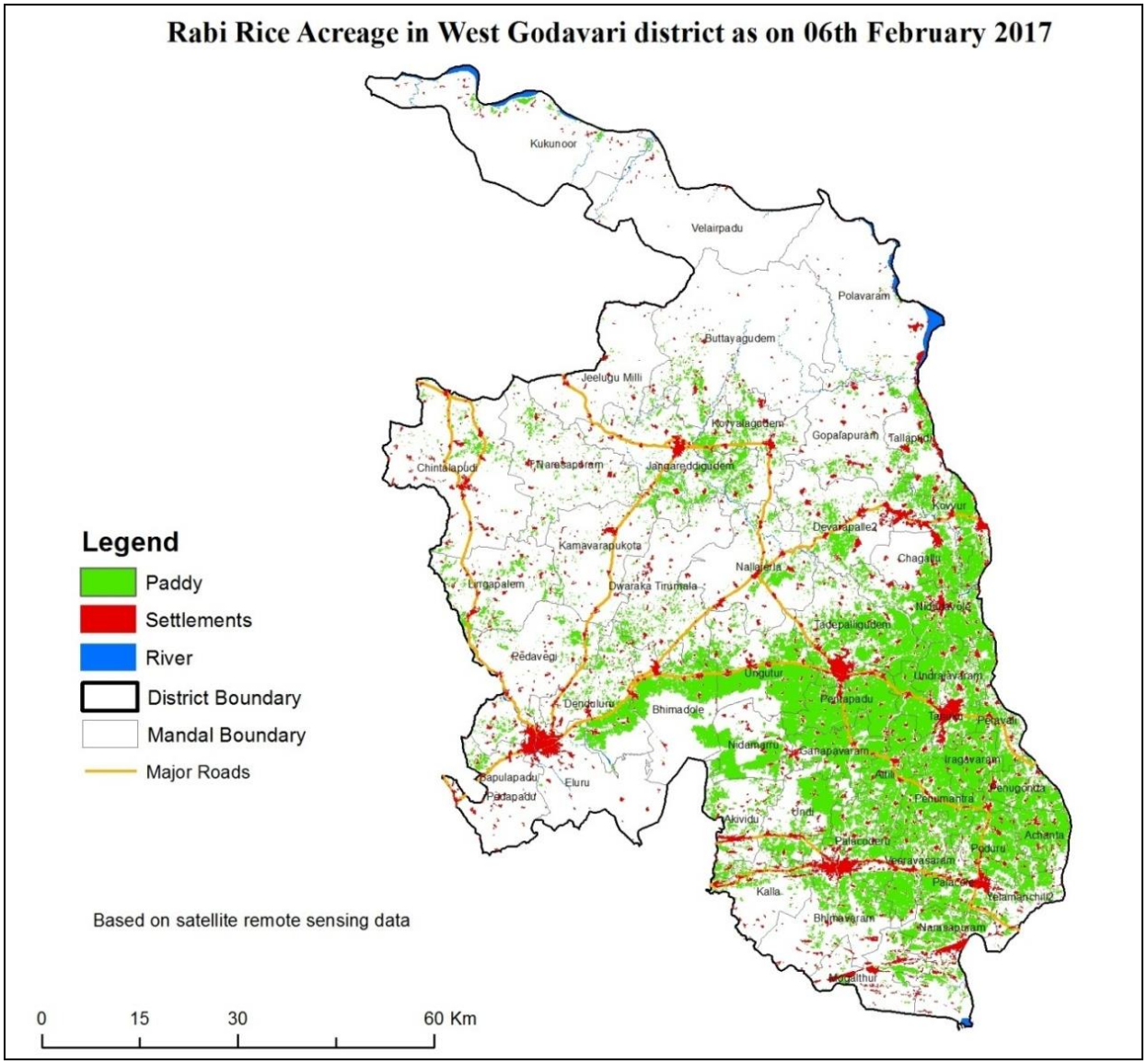


Fig: 14 Rabi Rice crop acreage estimation 2016-17

SNo.	District	Rabi Paddy acreage (ha.) using optical RS data
1	West Godavari	178021

3.3 Soils and its Classifications

The different types of soils encountered in the District are red soils, black cotton soils, deltaic alluvial soils and coastal sands. The red soils (35.05%) are seen mostly around Chintalapudi, Koyyalagudem, Nallajerla and southeast Polavaram villages which are permeable and well drained to moderately well drained. The black cotton soils are encountered in around Eluru, Nidamarru in the District. Deltaic alluvial soils are very deep and highly fertile. These are seen mostly around Polavaram, Kovvuru, Nidadavolu and Tanuku. The coastal sands are seen occurring as patches in the south west and southern most parts of the District.

Table:3.1 Soils and their Classifications

S.No	Soil Type	Percentage
1	Red Sandy Loams	35.05
2	Clay Loams	22.89
3	Alluvial	14.00
4	Sandy Alluvial	12.53
5	Deltaic Alluvial	9.98
6	Coastal Sandy Loams	3.14
7	Heavy Clays	1.98
8	Saline Soils	0.43

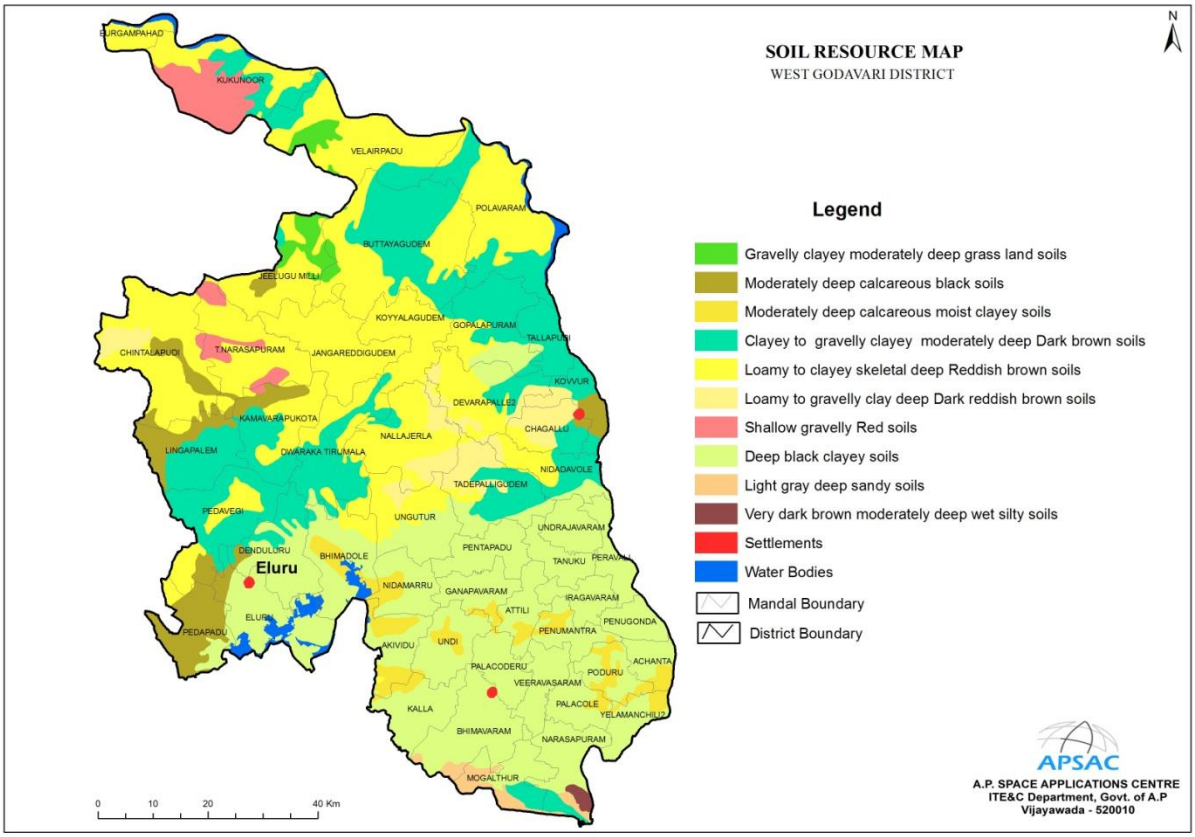


Fig.15 Soil Resources Map of West Godavari District, Andhra Pradesh

3.4.Horticulture:-

Horticulture crops are growing in an area of 1,39,781 hectares out of the net cropped area of 3.86 lakh hectares which constitutes 36.01%. 85% of the horticulture crops are growing in 24 upland mandals and 15% in 22delta mandals. Coconut, oil palm, cashew are important plantation crops. Mango, sweet lemon orange and banana are the leading fruit crops. Tomato, brinjal, and bhendi are the major vegetables.

Fresh Fruits:-

The Total area grown under various fruits in the District is 28015 Ha. Out of that, the major seasonal and perennial fruits grown are Banana, Mango, Lemon and Guava which have been distributed in the upland mandals in the District. The details of fruit-wise areas and the production are as follows.

Table: 3.2 Areal Extent (Ha) of Fresh Fruits with Production (MT) in West Godavari District (2017-18)			
Sl.No	**Name of The Fresh Fruit**	**Statistics**	
1	Amla	*Area*	2
		Production	40
2	Banana	*Area*	14025
		Production	846800
3	Ber	*Area*	0
		Production	0
3	Lemon (Lime & Other Citrus Fruits)	*Area*	5225
		Production	83600
4	Orange & Batavia	*Area*	179
		Production	4654
5	Custered Apple	*Area*	5
		Production	40
6	Grapes	*Area*	0
		Production	0
7	Guava	*Area*	1861
		Production	72718
8	Jack Fruit	*Area*	0
		Production	0
9	Mango	*Area*	5528
		Production	77389
10	Papaya	*Area*	515
		Production	50727.5
11	Pineapple	*Area*	0
		Production	0
12	Pomegranate	*Area*	0
		Production	0
13	Sapota	*Area*	252
		Production	3430
14	Muskmelon	Area	0
		Production	0
15	Watermelon	Area	118
		Production	3549.44
16	Other Fruits	Area	306
		Production	7956
	Total Fresh Fruits	Area	28015.8125
		Production	1150904.035

Fresh Vegetables:-

The Total area grown under various Vegetables in the District is 7030 Ha. Out of that, the major types of Vegetables grown are Brinjal, Bendi and Elephant Foot Yam which have been distributed in the upland mandals in the District. The details of areas and the production related to each of the Vegetable types are presented below.

Table:3.3 Aerial Extent (Ha) of Vegetables with Production (MT) in West Godavari District (2017-18)

Sl.No	Name of The Vegetables	Statistics	
1	Beans	Area	364
		Production	5714.8
2	Bitter Guard	Area	390
		Production	7020
3	Bottle Gourd	Area	218
		Production	4578
4	Brinjal	Area	1642
		Production	48767
5	Cabbage & Knol-Khol	Area	46
		Production	874
6	Capsicum	Area	1
		Production	33
7	Carrot	Area	0
		Production	0
8	Cauliflower	Area	234
		Production	3510
9	Cucumber	Area	272
		Production	6800
10	Chillies Green	Area	359
		Production	10052
11	Garlic	Area	0
		Production	0
12	Elephant Foot Yam	Area	618
		Production	3708
13	Bendi	Area	868
		Production	14756
14	Onion	Area	0
		Production	0
15	Parwal / Ponted Gourd	Area	0

		Production	0
16	Peas	Area	0
		Production	0
17	Potato	Area	0
		Production	0
18	Radish	Area	0
		Production	0
19	Pumpkin	Area	21
		Production	441
20	Sweet Potato	Area	0
		Production	0
21	Tapioca	Area	194
		Production	3686
22	Tomato	Area	0
		Production	0
23	Other Vegetables	Area	1803
		Production	43272
	Total Vegetables	Area	7030
		Production	153212.2

Plantation:- Oil palm and Cocoa are the major plantations growing in the northern part of the District. From the above plants, oils have been extracted for various uses. Total area grown under the category of plantations is 1,00,000 Ha. One of the other plantations covered in the District is cashew which is growing in northern part and coastal sand areas with an area of 12,625 ha., and another plantation is coconut. The coconut plantation is growing in the entire the District both in delta and upland areas including the aquaculture tank bunds. The area covered in coconut plantation is 26,525 ha. The details of areas and the production related to each of the plantations are presented below.

Table: 3.4 Aerial Extent (Ha) of Plantation with Production (MT) in West Godavari District(2017-18)

Sl.No	Name of The Plantation	Statistics	
1	Arecanut	*Area*	0
		Production	0
2	Cashew	*Area*	12625

		Production	13761
3	Cocoa	*Area*	15250
		Production	12877
4	Coconut	*Area*	26575
		Production	3213
5	Oilpalm	*Area*	85007
		Production	1615133
6	Coffee	*Area*	0
		Production	0
	Total Plantations	Area	139457
		Production	1641771.35

The area covered in various types of Spices is 2654 ha. Out of the spices grown Chilies (Dried) is in the major area of 2114 ha in the District. The details of each type of Spices with areas and their production are as follows.

Table: 3.5 Aerial Extent (Ha) of Spices with Production (MT) in West Godavari District (2017-18)

Sl.No	Name of The Spices	Statistics	
1	Ajwan	Area	0
		Production	0
2	Betelvine	Area	89
		Production	1517628
3	Pepper	Area	125
		Production	82
4	Chillies (Dried)	Area	2114
		Production	12682.5
5	Coriander	Area	5
		Production	10
6	Ginger	Area	0
		Production	0
7	Tamarind	Area	0
		Production	0
8	Turmeric	*Area*	321
		Production	3531
9	Others Spices	*Area*	0
		Production	0
	Total (Spices)	Area	2654
		Production	16305.5

Flowers also are grown in a limited area in the District. The details of types of the flowers with areas and their production are as follows.

Table: 3.6 Areal Extent (Ha) of Flowers with Production (MT) in West Godavari District (2017-18)			
Sl.No	**Name of The Flowers**	**Statistics**	
1	Chrysanthemum	*Area*	5
		Production	100
2	Jasmine	*Area*	8
		Production	50
3	Marigold	*Area*	48
		Production	528
4	Rose (Lakhs of Flowers)	*Area*	8
		Production	48
5	Tuberose	*Area*	6
		Production	72
6	Crossandra	*Area*	15
		Production	50
7	Other Flowers	*Area*	
		Production	0
8	Total Flowers	Area	90
		Production	799.9

Table: 3.7. Areal Extent (Ha) of Medicinal & Aromatic Plants with Production (MT) in West Godavari District (2017-18)			
Sl.No	**Name of The Medicinal & Aromatic Plants**	**Statistics**	
1	Cholorophytum	Area	0
		Production	0
2	Palma Rosa	Area	0
		Production	0
3	Annota	Area	0
		Production	0
4	Lemon Grass	Area	0
		Production	0
5	Coleus	Area	0
		Production	0
6	Ashwagandha	Area	0
		Production	0
7	Citronella	Area	0
		Production	0
8	Other Medicinal Plants	Area	0
		Production	0
	Total Medicinal & Aromatic Plants	Area	0
		Production	0

4. Coastal Resources of the District

4.1 Aqua Culture

In Andhra Pradesh, highest Aquaculture area has been distributed in West Godavari District i.e. 62,481 ha Aquaculture (existing), 22,261 ha, dry/abandoned/potential area occupied and the total 84,832 ha i.e. equal to 38 % of the total state aquaculture area of Andhra Pradesh. In West Godavari District, highest aquaculture area is distributed in Bhimavaram Mandal, with 6,763 ha aquaculture, 624 ha abandoned/dry/potential and 7,387 ha total aqua area, Mogalthur 3,898 ha aquaculture, 777 ha abandoned/dry/potential, 2 ha Saltpans and 4,677 ha total aqua area and Narasapuram 3,157 ha aquaculture, 1,390 ha abandoned/dry/potential and 4,566 ha.

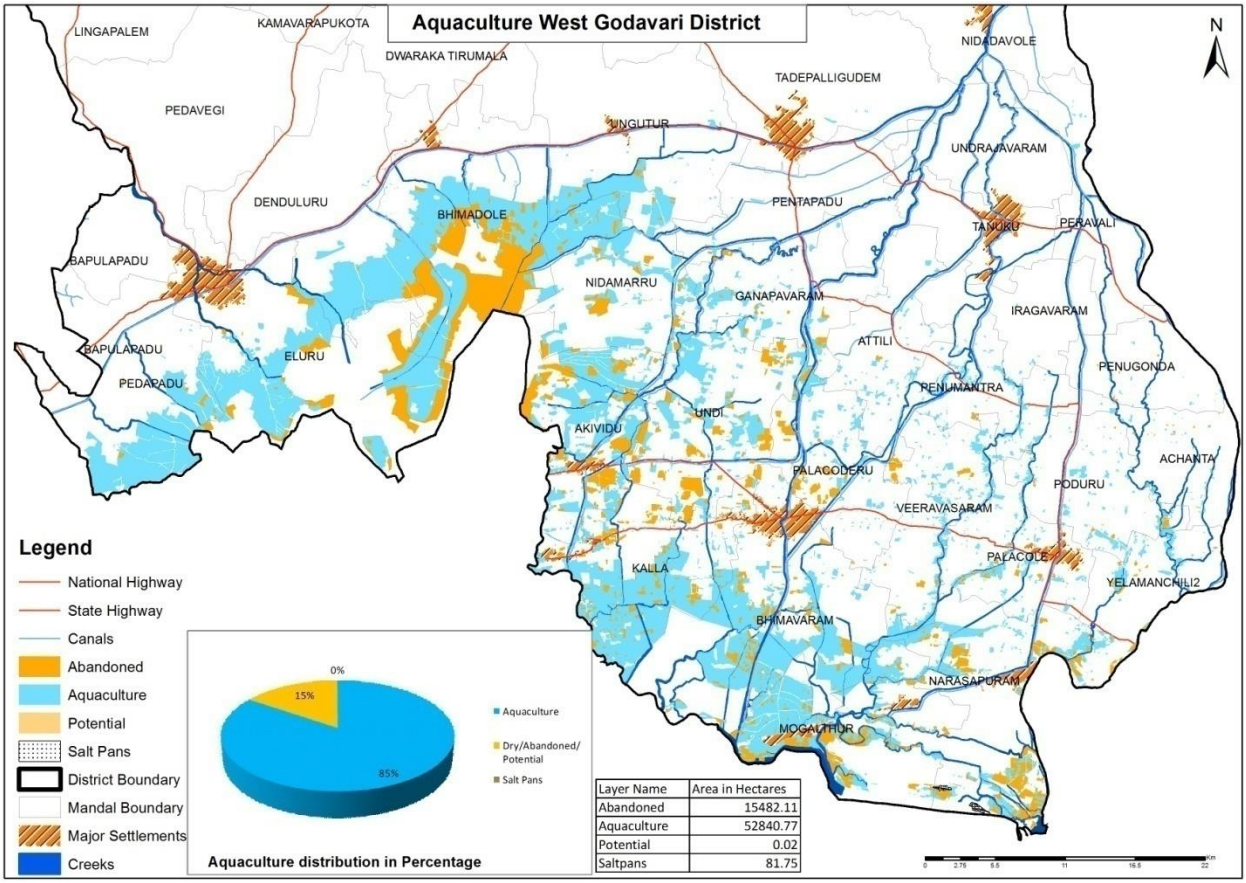


Fig.16 Aquaculture distributed area in West Godavari District

Table.4.1 Mandal - wise Aquaculture distribution in West Godavari District

Aquaculture distribution in West Godavari District (Area in ha)

S.No	Mandal	Aqua culture	Dry/Abandoned/ Potential	Saltpans	Total
1	Achanta	181	26		207
2	Akividu	4067	2272		6339
3	Attili	492	13		505
4	Bhimadole	4918	5443		10361
5	Bhimavaram	10905	1223		12129
6	Denduluru	408	66		474
7	Eluru	1330	327		1657
8	Ganapavaram	541	56		597
9	Iragavaram	39	0		39
10	Kalla	2215	387		2602
11	Mogalthur	3898	777	2	4677
12	Narasapuram	3157	1390	19	4566
13	Nidamarru	1383	139		1522
14	Palacoderu	468	64		532
15	Palacole	848	100		948
16	Pedapadu	1084	13		1097
17	Pentapadu	54	5		59
18	Penugonda	32	10		42
19	Penumantra	588	18		606
20	Peravali	63	0		63
21	Poduru	692	84		776
22	Sakhinetipalle	3	4		7
23	Tadepalligudem	10	0		10

S.No	Mandal	Aqua culture	Dry/Abandoned/ Potential	Saltpans	Total
24	Tanuku	7	0		7
25	Undi	1134	123		1257
26	Undrajavaram	3	0		3
27	Ungutur	530	41		571
28	Veeravasaram	1169	32		1201
29	Yelamanchili	764	374		1138
	Total	**30,310**	**5,533**	**21**	**35,864**

Many paddy cultivators have shifted to shrimp culture, attracted by the tremendous difference in profitability. Apart from this, the District in which water salinity is a problem, many agriculturists shifted to aquaculture, because farmers at the tail end of the irrigation canals had little access to fresh water, and are forced to use saline water. In this situation, shrimp culture stands as a promising option. The profits made in the first year are used to buy or lease more land for the second season, which lead the aqua farms to increase manifold. Mandal wise distribution of existing aquaculture and dry/abandoned/potential areas is given in the Table-1. High resolution satellite remote sensing based aquaculture mapping in West Godavari District is carried out which shows that the existing aquaculture area is 60,226 ha and dry/abandoned/potential for aquaculture development is 23,085 ha (APSAC, 2017a).

4.2 Coastal studies (Shoreline Changes)

West Godavari District has a richly cultivated land, divided into the Delta and the uplands. In the Delta, coconut, lemon, rice farming and aquaculture are practiced. In the uplands, oil palm, tobacco, cotton, sugarcane, corn, cashew, mango, banana, and other fruit farming is practiced. Cotton barrage was built on River Godavari at Dhavaleswaram channelling two canals, from which one canal

passes through West Godavari, making the soil fertile. In the coastal belt of the District, a large portion of prawns and fish is exported to Japan, and the United States. Eluru is the biggest city in West Godavari District. It is famous for its thriving woolen pile carpet industry. Bhimavaram is a hub for Prawn export. The region mostly has a tropical climate like the rest of the Coastal Andhra. The summers (March–June) are very hot and humid while the winters are pleasant. The rainy season (July–December) is the best time to visit the District with the fields being brilliantly green with vegetation.

The shoreline change estimation was carried out for the entire West Godavari coast which is about 22.81 km in length. In this study, shorelines were extracted from satellite images for 1989, 1999, 2005, 2010 and 2012 by visual interpretation. As a result of the analyses, the most significant changes were observed at West Godavari Coast. Summary statistics for the rate of change is given in Table. The analysis discovered that about 49.69% of the coastlines were under accretion, whereas remaining 41.96% of the region was experiencing varying erosion and 8.34% of the coast has stable form. While near Vasishta river mouth area and north side of Upputeru river is noticed with high accretion and near Allamvarimeraka south side Vasishta river area has most erosion area found. In West Godavari, coast had severe erosion in last few decades, most of this coast erosion and half of the coast eroded due severe wave action and orientation of the coast.

Table:4.2 Shoreline Characteristics and statistics for West Godavari Coast

Classification of Coast	Extent (km)	Percentage of Coast (%)	Cumulative (%)
High Erosion	7.09	31.08	41.96
Medium Erosion	1.47	6.46	
Low Erosion	1.01	4.42	
High Accretion	7.10	31.13	49.69

Medium Accretion	2.44	10.71	
Low Accretion	1.79	7.86	
Stable Coast	1.90	8.34	8.34
Length of coastline Including River Mouth and Ports	22.81		

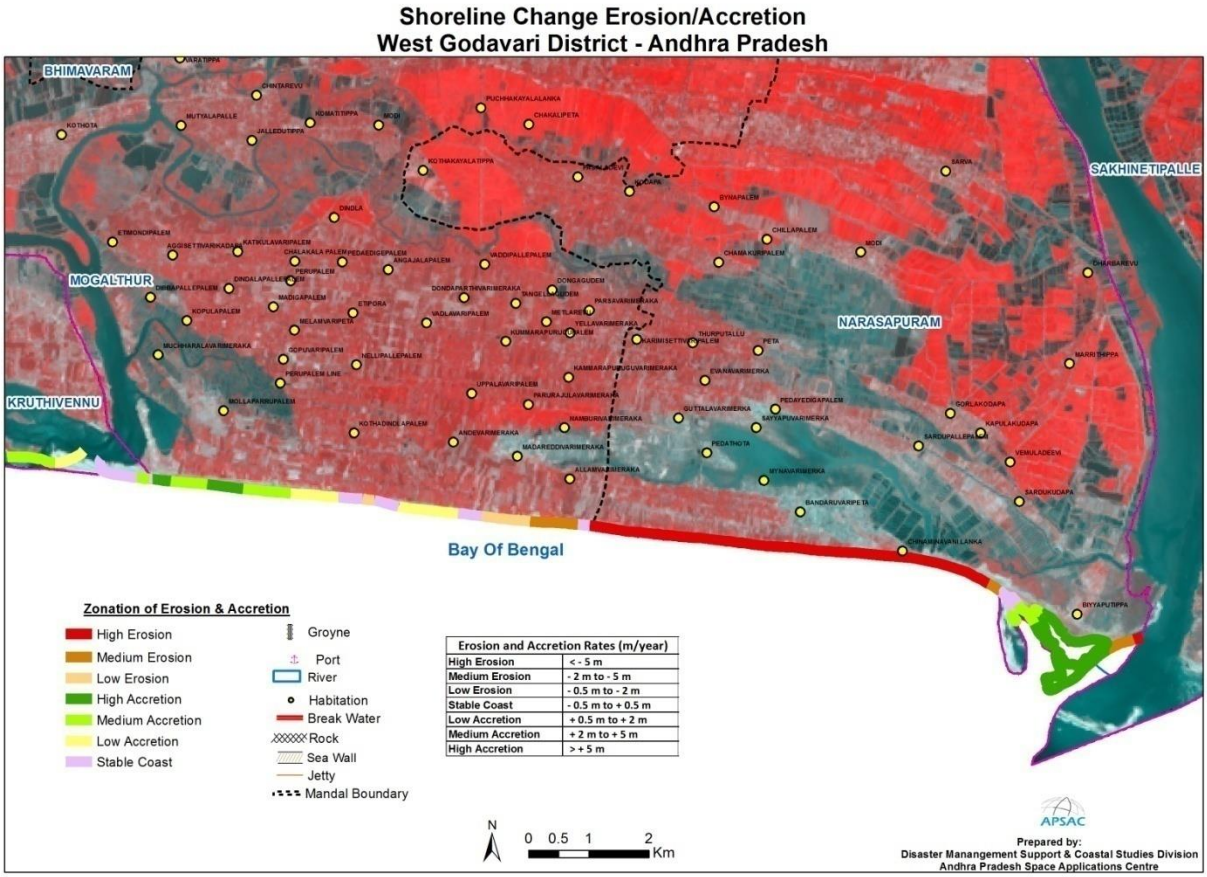


Fig:17.Shore line Change Erosion/Accretion West Godavari District

5. Water Resources of the District

5.1.1 Surface Water

5.1.2 Reservoir Studies / River basin

As per the Master plan records available with Water Resources Department, the District drainage is divided into the following sub basins.

- Lower Godavari basin
- Kovvada kalava basin
- Yerra Kalava basin
- Tammileru Basin
- Gunderu Basin
- Ramileru Basn
- Other Drainage joining to Kolleru lake
- Drainage in Godavari Delta.
- Other Drainage directly joining the sea.

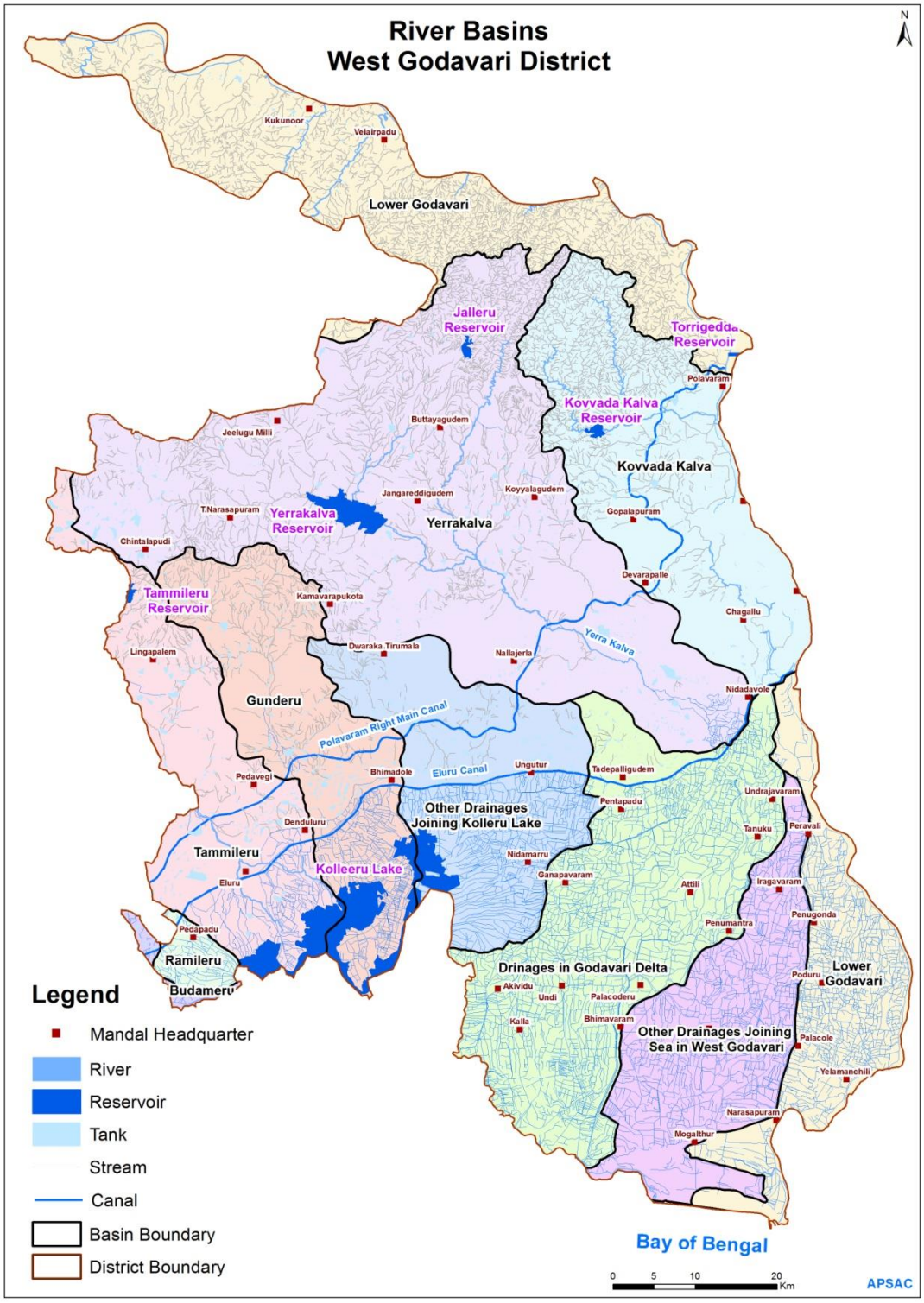


Fig. 18 River Basins of West Godavari District

51.2 Major and Medium Irrigation Projects in West Godavari District

Irrigation has assumed an increasing significance in agriculture in the context of new technology, where high yielding varieties and multiple cropping are being practiced. The main reasons for low yields are inadequate rainfall, uneven and uncertain rains during the period of crop growth. It is generally found that the introduction of irrigation is associated with changes in the cropping pattern. The shift from traditional cropping pattern to the most advantageous cropping pattern is possible only in the presence of irrigation facilities. The new agricultural technology is highly based on sufficient moisture conditions. Thus, the development of irrigation is crucial for increasing agricultural production. The irrigation projects are classified as major, medium and minor irrigation projects.

i. Major Irrigation Projects

The major irrigation projects covered in West Godavari District are Godavari Western Delta, Krishna Eastern Delta and Nagarjuna sagar Left Bank Canal Project. In Godavari Western Delta irrigates an extent of 5,29,962 acres, Krishna eastern delta an extant of 58,471 acres, and in Tadipudi lift irrigation Project an extant of 1,61,000 acres are covered. The mandals covered are Achanta, Bhimavaram, Denduluru, Eluru, Kovvur, Narasapuram, Nidadavole, Palacole, Tadepalligudem, Tanuku, Undi and Unguturu. The overall coverage under major irrigation project is 5,95,167 acres. The major ongoing irrigation project is Indira Sagar project right main canal. Under this ongoing project, about 2,58,000 acres are covered. The mandals covered are Denduluru, Eluru, Gopalapuram, Tadepalligudem and Unguturu.

ii. Medium Irrigation Projects

The Medium Irrigation projects are Tammileru ayacut with 4,244 acres, Kovvada Kalava ayacut 17,740 acres, Vijarai anicut ayacut 10,720 acres Jalleru ayacut 3800 acres and Yerra Kalava project ayacut 24,700 acres.

Minor Irrigation Sources: - There are around 3000 Tanks in the Northern part of the District with an irrigated area of about 1,35,000 acres.

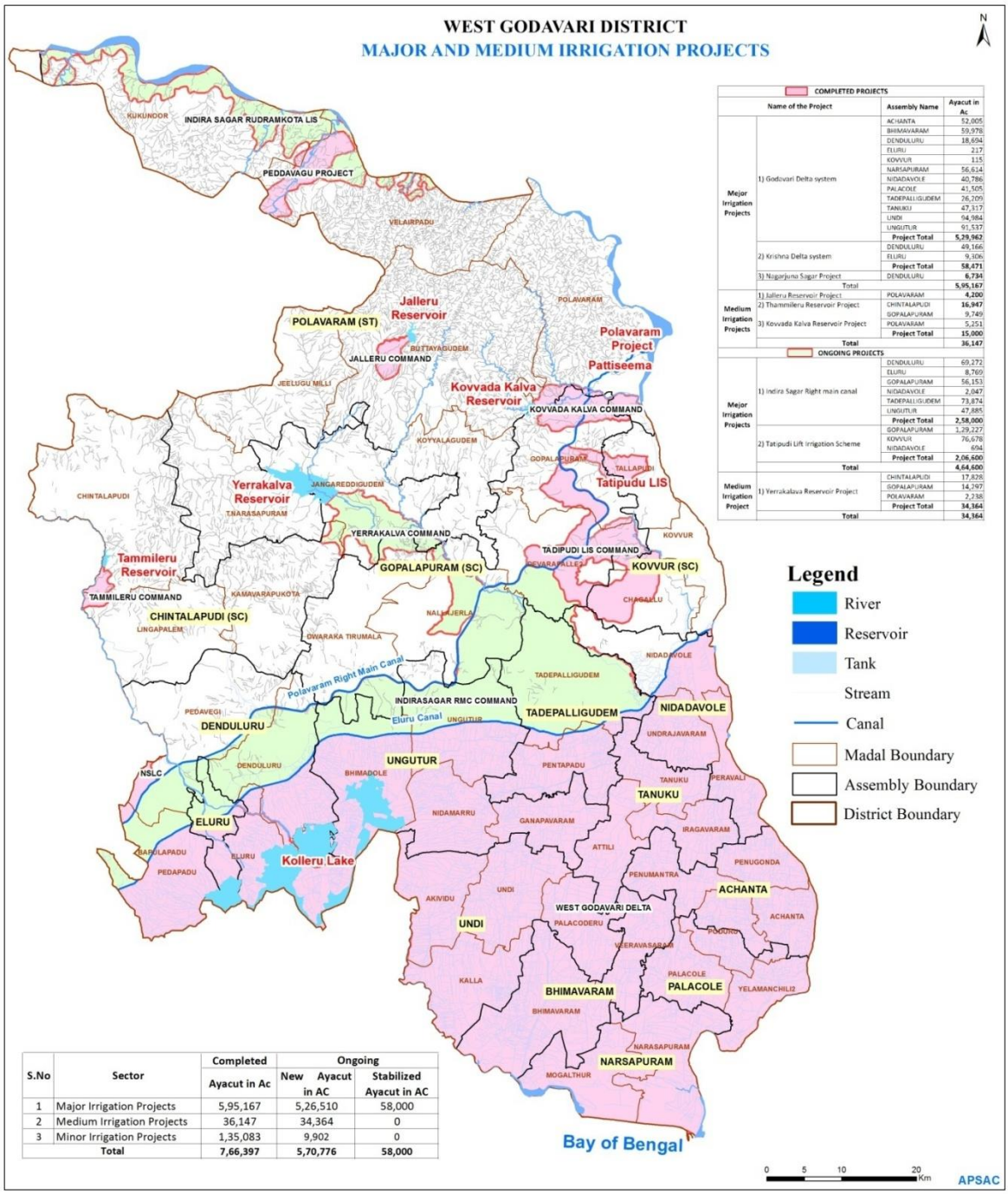
In recent years with the concept of Interlinking of rivers, the linking of major rivers, the Godavari and Krishna was completed. The water being lifted from Pattiseema lift irrigation through Polavaram Right bank canal has been interlinked at Prakasam Barrage located in Vijayawada. As the result of interlinking of rivers _the ayacut of both West Godavari and Krishna irrigated along the right main canal of Polavaram.

Table:5.1. Drainage System with Description of main rivers

S.No	Name of the River	Area Drained (Sq.KM)	% of Area Drained in the District
1	Godavari	4114.80	48.60
2	Yerrakalava	3579.6	113.57
3	Tammileru	678.79	8.01
4	Ramileru	91.45	1.08

Table:5.2.Salient Features of Important Rivers and Streams

S.No	Name of the River or Stream	Total Length in the District (in Kms)	Place of Origin	Altitude at Origin
1	Godavari	241.69	Nasikatrayambkam, Maharastra	1067 mts
2	Yerrakalava	113.57	Sitanagaram Village	200 mts
3	Tammileru	69.54	Vemsoor,Khammam	140 mts
4	Ramileru	11.13	Nuzvidu	340 mts



COMPLETED PROJECTS			
Name of the Project		Assembly Name	Ayacut in Ac
Mejor Irrigation Projects	1) Godavari Delta system	ACHANTA	52,005
		BHIMAVARAM	59,978
		DENDULURU	18,694
		ELURU	217
		KOVVUR	115
		NARSAPURAM	56,614
		NIDADAVOLE	40,786
		PALACOLE	41,505
		TADEPALLIGUDEM	26,209
		TANUKU	47,317
		UNDI	94,984
		UNGUTUR	91,537
		Project Total	**5,29,962**
	2) Krishna Delta system	DENDULURU	49,166
		ELURU	9,306
		Project Total	**58,471**
	3) Nagarjuna Sagar Project	DENDULURU	**6,734**
	Total		**5,95,167**
Medium Irrigation Projects	1) Jalleru Reservoir Project	POLAVARAM	**4,200**
	2) Thammileru Reservoir Project	CHINTALAPUDI	**16,947**
		GOPALAPURAM	9,749
	3) Kovvada Kalva Reservoir Project	POLAVARAM	5,251
		Project Total	**15,000**
	Total		**36,147**
ONGOING PROJECTS			
Mejor Irrigation Projects	1) Indira Sagar Right main canal	DENDULURU	69,272
		ELURU	8,769
		GOPALAPURAM	56,153
		NIDADAVOLE	2,047
		TADEPALLIGUDEM	73,874
		UNGUTUR	47,885
		Project Total	**2,58,000**
	2) Tatipudi Lift Irrigation Scheme	GOPALAPURAM	1,29,227
		KOVVUR	76,678
		NIDADAVOLE	694
		Project Total	**2,06,600**
	Total		**4,64,600**
Medium Irrigation Project	1) Yerrakalava Reservoir Project	CHINTALAPUDI	17,826
		GOPALAPURAM	14,297
		POLAVARAM	2,238
		Project Total	**34,364**
	Total		**34,364**

S.No	Sector	Completed	Ongoing	
		Ayacut in Ac	New Ayacut in AC	Stabilized Ayacut in AC
1	Major Irrigation Projects	5,95,167	5,26,510	58,000
2	Medium Irrigation Projects	36,147	34,364	0
3	Minor Irrigation Projects	1,35,083	9,902	0
Total		**7,66,397**	**5,70,776**	**58,000**

Fig. 19 Major and Medium Irrigation Projects of West Godavari District

5.1.4 Tank Information System

Andhra Pradesh Space Applications Centre developed a Web Portal GIS for Tank Information System (TIS) in Andhra Pradesh. In the said web portal, minor irrigation tanks are classified as more than 40 ha, 10 to 40 ha and less than 10 ha command. Information pertaining to nearly 15,000 tanks in Andhra Pradesh has been published in APSAC website while information regarding 428 tanks (out of 3000 tanks) existing in West Godavari District has so far been published in the website (http://apsac.ap.gov.in:8090/tis). In the information published in the respective website cited, all the 428 are of 10 to 40 ha category and less than 10 ha. The tank-wise information presents the location details, hydrological details and other standard information related to the tank. The following details are shown in the website

5.2 Ground Water

5.2.1 Geology

District is underlain by a variety of geological formations comprising from the oldest Archaeans to Recent Alluvium. The oldest rock types are of Archaean age, belonging to the Eastern Ghat Super group represented by Khondalite, Charnockite group and granite gneiss (migmatite). Talchir, Barakar and Kamthi formations of Lower Gondwana, and Kota and Gangapur formations of Upper Gondwana represent Gondwana sediments of U.Carboniferous to L.Cretaceous age. Gollapalli, Raghavapuram and Tirupati formations represent East coast Gondwanas. The Deccan Traps overly these Gondwana rocks. The Deposits of Rajahmundry Sandstone indicate marine transgression during Mio-Pliocene. Laterite capping on Khondalite and Charnockite are seen on hilltops. Quaternary sediments occur along the rivers and the beach.

Khondalite and Charnockite group with patches of granite gneiss occur to the NE of Jangareddygudem and around Polavaram. The Khondalite Group is

represented by Garnet-sillimanite-graphite-biotite gneiss, forming strike ridges, steep scarp sections and hillocks or conical mounds and also as bands of varying dimensions within the migmatitic terrain. Calc-granulite and quartzite occur as impersistent, narrow bands conformable to the Sillimanite gneiss. The Charnockite Group comprises basic, intermediate and acid variants. Quartzo-feldspathic injections are common within acid Charnockite. The lower topographic levels are occupied by Migmatite rocks and are characterized by variation in lithology, texture and mineralogy. They include leptynite and various products of migmatisation of Khondalite, Charnockite and pyroxene granulite.

The Gondwana formations are seen in the central part, around Jilugumilli-Chintalapudi and Dwaraka-Tirumala. The Talchir Formation comprises green shale and siltstone, occurring as a small lensoidal bodies near Chintalapudi. The Barakar Formation comprising sandstone, shale and coal occurs near Bedadanur on the western margin of the Gondwana basin. Ferruginous sandstone and shale of Kamthi Formation occur north of Chintalapudi and east of Gokavaram.

Kota Formation represented by sandstone and limestone occurs over a considerable area around Jangareddigudem. Gangapur Formation is represented by white sandstone, characterized by horizontal beds. The coastal Gondwanas, a marine and fluvio-marine sequence is found as discontinuous outcrops along the east coast. They are designated as Gollapalle Formation, Raghavapuram Formation and Tirupati Formation, and dominantly comprise sandstone, shale and sandstone, respectively. Tirupati Formation contains plant remains, fossils of brachiopod, cephalopod and foraminifera.

The Deccan Traps are disposed as horizontal to sub-horizontal basaltic lava flows near Duddukuru and Devarapalli. Infratrappean sediments are exposed near Pangadi. The traps are overlain by Rajahmundry Sandstone occurring as disconnected outcrops between Bhimadolu and Chagallu, and comprise ferruginous sandstone, clay, pebble beds and lignite.

Laterite occurs on hilltops, invariably overlying the white clay and friable sandstone of Rajahmundry sandstone. Bauxitic laterite occupies several flat topped and gently sloping hills at elevations of 1000m and above, the basement rock of which is mostly Khondalite and Charnockite.

Quaternary sediments of both fluvial and marine regimes occur in the south of the District. The fluvial are flood plain, levee and active channel. The marine are palaeo-beach ridge, palaeo-tidal flat and active beach. Kolleru Lake is to the southwest. The flood plain occupies major part of the delta and is mainly composed of black silt clay and the levee is made of brown silt. The active channel comprises coarse sand with rock fragments. The palaeo-channels are made up of 2.5m to 3.00m thick black clay on top, underlain by coarse sand. The palaeo-beach ridges rise about 2m above the present surface and are made of highly oxidized brown, fine sand with inter-ridge lows or tidal flats composed of alternating sequence of brown silt clay and sand. The present day beach is made of grey to cream, fine sand. Evidence of movements during Quaternary is recorded along ENE-WSW trending Narsapur - Yanam fault.

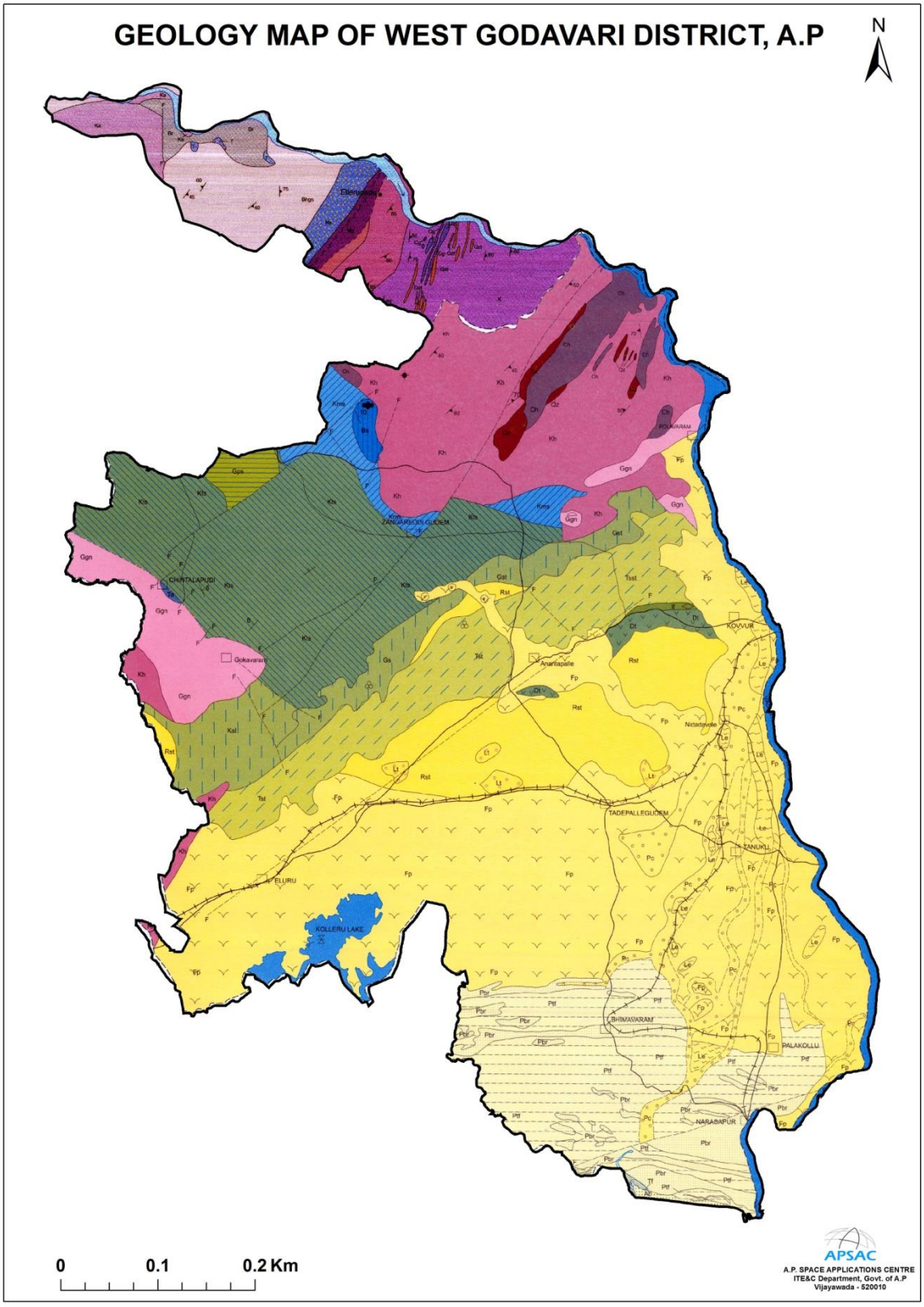


Fig.20 Geology of West Godavari District, Andhra Pradesh (Source: GSI,2000)

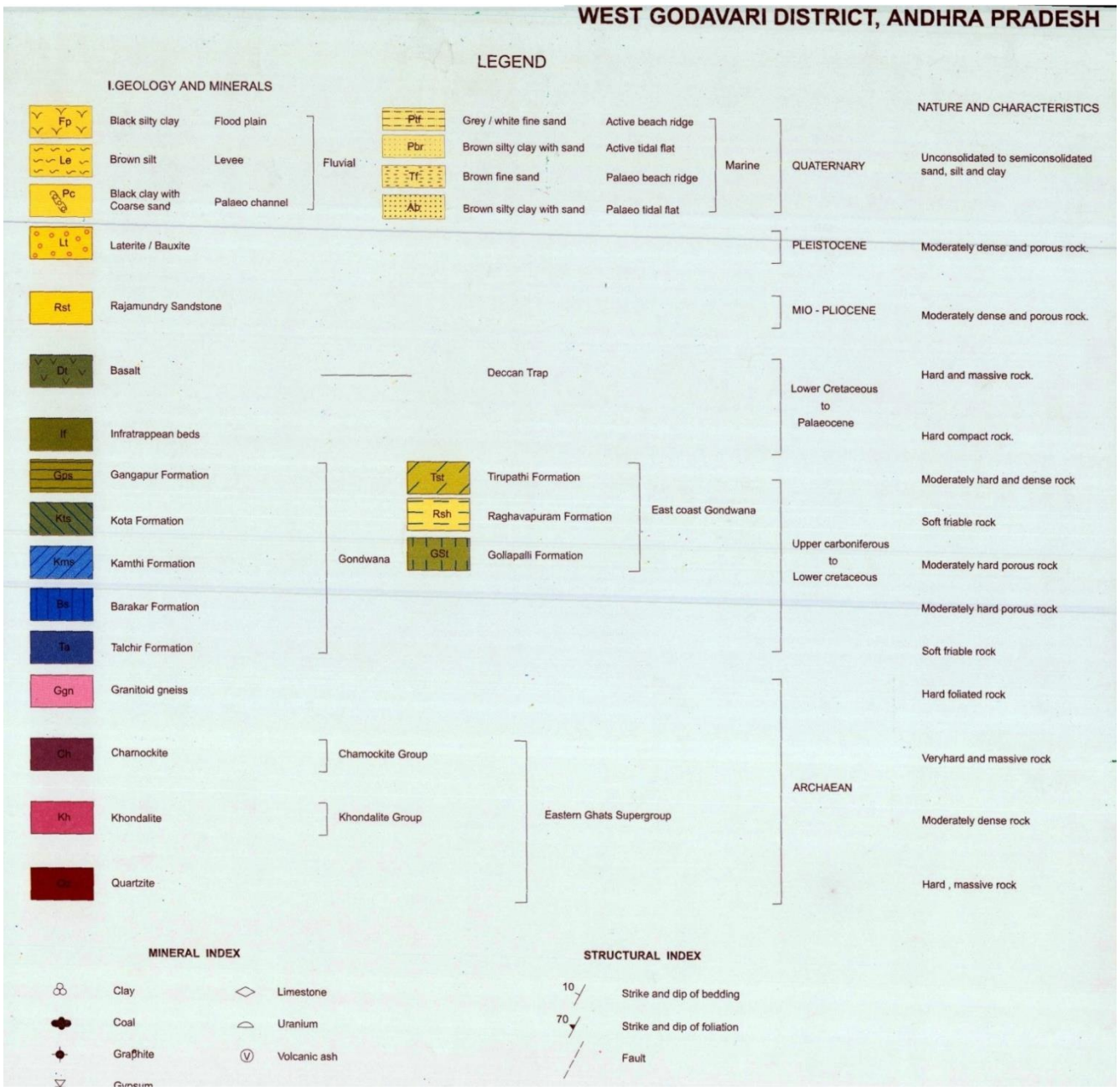


Fig.26 Detailed legend with stratigraphic sequence of West Godavari District

5.2.2 Mineral Resources

Ball Clay Deposit:

Ball Clay is associated within the Raghavapuram shale of the upper Gondwana Group occurs in a 20 km long NE-SW trending belt between Yerrakalava and Venkatakrishnapuram. Prominent deposits are found at Dwaraka Tirumala and its neighbourhood where the clay horizon is 18 m thick . A reserve of about 44 MT (Million Tonnes) is available. The deposits are being mined by APMDC and other Pvt. Mine/Quarry owners. Besides, clay is reported from Kothapalli and Kuchipudi area.

The Jangareddigudem – Dwaraka Tirumala belt, famous for ball clay mines, comprises sedimentary rock formations of Gondwana Super group which are commonly referred to as 'Coastal Gondwanas' over lined on Rajahmundry. The following is generalized stratigraphic sequence established in the area. The Raghavapuram Shale Formation, sandwiched between Tirupati Sandstone Formation and Gollapalli Sandstone Formation, comprises a litho-sequence of shale and clay

Geology Ball clays:

Ball clays are kaolinite rich secondary clay which is available in dark brown to black color due to relatively high organic impurity content. Once it is fired, it will become white to light cream color. It consist of three major minerals that are Kaolinite, mica & quartz. It is high plastic clay and contains more fine particles. It is also known as plastic clay. The name ball clay came from the mining method of cutting the clay out in balls. Many properties are similar to stoneware clays but stoneware never gives white product after burning.

Ball clays are fine grained and plastic in nature and commonly used in the manufacture of various ceramic products where their main purpose is to act as a binding agent to impart plasticity, rheological stability and strength in a pre fired

ceramic body. The Ball Clay from 0 to 8 meters is in contaminated clay with Quartz, Clay and Ochre, and from 8 to 15 meters it happens to be the fine grade of Ball Clay consisting of Kaoline, Quartz and white clay.

Ball clays are Kaolinitic sedimentary clays that commonly consist of 20–80% Kaolinite, 10–25% mica, 6–65% quartz . Localized seams in the same deposit have variations in composition, including the quantity of the major minerals, accessory minerals and carbonaceous materials such as lignite. They are fine-grained and plastic in nature, and, unlike the most earthenware clays, produce a fine quality white-coloured pottery body when fired, which is the key to their popularity with potters.

Ball clays are characterized by higher plasticity, dry shrinkage and dry strength as compared to china clays. They are chemically impure and often contain a large proportion of silica, iron and titanium impurities. The ball clay deposit is sedimentary and consists of numerous strata which frequently vary greatly in physical properties although perhaps not greatly in chemical composition. Ball Clay is Kaolin that has been transported from its primarily decomposed parent or igneous rock which were usually granite by nature via glacial displacement making it a secondary clay, and in this process it not only does gain high organic impurities and iron contaminants but the material gets ground down into a finer particle size!

These clays, being sedimentary in nature, also contain carbonaceous matter and lignite in agglomerate form (>50Mic) and colloidal form (<2 Mic.). It is believed that the carbonaceous matter within prescribed limit (<2wt %) influences the physical properties of the clay and also increases the unfired strength of clays. However, it increases porosity after firing resulting in decrease in fired strength. It also increases the casting thickness.

Ball Clay Uses:

Ball clays or plastic clays are fine grained, highly plastic sedimentary clays, which fire to a light or near white colour. They are used mainly in the manufacture of ceramic white ware and are valued for their key properties of plasticity, unfired strength and their light fired colour. In this District, there are 15 Ball Clay leases located around Dwaraka Tirumala Mandal. Previously they were in Major minerals, but after the amendment of MMDR Act 2015, all the Ball Clay minerals got converted into Minor Minerals of APMMC Rules 1966. Further, the production of Ball Clay started from 1963 and so far 15 Lakh tonnes approximately was excavated as A& B grades and revenue collected was 525 Lakhs approximately. The B grade material is transported to other places, in Rajasthan, Tamil Nadu, Gujarat, Karnataka and Kerala for bending purpose, where as the fine quality A grade material is transported to some of the Ceramic Industries like Regency tiles factory, Johnson and Johnson company, Sentiny Ceramics etc.

Fire clay

Fire clay is a range of refractory clays used in the manufacture of ceramics, especially fire brick. The United States Environmental Protection defines fire clay very generally as a "mineral aggregate composed of hydrous silicates of aluminium ($Al_2O_3 \cdot 2SiO_2 \cdot 2H_2O$) with or without free silica". Fire clay is resistant to high temperatures, having fusion points higher than 1,600 °C (2,910 °F); therefore it is suitable for lining furnaces, as fire brick, and for manufacture of utensils used in the metal working industries, such as crucibles, saggars, retorts and glassware. Because of its stability during firing in the kiln, it can be used to make complex items of pottery such as pipes and sanitary ware.

There are 02 Fire Clay leases located in Asannagudem of Linapalem Mandal and Ankalammapadu of Kamavarapukota Mandal in this District. Further, the production of Fire Clay from establishment of this office so far stood at 1.5 Lakh

tonnes approximately which was excavated and the revenue collected was 67 Lakhs approximately. The Fire Clay belongs to upper and lower Gondwana formations. The flint clay parting in the Fire Clay coal bed allows separation of several distinct benches of coal. Coal benches show significant differences in thickness, palynology, total sulfur content, and ash yields, which suggest that the benches represent distinctly different mires rather than a single mire, interrupted for a short period of time by clastic influx. Hence, rather than a single succession, the Fire Clay coal bed is probably best thought of as a series of mire successions that combined to form a single coal seam.

Quartz :

Quartz is the most abundant and widely distributed mineral found at Earth's surface. It is present and plentiful in all parts of the world. It forms at all temperatures. It is abundant in igneous, metamorphic , and sedimentary rocks. It is highly resistant to both mechanical and chemical weathering. This durability makes it the dominant mineral of mountaintops and the primary constituent of beach, river, and desert sand. Quartz is ubiquitous, plentiful and durable. Minable deposits are found throughout the world.

Quartz is a mineral composed of silicon and oxygen atoms in a continuous framework of SiO_4 silicon–oxygen tetrahedra with each oxygen being shared between two tetrahedra, giving an overall chemical formula of SiO_2 .

While the majority of quartz crystallizes from molten magma, much quartz also chemically precipitates from hot hydrothermal veins as gangue, sometimes with ore minerals like gold, silver and copper. Large crystals of quartz are found in magmatic pegmatites. Well-formed crystals may reach several meters in length and weigh hundreds of kilograms.

Quartz crystals are chiral, and exist in two forms, the normal quartz and the high-temperature quartz. The transformation from quartz to quartz takes place

abruptly at 573 °C (846 K). Since the transformation is accompanied by a significant change in volume, it can easily induce fracturing of ceramics or rocks passing through this temperature limit.

There are many different varieties of quartz, several of which are semi-precious gemstones. Since antiquity, varieties of quartz have been the most commonly used minerals in the making of jewellery and hard stone carvings, especially in Eurasia.

Quartz is a defining constituent of granite and other felsic igneous rocks. It is very common in sedimentary rocks such as sandstone and shale. It is a common constituent of schist, gneiss, quartzite and other metamorphic rocks Quartz has the lowest potential for weathering in the Goldich dissolution series and consequently, it is very common as a residual mineral in stream sediments and residual soils.

Quartz Uses :

Quartz is a chemical compound consisting of one part silicon and two parts oxygen. It is silicon dioxide (SiO_2). It is the most abundant mineral found at Earth's surface, and its unique properties make it one of the most useful natural substances.

Its usefulness can be linked to its physical and chemical properties. It has a hardness of seven on the Moh's Scale which makes it very durable. It is chemically inert in contact with most substances. It has electrical properties and heat resistance that make it valuable in electronic products. Its lustre, color, and diaphaneity make it useful as a gemstone and also in the making of glass

Geological processes have occasionally deposited sands that are composed of almost 100% quartz grains. These deposits have been identified and produced as sources of high purity silica sand. These sands are used in the

glassmaking industry. Quartz sand is used in the production of container glass, flat plate glass, specialty glass, and fiber glass.

The high hardness of quartz, seven on the Moh's Scale, makes it harder than most other natural substances. As such it is an excellent abrasive material. Quartz sands and finely ground silica sand are used for sand blasting, scouring cleansers, grinding media, and grit for sanding and sawing.

Quartz is very resistant to both chemicals and heat. It is therefore often used as a foundry sand. With a melting temperature higher than most metals, it can be used for the moulds and cores of common foundry work. Refractory bricks are often made of quartz sand because of its high heat resistance. Quartz sand is also used as a flux in the smelting of metals.

Quartz sand has a high resistance to being crushed. In the petroleum industry, sand slurries are forced down oil and gas wells under very high pressures in a process known as hydraulic fracturing. This high pressure fractures the reservoir rocks, and the sandy slurry injects into the fractures. The durable sand grains hold the fractures open after the pressure is released. These open fractures facilitate the flow of natural gas into the well bore.

Quartz sand is used as a filler in the manufacture of rubber, paint, and putty. Screened and washed, carefully sized quartz grains are used as filter media and roofing granules. Quartz sands are used for traction in the railroad and mining industries. These sands are also used in recreation on golf courses, volleyball courts, baseball fields, children's sand boxes and beaches.

It is submitted that there are 02 quarry leases located in Saggonda area of Gopalapuram mandal. The production of Quartz from establishment of this office stood at 04 Lakh tonnes approximately which was excavated and the revenue collected was 180 Lakhs approximately.

Deccan Traps (Road Metal)

Deccan Traps are a large igneous province located on the Deccan Plateau of west-central India (17°–24°N, 73°–74°E) and are one of the largest volcanic features on Earth. They consist of multiple layers of solidified food basalt that together are more than 2,000 m (6,600 ft) thick, cover an area of c. 500,000 km2 (200,000 sq mi), and have a volume of c. 1,000,000 km3 (200,000 cu mi). Originally, the Deccan Traps may have covered c. 1,500,000 km2 (600,000 sq mi), with a correspondingly larger original volume.

Deccan Traps (Road Metal) Deposit:

The Deccan traps are found in East and West Godavari Districts. Outcrops Tertiary formations are found in East and West Godavari and Visakhapatnam Districts, and the Quaternary sediments occurring as thick blankets of alluvium are found in the river valleys, deltas and along the East coast. The Rajahmundry Trap Basalts (RTB) are erupted through fault – controlled fissures in the Krishna – Godavri Basin (K-G Basin) of Godavari Triple Junction, occurring as a unique outcrop sandwiched between Cretaceous and Tertiary sediments along the east coast of India. The lowest flow (Flow 1) at Duddukuru overlying an infra-trappean bed is a thick pahoehoe sheet lobe with intermittent basal hummocky. In West Godavari District, basaltic traps are available in Decherla, I. Pangidi in Kovvuru Mandal ,Kondagudem, Gowripatnam, Duddukuru, Laxmipuram, Bandhapuram, Devarapalli villages of Devarapalli Mandal and Pragadavaram Village in Chinthalapudi mandal.

The Volcanic flow erupted in fault zones, fissures underline sandstones form of basaltic trap. The solidified condition of two or more contact zones of calcareous and clay tuff occurred at different levels and columnar structures of basaltic rock occurred at the beneath of contact zones. In this region, all the

quarries are sub-surfaced quarries with the different strata of overburden i.e. from 0 to 20 meters, 20 to 21 or 22 meters a contact zone, further 22 to 40 meters basaltic trap with weathered Rajahmundry sandstone with tuff.

There are 122 quarry leases in this District and the production of Road Metal from establishment of this office is so far 30 Lakhs tonnes approximately was excavated and revenue collected is Rs.1590 Lakhs approximately.

Building Stone:

The Mineral Building Stone occurred in Gopalapuram and Koyyalagudem mandals consist of sandstone which belongs to Rajahmundry sandstone formation.

Gravel:

The Mineral Gravel is a thick blanket of Aluminium formed during the period of Tertiary, Quarterly Sediments known as Gravel. The Mineral Gravel occurred in Tadepalligudem, Unguturu, Pedavegi, and Bhimadole mandals. There are 09 quarry leases in this District and the production of Gravel from establishment of this office stood so far at 10 Lakhs approximately which was excavated and the revenue collected was 21 Lakhs approximately

Ordinary Sand:-

The mineral Ordinary Sand is available in Godavari River i.e. coastal line from Polavaram to Narasapuram.

COAL :-

In Andhra Pradesh, Coal is associated with Gondwana formation seen along with NNW - SSE trending Godavari valley extending between Chintalapudi and Jangareddygudem in west Godavari District . The belt is supposed to be promising which has not been exploited, though authentic reserve estimation has not been done, however tentatively it is expected to be between 3500 to 300 MT (Million Tonnes).

5.2.3. Geomorphology

Physiographically, the District is divided into 3 natural regions viz., Alluvial plain, upland areas and Hill ranges. The alluvial plain covers 30 % of the area in southern part of the Eluru – Kovuru railway line, while uplands which include agency area constitute 70% of the total District area. The important landforms in the District include Structural hills, Pediplain, Pediment inselberg complex, Coastal landforms and Valley fills.

Papikonda hills in the north form structural hills. The plains in the central part, mostly occupied by Gondwanas form a pediplain with a few plateaus. The vast plains around Eluru and Tadepalligudem are the flood plains of Godavari River and its tributaries. The geomorphic units associated with the flood plain are levee, paleao-channel and active channel. Palaeo-beach ridge, tidal flat and active beach are the other geomorphic units. Palaeo-beach ridges rise about 2m above the present surface.

Using IRS satellite data and GIS detailed geo morphological and structural map of West Godavari District was generated as per Rajiv Gandhi National Drinking Water Mission (RGNDWM) guidelines on 1: 50,000 scale. The objective of this is to map lithology, geomorphology and structural characteristics of an area on 1:50,000 scale and to integrate the same to locate potential ground water prospect zones and to recommend suitable structures for ground water recharge. Various hydro geomorphic units are delineated and suitable recharge structures are proposed at drinking water affected villages under this project. The description of geomorphic units of different origins (Fig.9) mapped in the District are described as follows.

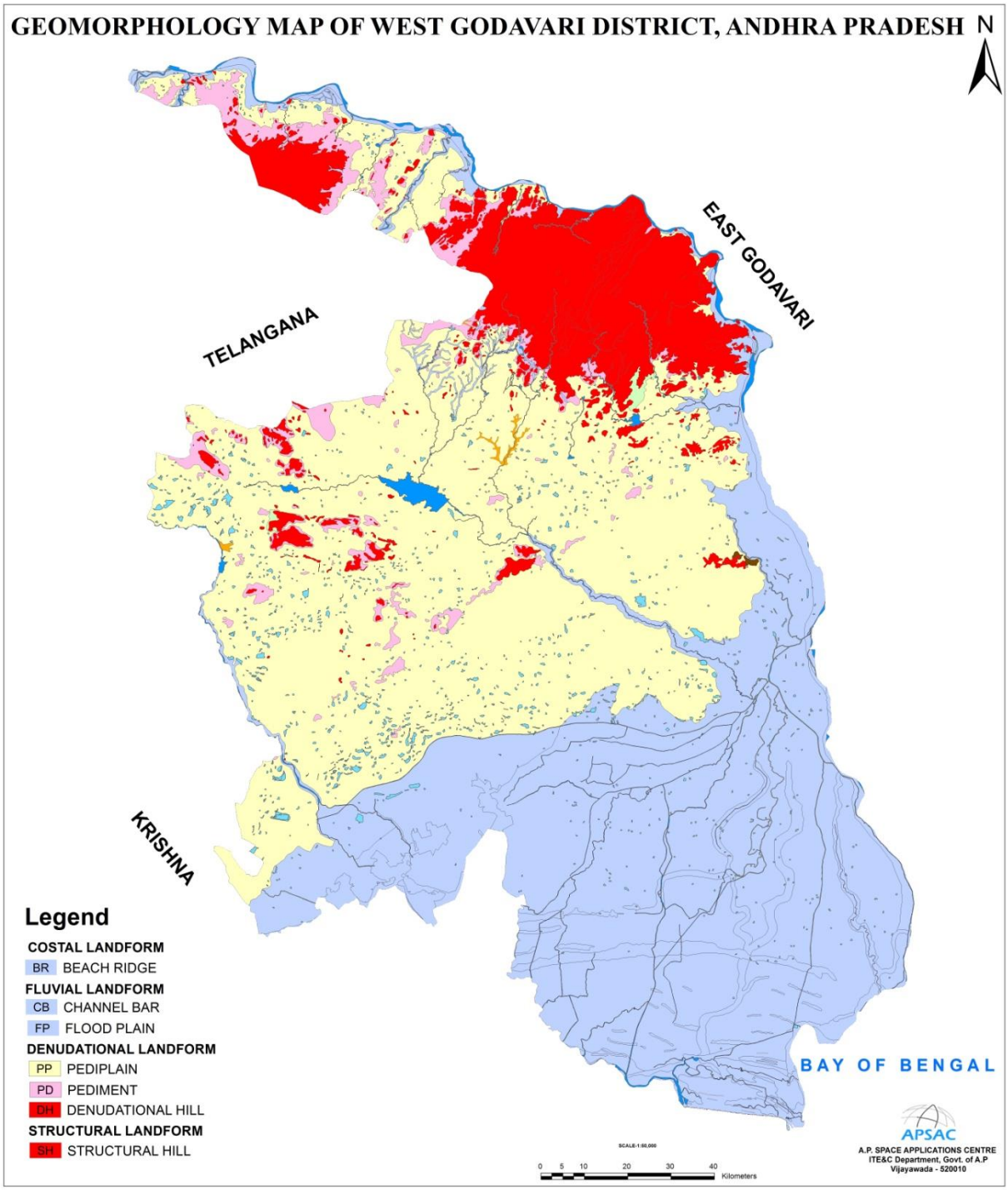


Fig. 22 Geomorphology of West Godavari District, Andhra Pradesh

5.2.4 Landforms of fluvial origin

The word fluvial is used in Earth science to refer to processes and landforms produced by running water. As with other surfacial processes, running water can either erode material from the earth's landscape, or deposit layers of sediment. The resulting landforms can thus be classified as either erosional landforms or depositional landforms. The incredible power of running water in carving various erosional and depositional landforms is well known. Although the quantity of water in stream is small at one time during the course of the year, very large volumes of water move through the channel and they form an important component in the hydrological cycle. The fluvial dissection of the landscape consists of valleys and their included channel ways organized into a system of connection known as a drainage network. Drainage networks display many types of quantitative regularity that are useful in analyzing both the fluvial systems and the terrains that they dissect (NRSA, 2007).

Alluvial plain: A level or gently sloping tract or a slightly undulating land surface produced by extensive deposition of alluvium, usually adjacent to a river that periodically overflows its banks; it may be situated on a flood plain, a delta, or alluvial fan. This landform is predominantly seen on the southern part of the District.

Palaeo-Channel: Deep valleys cut in the bedrock terrain and today filled largely with alluvium, glacial outwash gravels and sands or with tills. These are good source for underground water.

Flood plain: The surface or strip of relatively smooth land adjacent to a river channel constructed (or in the process of being constructed) by the present river in its existing regimen and covered with water when the river overflows its banks

at times of high water. It is built of alluvium carried by the river during floods and deposited in the sluggish water beyond the influence of the swiftest current.

Delta: The low, nearly flat, alluvial tract of land deposited at or near the mouth of a river, commonly forming a triangular or fan shaped plain of considerable area enclosed and crossed by many distributaries of the main river, perhaps extending beyond the general trend of the coast, and resulting from the accumulation in a wider body of water (usually a sea) of sediment supplied by a river in such quantities that it is not removed by tides, waves and currents.

Valley fill: The unconsolidated sediment deposited by any agent so as to fill or partly fill a valley.

5.2.5. Landforms of coastal origin

Coasts are also the loci of a unique assemblage of erosional and depositional processes. The various landforms of coastal areas are almost exclusively the result of the action of ocean waves. Wave action creates some of the world's most spectacular erosional landforms. Where wave energy is reduced, depositional landforms like beaches are created. The source of energy for coastal erosion and sediment transport is wave action. A wave possesses potential energy as a result of its position above the wave trough, and kinetic energy caused by the motion of the water within the wave. This wave energy is generated by the frictional effect of winds moving over the ocean surface. Higher the wind speed is and longer the fetch or distance of open water across which the wind blows and waves travel, larger the waves and the more energy they therefore possess. Long open ocean waves or swells travel faster than short, locally generated sea waves. They also have longer wave periods and this is how they are distinguished from the short sea waves on reaching the coast. Long swells, which have travelled hundreds of

kilo meters, may have wave periods of up to 20 seconds. Smaller sea waves have wave periods of 5 to 8 seconds. Where ocean depths are greater than the length of the waves, the wave motion does not extend to the ocean floor and therefore remains unaffected by the floor. As the ocean depth falls below half the wavelength, the bottom increasingly affects the wave motion. As the depth of water decreases, the wave height increases rapidly and the wavelength decreases rapidly. Thus, the wave becomes more and more peaked as it approaches the shore, finally curling over as a breaker and breaking on the shore. As the wave breaks, its potential energy is converted into kinetic energy, providing a large amount of energy for the wave to do the work along the shoreline. Transportation by waves and currents is necessary in order to move rock particles eroded from one part of a coastline to a place of deposition elsewhere. One of the most important transport mechanisms results from wave refraction. Since waves rarely break onto a shore at right angles, the upward movement of water onto the beach (swash) occurs at an oblique angle. However, the return of water (backwash) is at right angles to the beach, resulting in the net movement of beach material laterally. This movement is known as beach drift. The endless cycle of swash and backwash and resulting beach drift can be observed on all beaches. Frequently, backwash and rip currents cannot remove water from the shore zone as fast as it is piled up there by waves. As a result, there is a build up of water that results in the lateral movement of water and sediment just offshore in a direction with the waves. The currents produced by the lateral movement of water are known as long shore currents. The movement of sediment is known as long shore drift, which is distinct from the beach drift described earlier, which operates on land at the beach. The combined movement of sediment via long shore drift and beach drift is known as littoral drift. Tidal currents along coasts can also be effective in moving eroded material. While incoming and outgoing tides produce currents in opposite directions on a daily basis, the current in one direction is usually stronger than in the other resulting in a net one-way transport of sediment.

Long shore drift, long shore currents, and tidal currents in combination determine the net direction of sediment transport and areas of deposition. Using multi-temporal satellite data can bring out the dynamics of the coast (NRSA, 2007).

Beach: A gently sloping zone, typically with a concave profile, of unconsolidated material that extends landward from the low-water line to the place where there is a definite change in material or physiographic form (such as a cliff) or to the line of permanent vegetation (usually of the effective limit of the highest storm waves).

Beach ridge: A low, essentially continuous mound of beach or beach and dune material (sand, gravel, shingle) heaped up by the action of waves and currents on the backshore of a beach beyond the present limit of storm waves or the reach of ordinary tides, and occurring singly or as one of a series of approximately parallel deposits. The ridges are roughly parallel to the shoreline and represent successive positions of an advancing shoreline.

Coastal plain: A low, generally broad but sometimes narrow plain that has its margin on the shore of a large body of water (esp. the ocean) and its strata either horizontal or very gently sloping toward the water, and that generally represents a strip of recently emerged sea floor or continental shelf.

Dune and Swale complex: It is a large complex of parallel wetland swales and upland beach ridges (dunes) found in coastal embayment and on large sand spits along the shorelines of the Great Lakes. The upland dune ridges are typically forested, while the low swales support a variety of herbaceous or forested wetland types, with open wetlands more common near the shoreline and forested wetlands more prevalent further from the lake.

Tidal flat: An extensive, nearly horizontal, marshy or barren tract of land that is alternately covered and uncovered by the rise and fall of the tide, and consisting of unconsolidated sediment (mostly mud and sand). It may form the top surface of a deltaic deposit.

5.2.6. Landforms of Structural Origin

Landform of structural origin is related to structural aspect of the area. Most of the landforms under this class has genesis related to underlying structure. Structure plays an important role for reducing the resistance of rock which manifests itself in different geomorphic forms. Some of the variations are minor and some are in mega scale. The mega scale forms have a dramatic effect on the genesis of landforms and hence mapping of such forms indirectly indicates the structural set up of the area. The mega scale structural features like fault and fold depending on its type plays an important role in genesis of structural landform. The influence of geologic structures on the development and appearance of landscapes is prominent. The influence of geologic structures ranges from large features, which exert a dominant influence on the form of an entire landscape, to small features, which affect an individual landform and the geomorphic processes operating on it. The structural control could be active structures whose form is directly impressed on the modern landscape or ancient structural features whose influence on a modern landscape is due primarily to differential erosion (NRSA, 2007).

Dome: A general term for any dome shaped landform or rock mass, such as a smoothly rounded rock-capped mountain summit, roughly resembling the dome of a building.

Structural Hills: Hills and valleys, which are originated due to tectonic process and are highly dissected by the drainage lines. This can be further classified as

highly, moderately and low dissection depending on the density of joints and drainage. Mostly this will be interpreted from a planimetric satellite data and the classification is highly subjective.

Dyke Ridge: Intrusive features that are emplaced within the pre-existing fractures or where the fluid pressure is great enough for them to form their own fracture during emplacements. They are discordant bodies.

Cuesta: A hill or ridge with a gentle slope on one side and a steep slope on the other; specifically an asymmetric ridge with one face (dip slope) long and gentle and conforming with the dip of the resistant bed or beds that form it, and the opposite face (scarp slope) steep or even cliff-like and formed by the out crop of the resistant rocks, the formation of the ridge being controlled by the differential erosion of the gently inclined strata.

5.2.7 Landforms of denudational origin.

Landform of denudational origin is formed where the denudation process dominates over the other process. Most of the landform resulting due to this process is the combined effect of mechanical and chemical weathering. Denudation is the process of removal of material by erosion and weathering. This has direct influence on the relief of the area especially in the reduction of relief to the base level. The agents are mostly water, ice and wind. The major factors affecting denudation are geology, climate, tectonics and anthropogenic effects. All rocks and minerals at or near surface are attacked by physical and chemical process. The effect of this process is not the same everywhere because of rocks' varying resistance to change. As a result, weathering and erosion yield number of landforms, which have typical shape and forms. Weathering is an essential part of the rock cycle. The parent material, or rock weathered material is disaggregated to

form smaller fragments and some of the minerals are dissolved and removed by the agent of water. This removal of material is erosion and is accomplished by running water, wind, glacier etc. The weathering provides a raw material for the sedimentary rock and soil (NRSA, 2007).

Denudational Hill: It is a highly dissected hill which has obliterated the structures.

Inselberg: A prominent, isolated, steep sided, usually smoothed and rounded, residual knob, hill or small mountain of circumdenudation rising abruptly from and surrounded by an extensive and nearly level, lowland erosion surface in a hot, dry region (as in the deserts of southern Africa or Arabia), generally bare and rocky, although partly buried by the debris derived from and overlapping its slopes; it is characteristic of an arid or semiarid landscape in a late stage of the erosion cycle.

Pediment: A broad, flat or gently sloping, rock floored erosion surface or plain of low relief, typically developed by sub aerial agents (including running water) in an arid or semiarid region at the base of an abrupt and receding mountain front or plateau escarpment, and underlain by bedrock (occasionally by older alluvial deposits) that may be bare but more often partly mantled with a and discontinuous veneer of alluvium derived from the upland masses and in transit across the surface.

Pediment-Inselberg Complex: The pediments dotted by numerous inselberg of small sizes, which make it difficult to distinguish from the pediments. Hence, it is called a complex of pediment and inselberg.

Pediplain: An extensive, multi-concave, rock cut erosion surface formed by the coalescence of two or more adjacent pediments and occasional desert domes, and representing the end result (the “peneplain”) of the mature stage of the

erosion cycle. Based on the thickness of weathering, they are further classified as shallow, moderate and deep pediplains.

Residual Hill: A small remnant hill, which has witnessed all forms of denudation.

5.2.8. Structural Features of West Godavari District

The oldest rock types are of Archaean age, belonging to the Eastern Ghat Super group, represented by Khondalite, Charnockite group and granite gneiss (migmatite).Talchir, Barakar and Kamthi formations of Lower Gondwana, and Kota and Gangapur formations of Upper Gondwana represent Gondwana sediments of U.Carboniferous to L.Cretaceous age. Gollapalli, Raghavapuram and Tirupati formations represent East coast Gondwanas. The Deccan Traps overly these Gondwana rocks. Deposition of Rajahmundry Sandstone indicates marine transgression during Mio-Pliocene. Laterite cappings on Khondalite and charnockite are seen on hilltops. Quaternary sediments occur along the rivers and the beach.

Khondalite and Charnockite group with patches of granite gneiss occur to the NE of Jangareddygudem and around Polavaram. The khondalite Group is represented by garnet-sillimanite-graphitebiotite gneiss, forming strike ridges, steep scarp sections and hillocks or conical mounds and also as bands of varying dimensions within the migmatitic terrain. Calc-granulite and quartzite occur as impersistent, narrow bands conformable to the sillimanite gneiss. The Charnockite Group comprises basic, intermediate and acid variants. Quartzo-feldspathic injections are common within acid charnockite. The lower topographic levels are occupied by migmatite rocks and are characterized by variation in lithology, texture and mineralogy. They include leptynite and various products of migmatisation of Khondalite, Charnockite and pyroxene granulite.

The Gondwana formations are seen in the central part, around Jilugumilli-Chintalapudi and Dwaraka-Tirumala. The Talchir Formation comprises green shale and siltstone, occurring as a small lensoidal bodies near Chintalapudi. The Barakar Formation comprising sandstone, Shale and coal occurs near Bedadanur on the western margin of the Godwana basin. Ferruginous sandstone and shale of Kamthi Formation occur north of Chintalapudi and east of Gokavaram.

Kota Formation represented by sandstone and limestone occurs over a considerable area around Jangareddigudem. Gangapur Formation is represented by white sandstone, characterized by horizontal beds. The coastal Gondwanas, a marine and fluvio-marine sequence is found as discontinuous outcrops along the east coast. They are designated as Gollapalli Formation, Raghavapuram Formation and Tirupati Formation and dominantly comprise sandstone. shale and sandstone, respectively. Tirupati Formation contains plant remains, and fossils of brachiopod, cephalopod and foraminifera.

The traps are disposed as horizontal to sub-horizontal basaltic lava flows near Duddukuru and Devarapalli. Infratrappean sediments are exposed near Pangadi. The traps are overlain by Rajahmundry Sandstone occurring as disconnected outcrops between Bhimadolu and Chagallu, and comprise ferruginous sandstone, clay, pebble beds and lignite.

Laterite occurs on hilltops, invariably overlying the white clay and friable sandstone of Rajahmundry sandstone. Bauxitic laterite occupies several flat topped and gently sloping hills at elevations of 1000m and above, the basement rock of which is mostly Khondalite and Charnockite.

Quaternary sediments of both fluvial and marine regimes occur in the south. The fluvial are flood plain, levee and active channel. The marine are palaeo-beach ridge, palaeo-tidal flat and active beach. Kolleru lake is to the southwest. The flood plain occupies major part of the delta and is mainly composed of black silt clay

and the levee is made of brown silt. The active channel comprises coarse sand with rock fragments. The palaeo-channels are made up of 2.5m to 3.00m,thick black clay on top, underlain by coarse sand. The palaeo-beach ridges rise about 2m above the present surface and are made of highly oxidized brown, fine sand with inter-ridge lows or tidal flats composed of alternating sequence of brown silt clay and sand. The present day beach is made of grey to cream, fine sand. Evidence of movements during Quaternary is recorded along ENE-WSW trending Narsapur-Yanam fault.

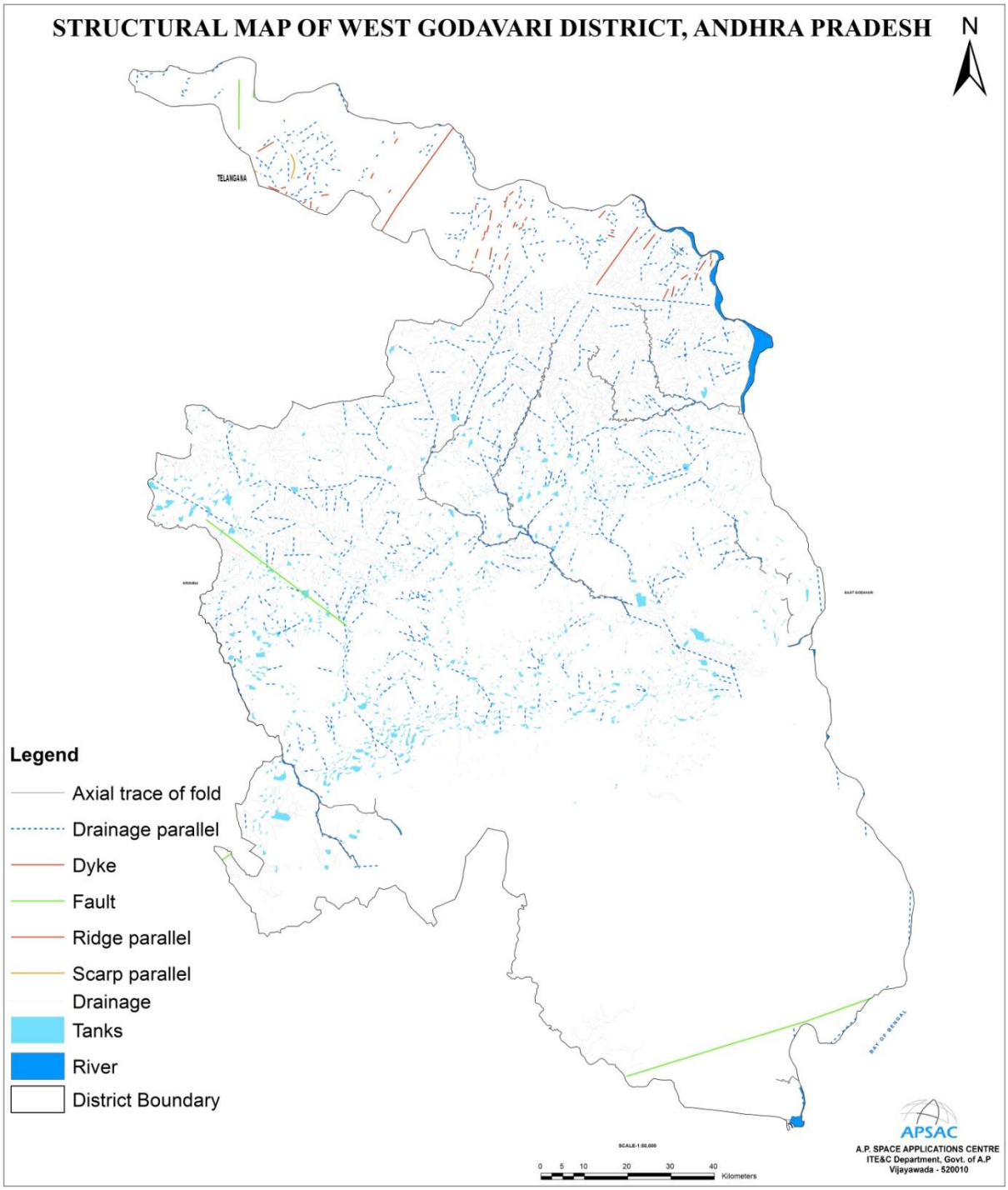


Fig.25 Structural Map of West Godavari District, Andhra Pradesh

5.3. Ground Water Prospects

Ground water occurs in almost all the geological formations and its potential depends upon the nature of geological formations, geographical setup, incidence of rainfall, recharge and other hydrogeological characters of the aquifer. In consolidated formations, ground water occurs under unconfined to semi-confined conditions. Ground water is developed in these formations by dug wells, dug cum bore wells and bore wells tapping weathered and fractured zones.

The deep exploration has revealed the occurrence of aerially extensive multiple aquifer system. Chintalapudi, Gollapalli and Tirupati sandstones of Gondwana Super Group and Rajahmundry sandstones of Tertiary age form important aquifers. The Tertiary Rajahmundry formation has a minimum of 9 m thickness at Decherla and a maximum of 442 m at Tanuku while the Gondwana has a maximum thickness of 600 m at Achuthapuram. The thickness of coarse granular zones tapped in wells ranges from 24 to 107 m in Chintalapudis, 12-71 in Gollapallis, 20-224 in Tirupatis and 42-355 m in Rajahmundry outcropped areas. The principal aquifer zones available vary from one to six. The percentage of granular zone thickness ranges from 14 to 93 down to 300 m while the same varies from 25 to 77 beyond 300-600 m depth. The depth of encounterance of Gondwana ranges from 46 to 383 m bgl. The yield of wells ranges from 3,700 to 60,000 lpm for draw downs of 19 to 25m. The average permeability is of the order of 10 m/day. The transmissivity of aquifers ranges from 25 to 3540 sq.m/day.

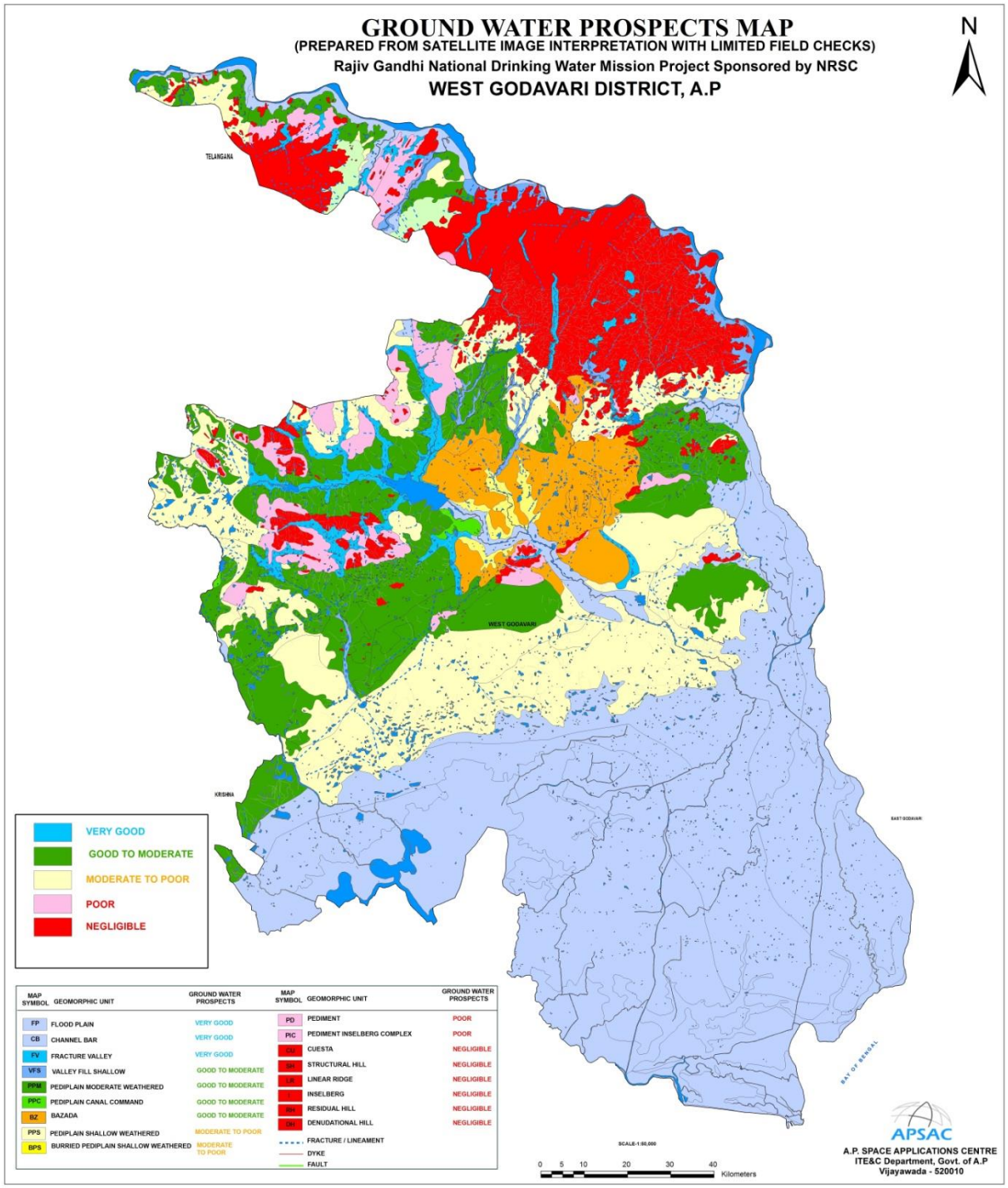


Fig:24 .Ground water prospects map of West Godavari District, A.P.

The northern part of the area is mainly covered by Chintalapudi sandstones and the boreholes are not drilled beyond Chintalapudi sandstones. In the central part of the District, more than one geological formation is encountered while in the southern part, the boreholes could not be drilled beyond alluvium because of its

huge thickness. The granites are encountered at shallow depths near Gopalapuram in northeastern part of the area and at Jeelakarragudem and Pragadavaram in western part of the District. From the panel diagram, five faults could be inferred between (1) Achutapuram and Gopalapuram (2) Bhimadolu and Kaikaram (3) Gopalapuram and Chityala (4) Dharmajigudem and Kallacheruvu and (5) T Nyampalle and Denduluru. Ground water occurs under unconfined, semi to confined conditions in different formations of the area. In the crystalline formation the yield of the open wells range from 20 – 50 m3/day and the discharge of bore wells vary from 17.28 to 648 m3/day. The Chintalapudi formations are relatively hard on surface and forms good aquifers with granular zone thickness varying from 24 – 107m and the yield of wells ranges between 604.8 and 2419.2 m3/day and the transmissivity values are in the order of 50 to 1338 m2/day. In Gollapalli sandstone, the thickness of granular zones varies from 12.0 and 71.0 m and the depth of the wells range between 75 and 120m with discharges of 691.2 to 1382.4 m3/day. Raghavapuram shales have a maximum thickness of 10m and are poor aquifers. In Tirupati sandstone formation, the depth of the wells range between 99 and 250m with yields varying from 345.6 to 1555.2 m3/day and the thickness of granular zone is in the order of 20 – 93m. The depth of the wells in Rajahmundry sandstones range between 32 and 611m, and the discharge varied from 1296 to 3024 m3/day with thickness of granular zone in the order of 18 to 175m (Table-3). Ground Water development is limited in alluvium and in general the deeper zones are brackish to saline in nature.

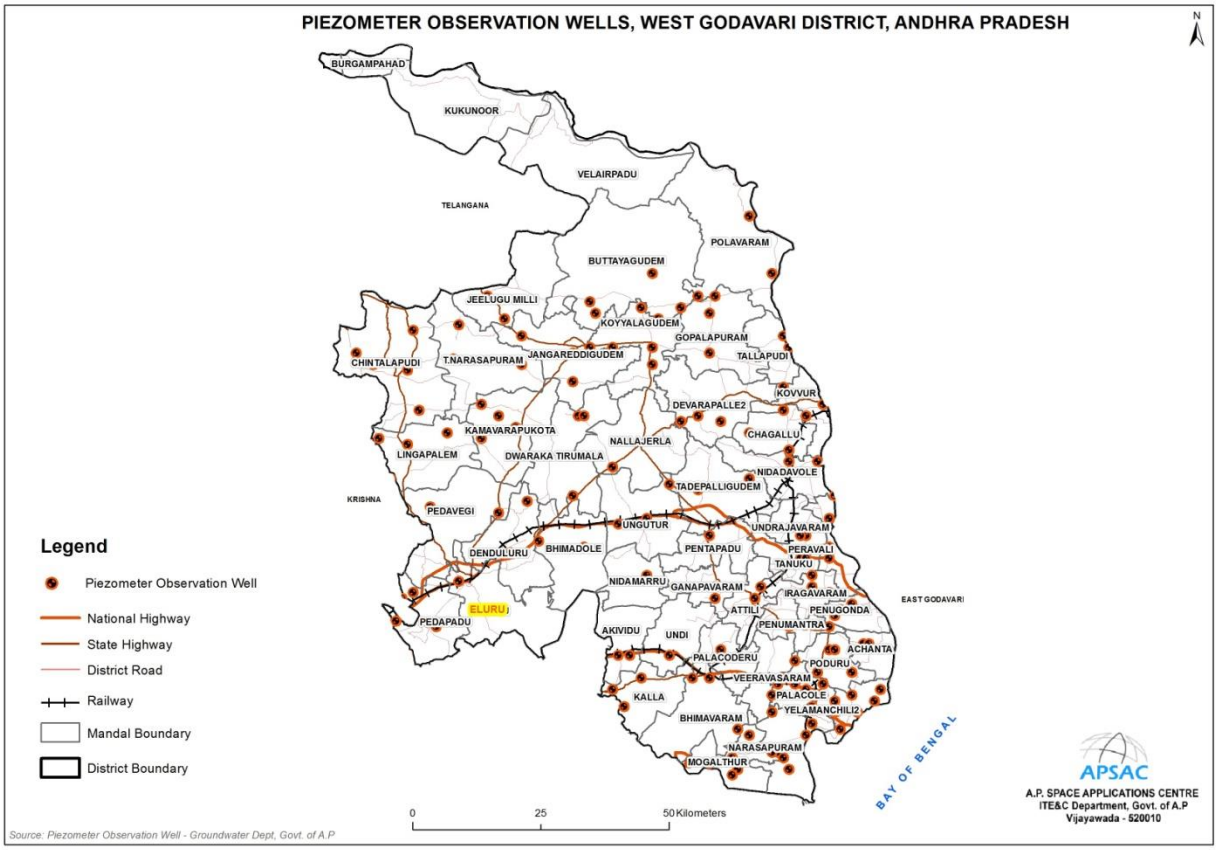


Fig. 25. Distribution of Piezometer Observation wells in West Godavari District, Andhra Pradesh

5.3.1.Ground Water Quality of the District

Ground water samples were collected from 1445 habitations out of 2307 habitations representing two seasons i.e., post monsoon and pre monsoon in December 2012 and June 2014 for the entire District. The water samples were collected from Rural Water Supply and Sanitation Department (*RWS & S*) and analyzed for physico-chemical parameters like TDS, TH, Cl, NO3, pH, F, Fe, TA and SO4 using standard techniques in the laboratory and compared with the BIS (10500-2015), in terms of desirable, permissible and non potable classes. Blue, yellow and red colours indicate pre monsoon quality and + , - , . symbols indicate post monsoon quality for desirable, permissible and non-potable classes, respectively.

From the analysis, it has been observed that the ground water is polluted in pre monsoon and post monsoon. About 5% of the area is under non potable category due to high concentration of Nitrate, Iron and Total Hardness. About 75% of the area is in potable category and the remaining 10% of the area is covered in hills and water bodies of entire the District. The occurrence and movement of groundwater in an area is governed by several factors such as topography, lithology, geological structure, depth of weathering, extent of factures, drainage pattern, climate conditions and inter relationship between these factors.

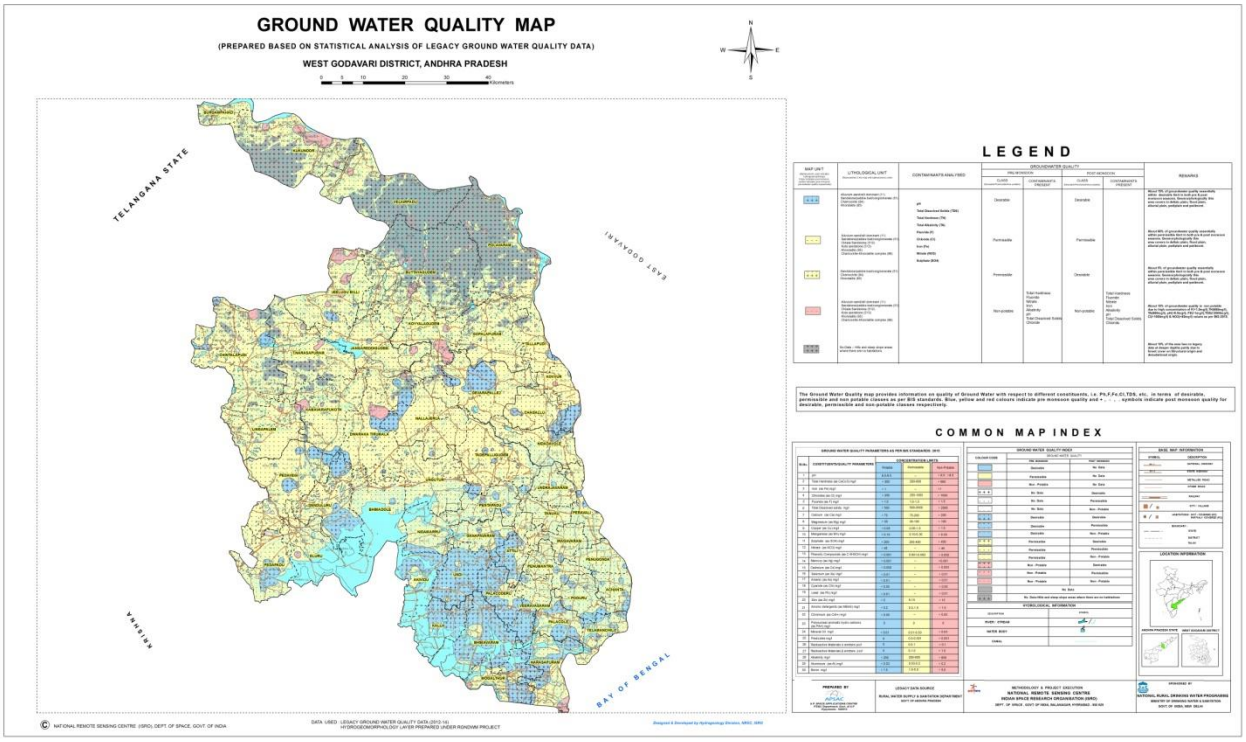


Fig. 26. Ground Water Quality Map of West Godavari District

6. Details of Major and Minor Minerals Their Production and Revenue in the District

ANNEXURE - 1

S.No	LesseeID	Lessee Name	Mineral Name	Extent(in Hectares)	Location			Lease Period		Production			Revenue Collection		
					SurveyNo	mandal	village	From	To	2015-16	2016-17	2017-18	2015-16	2016-17	2017-18
1	511050051	M/s Sri Kanaka Durga Stone Crusher	Road Metal	3	83	Devarapalle	Kondagudem	31.03.2005	30.03.2020	2407	3682.5	3256	155750	276187.5	244200
2	511050056	Sri Geda Soma Raju	Road Metal	0.8	83	Devarapalle	Kondagudem	28.04.2005	27.04.2005	850	851	849	63750	63825	63675
3	511050062	Smt.V.Hymavathi	Road Metal	1.42	83	Devarapalle	Kondagudem	23.04.2005	22.04.2032	849	992.5	991	63675	74437.5	74325
4	511050065	M/s Sri Srinivasa Metal Suppliers	Road Metal	1.62	90	Devarapalle	Kondagudem	27.04.2005	26.04.2020	1440	600	0	87000	45000	0
5	511050075	Sri Sai Venkata Durga Siva Ganesh Granite Metal Suppliers	Road Metal	1.4	75/1	Devarapalle	Laxmipuram	06-12-2005	05-12-2015	991	0	0	60175	0	0
6	511050083	M/s Vajri Stone Crusher	Road Metal	2.684	81/P	Devarapalle	Laxmipuram	10.02.2005	09.02.2020	4387	3113	0	297175	233475	0
7	511050116	M/s. Venkata Lakshmi Ganapathi Stone Crusher	Road Metal	2	450, 460, 484/1,2, 2A	Devarapalle	Bandapuram	23.04.2005	22.04.2020	1230	1449	1698	77250	108675	127350
8	511050168	Sri Durga Ganapthai Metal Suppliers	Road Metal	0.886	336/1	Devarapalle	Duddukuru	27.04.2005	26.04.2027	0	568	1150	0	42600	86250
9	511050175	Sri Balaji Metal traders	Road Metal	2.889	309/3	Devarapalle	Duddukuru	08.04.2005	07.04.2020	0	2027	2264	0	152025	169800
10	511050180	Nagendra Stone Crusher	Road Metal	0.886	336/1	Devarapalle	Duddukuru	06.10.2005	05.10.2020	2689	708	708	187525	53100	53100
11	511050181	Sri Gowri Earth Movers	Road Metal	1	331/2	Devarapalle	Duddukuru	17.03.2005	16.03.2020	1874	1132	3962	111400	84900	297150
12	511060085	Sri Santhoshi Devi Stone Crusher	Road Metal	0.606	94,95	Devarapalle	Laxmipuram	28.11.2006	27.11.2021	0	1698	2259	0	127350	169425
13	511060092	KVR Granite Metal Suppliers	Road Metal	0.43	303	Devarapalle	Gowripatnam	28.10.2006	27.10.2021	630	283	0	31500	21225	0
14	511060093	Sri Ch Srinu	Road Metal	2	306	Devarapalle	Gowripatnam	16.09.2006	07.05.2021	1132	1557	1841	77825	116775	138075
15	511060106	Sri K.S.N Babu	Road Metal	0.979	123/1	Kovvur	Isukapatlapangidi	17.11.2006	16.11.2006	1726	2548	0	111075	191100	0
16	511060120	Sri Venkata Sai Granite and Metals	Road Metal	1.163	463/P	Devarapalle	Bandapuram	11.09.2006	10.09.2021	1415	2264	775	91975	169800	58156
17	511060164	Sri B. Suresh Kumar	Building Stone	0.4	570	Gopalapuram	Bhimolu	15.06.2006	14.06.2016	300	0	0	15000	0	0
18	511060178	Smt G.V Subba Lamxi	Road Metal	1	343	Devarapalle	Duddukuru	18.08.2006	17.08.2021	0	283	0	0	2122	0

S.No	LesseeID	Lessee Name	Mineral Name	Extent(in Hectares)	Location			Lease Period		Production			Revenue Collection		
					SurveyNo	mandal	village	From	To	2015-16	2016-17	2017-18	2015-16	2016-17	2017-18
														5	
19	511060202	Sri Venkata Bala Balaji Granites	Road Metal	1.62	74,75	Kovvur	Decherla	18.11.2006	17.11.2021	1350	1167	566	88500	87513	42950
20	511060206	Sri D.V.V.S.Samba Siva Reddy	Road Metal	1.895	240	Kovvur	Decherla	28.08.2006	24.08.2016	1049	1348	0	71600	101100	0
21	511060258	Sri K. Kanakeswara Rao	Road Metal	5.72	62/P,17/P,23/P	Kovvur	Decherla	30.11.2006	29.11.2021	3255.5	3821	4636	226462.5	286575	347700
22	511060272	Sri Arlamma Granites	Road Metal	1.619	83	Kovvur	Decherla	23.03.2006	22.03.2016	1132	0	0	84900	0	0
23	511070053	M/s Shiridi Sai Stone Crusher	Road Metal	4.05	90/2	Devarapalle	Kondagudem	19.06.2007	23.05.2027	2831	3113	0	184025	233475	0
24	511070060	Sri V.Vijay Kumar	Road Metal	1.012	90/P	Devarapalle	Kondagudem	15.12.2007	10.11.2017	710	142	0	49700	10650	0
25	511070071	M/s Sudheer Granite Metals	Road Metal	1.214	61/2	Devarapalle	Laxmipuram	30.11.2006	29.11.2021	991	1558	2389	67250	116850	179175
27	511070095	Vijaya Laxmi Granite Metal Suppliers	Road Metal	1.045	303/P, 306/1P to 6P	Devarapalle	Gowripatnam	20.07.2007	15.09.2021	2689	3679	2547	173375	275925	191025
28	511070111	Sri Devi Satya Granites	Road Metal	1.449	122/P,123/P	Kovvur	Isukapatlapangidi	15.12.2007	14.12.2027	851	994	1474	60275	74550	110550
29	511070188	Sri Gowri Earth Movers	Road Metal	3.95	312/2,3A& 331/1,2	Devarapalle	Duddukuru	20.07.2007	01.07.2017	2898	4528	5089	159050	339600	381675
30	511070208	M/s Sri Siva Durga Metals	Road Metal	1.215	105/2	Kovvur	Decherla	06.06.2007	05.06.2017	709	975	819	49625	73125	63675
31	511070245	Sri V. Priya Raju	Building Stone	0.8	904	Gopalapuram	Gangolu	24.12.2007	23.12.2017	360	0	0	18000	0	0
32	511080086	Laxman Reddy Granites	Road Metal	4.38	112/1	Devarapalle	Laxmipuram	21.08.2008	20.08.2018	5905	2547	0	355425	191025	0
33	511080091	M/s Koduri Enterprises	Road Metal	6.4	320/P	Devarapalle	Gowripatnam	26.03.2008	25.09.2018	3866	4347	5660	215800	326025	424500
34	511080108	Maha Laxmi Granite Metal and Stone Crusher	Road Metal	2.452		Kovvur	Isukapatlapangidi	06.12.2008	05.12.2023	1500	1592	2380	93750	119400	*178500*
35	511080115	Sri Durga Bhavani Stone Crusher	Road Metal	2	01-Feb	Kovvur	Isukapatlapangidi	04.09.2008	03.09.2023	1132	1698	1438	77825	127350	107850
36	511080160	Sri Alla Anjaneyulu	Building Stone	0.5	254	Gopalapuram	Bhimolu	07.05.2008	06.05.2018	2220	0	0	111000	0	0
37	511080179	M/s Suryavathi Granites	Road Metal	1.42	343/P	Devarapalle	Duddukuru	11.02.2009	22.03.2028	4138	7924	6226	256425	594300	466950

S.No	LesseeID	Lessee Name	Mineral Name	Extent(in Hectares)	Location			Lease Period		Production			Revenue Collection		
					SurveyNo	mandal	village	From	To	2015-16	2016-17	2017-18	2015-16	2016-17	2017-18
38	511090123	M/s Subrahmanyeswara Granites	Road Metal	3.52	471/1	Devarapalle	Bandapuram	25.06.2009	24.06.2019	283	0	0	14150	0	0
39	511080190	Sri Raja Rajeswari Stone Crusher	Road Metal	1.862	333/1	Devarapalle	Duddukuru	18.11.2008	22.05.2017	0	2264	3113	0	169800	233475
40	511080201	Sri P. Srinivasa Rao	Road Metal	2.316	78	Kovvur	Decherla	02.06.2008	01.06.2008	*4472*	*1472*	*3113*	*273125*	*110400*	233475
41	511080212	Sri p. Hari Charan	Ordinary Earth	2.413	114	Kovvur	Decherla	14.05.2008	13.05.2008	8307	4162	5632	278925	198750	219900
42	511090109	Ratna Granites	Road Metal	1.85	97/1,2,3	Kovvur	Isukapatlapangidi	29.04.2009	28.04.2019	1166	1500	1236	73300	112500	92700
43	511090112	M/s Gayatri Granites and Stone Crusher	Road Metal	1.709	124/3,125/2	Kovvur	Isukapatlapangidi	21.03.2009	20.03.2024	2406	4982	5377	159225	373650	403275
44	511090123	M/s Subrahmanyeswara Granites	Road Metal	3.52	471/1	Devarapalle	Bandapuram	25.06.2009	24.06.2019	3538	2343.24	3683	229975	175743	276225
45	511090187	Smt B. Bharathi Vijaya Laxmi	Road Metal	1.316	329/1	Devarapalle	Duddukuru	25.06.2009	24.06.2019	991	880	992	70775	66000	74400
46	511090251	Gowri Sametha Ramalingeswara Metal Suppliers	Road Metal	1.246	302	Devarapalle	Gowripatnam	17.03.2009	16.03.2019	1350	2864	3396	78750	214800	254700
47	511100069	Sri Balaji Stone Crusher	Road Metal	2.996	74,75/3,4,5 & 78/1	Devarapalle	Laxmipuram	14.10.2010	19.10.2025	1982	2028	2547	113275	152100	191025
48	511100072	Sri KRK Chowdary	Road Metal	1	95	Devarapalle	Laxmipuram	26.10.2010	28.04.2020	851	710	566	56725	53250	42450
49	511100094	Sri Sri Sai Srinivasa Granites	Road Metal	2.023	305/P	Devarapalle	Gowripatnam	20.04.2010	01.07.2025	0	1348	0	0	101100	0
50	511100100	Mehar Surya Chandra Metal Suppliers	Road Metal	3.698	1,17,21,199	Devarapalle	Devarapalle	26.08.2010	25.08.2020	2689	3396	3396	180450	254700	254700
51	511100189	Sri Vasavi Granites	Road Metal	0.8	334	Devarapalle	Duddukuru	20.08.2010	19.08.2020	0	533.04	568	0	39978	42600
52	511100196	SCR Metal Suppliers	Road Metal	2.144	25	Kovvur	Decherla	01.11.2010	31.10.2020	2832	1132	0	184075	84900	0
53	511100198	M/s Vijaya Durga Granites	Road Metal	2.764	126/1,2	Kovvur	Decherla	13.09.2010	12.09.2020	3962	2830	2831	268850	212250	212325
54	511100200	Sri K.V.V.Satyanarayana Reddy	Road Metal	1.976	77/7	Kovvur	Decherla	02.08.2010	21.11.2016	2123	1981	0	141525	148575	0
55	511100205	M/s Suhas Granites	Road Metal	1.972	7/3,8/3	Kovvur	Decherla	29.01.2010	28.01.2020	1275	1417	1415	95625	106275	106125

S.No	LesseeID	Lessee Name	Mineral Name	Extent(in Hectares)	Location			Lease Period		Production			Revenue Collection		
					SurveyNo	mandal	village	From	To	2015-16	2016-17	2017-18	2015-16	2016-17	2017-18
56	511100210	Sri Laxmi Ganapthi Metal Suppliers	Road Metal	1.6	17	Kovvur	Decherla	03.08.2010	02.08.200	0	1246	1132	0	93450	84900
57	511100223	Sri Sri Laxmi Stone Crusher	Road Metal	1.205	460/3P	Devarapalle	Bandapuram	09.11.2010	08.11.2025	2972	0	0	183975	0	0
58	511100259	Venkata Tirumala Granites	Road Metal	0.641	76/2, 77/2	Kovvur	Decherla	29.06.2010	28.06.2020	600	150	6086	33750	11250	456450
59	511110070	Sri Ajantha Granite Metal Suppliers	Road Metal	1.295	93,95	Devarapalle	Laxmipuram	09.04.2011	08.04.2021	0	1162	1274	0	87150	95550
60	511110073	Sri Sai Venkata Durga Siva Ganesh Granite Metal Suppliers	Road Metal	1.178	73	Devarapalle	Laxmipuram	25.01.2011	24.01.2021	1840	1132	1132	123850	8490	84900
61	511110098	Satya Srinivasa Crusher and Granites	Road Metal	1.473	1175/2	Devarapalle	Devarapalle	12.09.2011	11.09.2021	719	900	0	53925	67500	0
62	511110099	Md Noushad Ali	Road Metal	0.829	1227/2	Devarapalle	Devarapalle	30.05.2011	29.05.2021	1259	0	0	80925	0	0
63	511110102	Sri Dev Granites	Road Metal	0.964	62/2	Kovvur	Isukapatlapangidi	17.06.2011	16.06.2021	900	1452	852	53400	108900	63900
64	511110104	Ratna Granites	Road Metal	4.61	97/2,3	Kovvur	Isukapatlapangidi	13.07.2011	12.07.2026	2349	3300	3300	139950	247500	247500
65	511110110	Sri K. Purna Chandra Rao	Road Metal	1.416	61/1,3,4	Kovvur	Isukapatlapangidi	18.05.2011	17.05.2021	3741.5	6034.5	951.5	205612.5	452587.5	71362.5
66	511110113	Smt L. Sri Harini	Road Metal	0.331	62/2	Kovvur	Isukapatlapangidi	17.06.2011	16.06.2021	270	2298	2264	20250	172350	169800
67	511110124	Sri Padma Srinivasa Granites	Road Metal	0.72	504/4	Devarapalle	Bandapuram	21.01.2011	20.01.2021	0	566	567	0	42450	42525
68	511110131	Sri D. Sita Ram	Road Metal	1.82	479/1,2,3	Devarapalle	Bandapuram	16.03.2011	30.05.2021	2548	0	2547	152175	0	191025
69	511110162	Sri P. Jesu Raju	Building Stone	0.5	254	Gopalapuram	Bhimolu	08-08-2011	07-08-2021	300	0	0	15000	0	0
70	511110163	Sri G. Gangadhara Rao	Building Stone	1	254	Gopalapuram	Bhimolu	30-12-2011	29-12-2021	900	0	0	45000	0	0
71	511110170	Sri Siri Stone Crusher and Company	Road Metal	1.756	336/P	Devarapalle	Duddukuru	20-01-2011	08-06-2018	4510	3679	4247	267950	275925	318525
72	511110183	Balaji Metal Traders	Road Metal	1.344	309/2	Devarapalle	Duddukuru	10-05-2011	22-05-2026	850	284	1133	49600	21300	84975
73	511110184	Smt G. Subhashini	Road Metal	1.312	329/1	Devarapalle	Duddukuru	24-02-2011	24-06-2019	708	993	142	53100	74475	10650
74	511110203	Smt T. Rama Aruna	Road Metal	1.072	128/1A	Kovvur	Decherla	12-09-2011	06-03-2021	850	849	3113	49600	63675	233475
75	511110220	Sri Sri Balaji Granites	Road Metal	1.5	3/1P	Kovvur	Isukapatlapangidi	08-02-2011	01-07-2027	878	283	1698	58775	21225	127350

S.No	LesseeID	Lessee Name	Mineral Name	Extent(in Hectares)	Location			Lease Period		Production			Revenue Collection		
					SurveyNo	mandal	village	From	To	2015-16	2016-17	2017-18	2015-16	2016-17	2017-18
76	511110222	Sri Sri Laxmi Stone Crusher	Road Metal	1.101	480/1,484/13,14	Devarapalle	Bandapuram	20-07-2011	19-07-2026	2972	0	567	183975	0	42525
77	511110250	Sree Ram Metals	Road Metal	2.677	289/2, 292/5	Devarapalle	Duddukuru	13-06-2011	24-06-2019	2264	2547	2547	141500	191025	191025
78	511110269	Sri M. Trimurthy Rao	Road Metal	5.605	330/P,328/1, 339/1	Devarapalle	Duddukuru	25-02-2011	05-05-2019	2830	3736	0	212250	280200	0
79	511110286	M/s Rishicon Traders	Road Metal	1.442	154/2A, 2B, 2C, 2D, 2E 2F	Kovvur	Decherla	22-03-2011	21-03-2021	0	2400	53250	0	72000	2614500
80	511120167	Sri G. Yesu Babu	Building Stone	0.846	199	Koyyalagudem	Saripalle	28-07-2012	27-07-2022	300	0	0	15000	0	0
81	511120246	Sri B. Ravi Kishore	Building Stone	0.5	254	Gopalapuram	Bhimolu	11-01-2012	10-01-2022	270	0	0	13500	0	0
82	511130058	Sri T.Venkatesham	Road Metal	2.02	90/1	Devarapalle	Kondagudem	05-12-2013	04-12-2023	5089	5660	4981	329175	424500	373575
83	511130059	Koripilli Venkata Rao	Road Metal	4.08	90/1	Devarapalle	Kondagudem	05-12-2013	04-12-2023	10500	4528	5349	652350	339600	401175
84	511130061	M/s Sri Siri Stone Crusher and Company	Road Metal	3.116	90/1	Devarapalle	Kondagudem	05-12-2013	04-12-2025	11224	8490	10473	674400	636750	785475
85	511130067	Sri j, Subba Rao	Road Metal	2.02	90/1	Devarapalle	Kondagudem	05-12-2013	04-12-2023	19669	22878	0	780700	1195740	0
86	511130096	P.S.R. Granites	Road Metal	3.94	356/P	Devarapalle	Gowripatnam	04-05-2013	04-03-2028	2972	3679	3679	208750	275925	275925
87	511130128	Sri M. Ram Babu	Road Metal	2.1	450/1A	Devarapalle	Bandapuram	26-03-2013	28-11-2018	1415	1415	1557	84900	106125	116775
88	511130182	Sri Siri Stone Crusher and Company	Road Metal	0.8	333/1	Devarapalle	Duddukuru	26-03-2013	03-02-2019	4600	2547	4840	272450	191025	363000
89	511130193	Sri Sambhavi Granites	Road Metal	2.833	83	Kovvur	Decherla	26-02-2013	25-02-2023	2349	1981	0	108675	148575	0
90	511130216	Sri D. Sita Ram	Road Metal	2.23	317P	Devarapalle	Gowripatnam	11-07-2013	04-03-2018	3256	2830	0	205275	212250	0
91	511130219	Sri N. Rama Rao	Road Metal	2.064	317P	Devarapalle	Gowripatnam	11-07-2013	04-03-2028	0	1735	3074	0	130125	230550
92	511130261	M/s SARC METALS PVT LTD.,	Road Metal	2.42	317/P	Devarapalle	Gowripatnam	11-07-2013	04-03-2028	1981	1698	2264	127350	127350	169800

S.No	LesseeID	Lessee Name	Mineral Name	Extent(in Hectares)	Location			Lease Period		Production			Revenue Collection		
					SurveyNo	mandal	village	From	To	2015-16	2016-17	2017-18	2015-16	2016-17	2017-18
93	511140052	Smt.Daparthi Anusha	Road Metal	1.5	83	Devarapalle	Kondagudem	29-03-2014	03-07-2025	0	997	997	0	74775	74775
94	511140066	Smt Gandham Kasi Vijaya Laxmi	Road Metal	2.024	90/1	Devarapalle	Kondagudem	16-04-2014	15-04-2024	1415	2265	5660	91975	169875	424500
95	511140078	Durga Granites	Road Metal	0.936	92	Devarapalle	Laxmipuram	03-04-2014	02-04-2024	1981	7483	708	120275	237225	53100
96	511140082	M/s Vijaya Durga Granites	Road Metal	1.618	90/1	Devarapalle	Kondagudem	17-04-2014	16-04-2024	1500	1900	0	93750	142500	0
97	511140087	Kantipudi Metal Suppliers	Road Metal	1.849	112/3,113	Devarapalle	Laxmipuram	21-05-2014	20-05-2029	0	1246	6928	0	93456	411600
98	511140141	Nagarjuna Construction Comapany	Gravel	1.651	72/2	Pedavegi	Koppaka	23-05-2014	22-05-2019	42000	10490	8000	996000	314700	240000
99	511140145	Sri KVVBM Krishnam Raju	Gravel	1.987	110/1B	Unguturu	Kaikaram	19-05-2014	18-05-2020	15300	1400	11790	339000	42000	353700
100	511140146	Sri K. Srinivasa Raju	Gravel	1.724	110/1A	Unguturu	Kaikaram	21-05-2014	20-05-2017	13400	2900	454	346000	87000	13620
101	511140147	Sri K. Siva Rama Krishnam Raju	Gravel	1.724	111/1	Unguturu	Kaikaram	21-05-2014	20-05-2017	8500	1400	585	247000	42000	17550
102	511140155	Sri E. Veeranjaneyulu	Gravel	1.744	380/1	Bhimadole	Amberpeta	24-06-2014	23-06-2019	25072	29450	450	698960	883500	13500
103	511140156	Sri Vejju Venkata Prabhakar Rao	Gravel	0.283	433/1	Bhimadole	Amberpeta	28-06-2014	27-12-2017	0	4101	0	0	123030	0
104	511140157	Sri A. Naga Raju	Gravel	0.336	433/1	Bhimadole	Amberpeta	28-06-2014	27-06-2016	13631	0	0	299882	0	0
105	511140158	Sri K. Chiranjeevi	Shingle	0.5	923	Chagallu	Chikkala	28-04-2014	27-04-2018	45	0	0	3375	0	0
106	511140174	M/S Kantipudi Narasimha Murthy Granite Metals	Road Metal	0.85	328/2	Devarapalle	Duddukuru	16-03-2014	16-03-2024	1276	992	567	77975	74400	42525
107	511140230	M/s Balaji Metal Trades	Road Metal	3.496	309/1A, B,1C & 309/2P	Devarapalle	Duddukuru	27-08-2014	26-08-2029	2123	2350	3962	138000	176250	297150
109	511150257	Sri P. Satish Kumar Raju	Gravel	1.081	141/2	Unguturu	Unguturu	24-06-2015	23-06-2019	450	0	0	9900	0	0
110	511140231	Sai Subrahmanyeswara Granites	Road Metal	2.068	239/1, 239/2	Kovvur	Decherla	30-08-2014	29-08-2024	1274	2480	2152	81400	105000	161400
111	511140233	Sri Balaji Stone Crusher	Road Metal	1.469	157	Devarapalle	Laxmipuram	01-07-2014	30-06-2024	1274	2124	0	95550	159300	0
112	511140234	Smt Alluri Kavitha	Road Metal	1.497	90/P	Devarapalle	Laxmipuram	27-08-2014	26-08-2024	3680	4811	2264	261825	3608	169800

S.No	LesseeID	Lessee Name	Mineral Name	Extent(in Hectares)	Location			Lease Period		Production			Revenue Collection		
					SurveyNo	mandal	village	From	To	2015-16	2016-17	2017-18	2015-16	2016-17	2017-18
														25	
113	511140237	Sri Andru Satyanarayana	Road Metal	1.858	62	Kovvur	Decherla	17-10-2014	19-08-2029	1500	1310	1247	93750	98250	93525
114	511140241	Sri Thotha Venkata Ramana	Gravel	0.664	337/6, 337/13	Tadepalligudem	Arugolanu	19-11-2014	18-11-2019	0	3774	0	0	113220	0
115	511140242	Sri Marlapati Srinivasa Rao	Gravel	0.724	340/1A	Tadepalligudem	Arugolanu	19-11-2014	18-11-2019	13338	6864	8838	371340	205920	265140
116	511140243	Smt Matta Padmavathi	Road Metal	7.157	125/1,4,5,6,7	Kovvur	Isukapatlapangidi	06-12-2014	22-10-2018	3821	5203	22376	265350	363225	727475
117	511140248	M/s Sai Srinivasa Granites	Ballast	2.42	504/2P, 3P	Devarapalle	Bandapuram	24-11-2014	23-11-2024	1839.5	1613	2151	116737.5	120975	161325
118	511140255	Sri Andru Venkateswara Rao	Road Metal	0.404	309	Devarapalle	Gowripatnam	07-06-2014	06-06-2024	0	734	0	0	55050	0
119	511140264	Sri Kakarla Venkateswara Rao	Road Metal	0.75	62	Kovvur	Decherla	12-09-2014	29-01-2022	1882	1132	1416	126575	84900	106200
120	511140268	Sri Matta Trimurthy Rao	Road Metal	1.8665	62/P, 15/P	Kovvur	Decherla	27-08-2014	30-09-2024	991	1247	50400	74325	93525	2520000
121	511140273	R. Raja Rajeswari	Ordinary Earth	0.5	342/2	Devarapalle	Duddukuru	07-06-2014	06-06-2024	3358	284	0	107130	21300	0
122	511140274	Sri Laxmi Prasanna Stone Crusher	Road Metal	1.574	77/4, 77/7	Kovvur	Decherla	12-11-2014	11-11-2029	849	5943	5943	63675	445725	445725
123	511140293	Narayanam Venkata Pedapapayya	Gravel	0.635	458/3 456/P	Bhimadole	Amberpeta	13-11-2014	12-11-2017	0	1590	0	0	47700	0
124	511150249	Sri M. Gangadharam	Road Metal	0.753	32	Kovvur	Decherla	24-04-2015	31-01-2025	47502	11933	0	3030100	894975	0
125	511150252	Smt.Manyam Neelima	Road Metal	1.62	343/P	Devarapalle	Duddukuru	29-05-2015	01-04-2027	0	1132	0	0	84900	0
126	511150253	Sri Daparthi Ammi Raju	Road Metal	4.249	84/1,2, 85/1,2	Devarapalle	Kondagudem	27-05-2015	26-05-2025	5094	3821	5660	346675	286575	424500
127	511150254	Vijaya Lakshmi Granite Metal Suppliers	Road Metal	2.509	500, 501	Devarapalle	Bandapuram	21-05-2015	09-01-2021	1274	1699	1699	95550	127425	127425
128	511150256	M/s Padmavathi Stone Crusher	Road Metal	0.607	309	Devarapalle	Gowripatnam	29-05-2015	28-05-2030	900	734	568	56250	55050	42600
129	511150257	Sri P. Satish Kumar Raju	Gravel	1.081	141/2	Unguturu	Unguturu	24-06-2015	23-06-2019	990	0	0	23460	0	0
130	511150260	Sri Gummadi Srinivasa Rao	Gravel	0.575	88/P	Unguturu	Chebrolukna hdrika	27-05-2015	26-05-2018	1655	1505	0	46250	45150	0

S.No	LesseeID	Lessee Name	Mineral Name	Extent(in Hectares)	Location			Lease Period		Production			Revenue Collection		
					SurveyNo	mandal	village	From	To	2015-16	2016-17	2017-18	2015-16	2016-17	2017-18
131	511150262	M/s Patel Soma JV	Road Metal	3.235	1	Devarapalle	Kondagudem	10-08-2015	15-01-2018	30817	6500	0	2054675	487500	0
132	511150263	Siva Rama Krishna Metals	Road Metal	0.9191	329/P	Devarapalle	Duddukuru	29-05-2015	11-05-2025	849	878	935	56600	65850	70125
133	511150265	Sri Kanaka Durga Stone Crusher	Road Metal	2.65	16-Feb	Kovvur	Isukapatlapangidi	23-06-2015	22-06-2030	1331	9056	26036	99825	679200	1952700
134	511150266	Sri Sri Balaji Granites	Road Metal	1.938	3/1P, 4/1	Kovvur	Isukapatlapangidi	14-08-2015	13-08-2025	2949	1415	2123	119600	106125	159225
135	511150267	Sri Lakshmi Narasimha Swamy Granite Metals	Road Metal	2.064	90/1	Devarapalle	Kondagudem	04-06-2015	03-06-2030	0	583	1376	0	30225	103200
136	511150271	Gummadi Srinivasa Rao	Gravel	0.915	88	Unguturu	Chebrolukna hdrika	27-07-2015	26-07-2018	4710	500	0	141300	15000	0
137	511150276	Sri Balaji Stone Crusher	Road Metal	4.962	302/2, 303, 304/1C, 1D 333/2	Devarapalle	Duddukuru	02-12-2015	01-12-2030	0	4117	4528	0	308775	339600
138	511150277	Sri Nidhi Granite Metal Suppliers	Road Metal	3.432	344/1A, 344/2, 344/1B	Devarapalle	Duddukuru	19-08-2015	18-08-2025	1200	4364	8207	90000	327300	615525
139	511150280	Sri Siri Stone Crusher and Company	Road Metal	3.043	332/1, 332/2A, 2B	Devarapalle	Duddukuru	06-08-2015	05-08-2030	0	2830	8180	0	212250	613500
140	511150281	Sri Alla Karthik	Road Metal	1.291	317/1	Pedavegi	Mundur	27-08-2015	26-08-2020	0	900	5715	0	27000	171450
141	511150292	KVR Granite Metal Suppliers	Road Metal	2.023	304/P 345/3P	Devarapalle	Duddukuru	19-08-2015	18-08-2030	0	1698	7075	0	127350	530625
142	511160279	Sri Mullapudi Satyanarayana	Road Metal	1.344	460/2P 461/2P	Devarapalle	Bandapuram	25-02-2016	24-02-2026	0	142	890	0	10650	66750
143	511160283	M/s Suma Metals	Road Metal	0.692	342/2, 343/P	Devarapalle	Duddukuru	20-02-2016	07-11-2023	0	1133	142	0	84975	10650
144	511160284	Sri Nukala Pavana Srinivas	Road Metal	0.692	342/1 343	Devarapalle	Duddukuru	20-02-2016	07-11-2023	0	2689.5	2123	0	201712.5	159225
145	511160287	M/s Monika Metals	Road Metal	0.522	76/2, 77/2 77/5	Kovvur	Decherla	12-01-2016	11-01-2026	0	426	2576	0	31950	193200

S.No	LesseeID	Lessee Name	Mineral Name	Extent(in Hectares)	Location			Lease Period		Production			Revenue Collection		
					SurveyNo	mandal	village	From	To	2015-16	2016-17	2017-18	2015-16	2016-17	2017-18
146	511160289	Dasari Swathi	Road Metal	1.926	240	Kovvur	Decherla	17-02-2016	16-02-2026	0	1285	1285	0	96375	96375
147	512000027	Manepalli Satyanarayana	Ball Clay (Crude)	2.38	23,64/1	Dwaraka Tirumala	Dwarakatirumala	05-05-2000	04-05-2020	4408	6300	1600	275260	378000	96000
148	512010009	Sri M. Satyanarayana	Fire Clay	1.6	125	Lingapalem	Asannagudem	21-04-2001	20-04-2021	2590	2200	2600	108548.4	110000	130000
149	512040020	M/s Dhanalakshmi Minerals	Ball Clay (Crude)	4.85	76	Dwaraka Tirumala	Dwarakatirumala	06-01-2004	05-01-2024	950	13450	21200	42480	807000	1272000
150	512060018	Sri Venkateswara Ceramic Industries	Ball Clay (Crude)	17.494	1,15,117	Dwaraka Tirumala	Gundugolanukunta	03-06-2006	06-06-2023	300	0	0	14208	0	0
151	512080004	Smt. M.Lakshmi Ramani	Ball Clay (Crude)	17.66	69/1	Dwaraka Tirumala	Kommugudem	15-04-2008	14-04-2028	12410	7450	10600	714186.4	447000	636000
152	512080033	M/s. Uma Group of Companies	Ball Clay (Crude)	4.368	04-Jan	Dwaraka Tirumala	Thimmapuram	16-04-2008	15-04-2028	600	0	0	21696	0	0
153	512090036	Sri M.Satyanarayana	Ball Clay (Crude)	2.081	22/3,28/1	Dwaraka Tirumala	Dwarakatirumala	14-08-2009	30-10-2024	8100	6025	13900	424984	361500	834000
154	512100003	M/s.Satya Sai Mines and Minerals	Ball Clay (Crude)	2.43	75/1	Dwaraka Tirumala	Kommugudem	29-05-2010	22-07-2030	29900	31500	27000	165064.8	189000	1620000
155	512100039	M/s.APMDC Ltd	Ball Clay (Crude)	13.93	15-Apr	Dwaraka Tirumala	Dwarakatirumala	04-12-2010	03-12-2030	3810	100	25300	224401.6	6000	1518000
156	512840034	Sri Jasti Satyanarayana Murthy	Quartz	15.39	15/P	Gopalapuram	Saggonda	04-12-1984	14-11-2023	14480	14500	6300	764853	108750	472500
157	512870019	M/s Dwaraka Mineral Works	Ball Clay (Crude)	5.45	70/2,74	Dwaraka Tirumala	Kommugudem	29-09-1987	28-09-2018	10950	8450	53150	559400	507000	3189000
158	512910031	Sri O.G.Raja Kumar	Ball Clay (Crude)	3.67	18/2,66/P	Dwaraka Tirumala	Dwarakatirumala	22-02-1991	21-02-2021	289	910	0	19720	54600	0
159	512920001	Sri O.K.Visweswara Rao	Ball Clay (Crude)	4.838	18/2,66	Dwaraka Tirumala	Dwarakatirumala	02-02-1992	13-02-2021	4600	4000	0	254696	240000	0
160	512930030	M/s. East Coast Minerals	Ball Clay (Crude)	3.644	109/1	Dwaraka Tirumala	Gundugolanukunta	17-05-1993	16-05-2018	2680	3280	0	160295.2	196800	0
161	512940006	Smt. O.S.K.Maha Lakshmi	Fire Clay	25.96		Lingapalem	Asannagudem	22-04-1994	21-04-2034	4760	4500	3600	199628	225000	180000
162	512950007	G.V.B.Gopala Murthy	Ball Clay (Crude)	1.92	63/1	Dwaraka Tirumala	Dwarakatirumala	28-03-1995	27-03-2045	2850	1070	701	149712	64200	42060
163	512960017	Sri M.Venkateswara Rao	Ball Clay (Crude)	4.573	11	Dwaraka Tirumala	Dwarakatirumala	24-03-1996	22-03-2036	300	1600	2700	18000	96000	162000

S.No	LesseeID	Lessee Name	Mineral Name	Extent(in Hectares)	Location			Lease Period		Production			Revenue Collection		
					SurveyNo	mandal	village	From	To	2015-16	2016-17	2017-18	2015-16	2016-17	2017-18
164	512970035	Smt.Ch.Sundaramma	Quartz	15.92	15	Gopalapuram	Saggonda	24-11-1997	23-11-2037	11360	8551	13940	504081	641325	1045500
165	512980028	M/s. Vijaya Bharathi Corporation Ltd.	Ball clay	42.668	1	Dwaraka Tirumala	Venkatakrishnapuram	23-03-1998	23-03-2018	0	50650	10000	0	3039000	600000
166	512980029	Smt. Maganti Lakshmi	Ball clay	0.838	62/2B	Dwaraka Tirumala	Kommugudem	09-01-1998	08-01-2018	0	950	1750	0	57000	105000
167	512990016	Sri M.V.L.K.Mohan Rao	Fire Clay	2	408	Kamavarapukota	Ankalampadu	09-06-1999	08-06-2019	1442	680	577	55386.32	34000	28850

ANNEXURE-II

Statement showing the Number of sand reaches and details of dispatches during the last three years pertaining to O/o ADM&G, Eluru.

Sl.no	Name of the Reach	Permitted Quantity in Cum	Dispatches in cum		
			2015-16	2016-17	2017-18
1	Koderu	49,990	-	49,990	-
2	Khandavalli	18000	-	18000	-
3	Kovvuru	49,900	-	49,900	-
4	Vadapalli	49,900	-	49,900	-
5	Usulumarru	49,900	-	-	-
6	Koderu	42,400	-	-	42,400
7	Khandavalli	12,600	-	-	12,600
8	Vegeswarapuram-Balliapadu	21,650	-	-	21,650
9	Mutyalavaripalem	14,500	-	-	-
10	Polavaram	1,00,000	-	1,00,000	-
11	Gutala	90,000	-	90,000	-
12	Tadipudi	80,000	-	80,000	-
13	Prakkilanka	80,000	-	80,000	-
14	Kovvuru	1,20,000	-	1,20,000	-
15	Aurangabad	1,20,000	-	1,20,000	-
16	Vadapalli	1,00,000	-	-	1,00,000
17	Vegeswarapuram	1,00,000	-	-	1,00,000
18	Narasapuram	1,00,000	-	-	40,000
19	Karugorimilli	1,00,000	-	-	-
20	Chinchinada	1,00,000	-	-	40,000
21	Yenuguvani Lanka	1,00,000	-	-	40,000
22	Elamanchili Lanka	1,00,000	-	-	40,000
23	Abbirajupalem	1,00,000	-	-	25,000
24	Doddipatla	1,00,000	-	-	40,000
25	Arikirevula	1,00,000	-	-	-
26	Polavaram	1,00,000	-	-	1,200
27	Gutala	1,00,000	-	-	1,200
28	Tadipudi	1,00,000	-	-	4,200
29	Prakkilanka	1,00,000	-	-	4,200
30	Kovvuru	1,00,000	-	-	4,200
31	Aurangabad	1,10,000	-	-	3,600
32	Vadapalli	1,40,000	-	-	3,600
33	Kumaradevam	31,710	-	-	-
34	Pandalaparru	2,40,000	-	-	4,800
35	Pendyla-Kanuru	1,62,000	-	-	4,800
36	Sidhantham	2,43,300	-	-	4,800

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