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Research Article

GEOENVIRONMENTAL EVALUATION OF AMARAVATHI, NEW CAPITAL CITY OF ANDHRA PRADESH, INDIA

***Rambabu T.[1], Raghuram P.[1], Sankara Pitchaiah P.[2] and Raju P.A.R.K.[1]**
[1]Department of Civil Engineering, Geospatial Information Centre, S.R.K.R. Engineering College, China Amiram, Bhimavaram, West Godavari District, Andhra Pradesh – 534204
[2]Department of Geology, Acharya Nagarjuna University, Nagarjuna Nagar, Guntur, Andhra Pradesh-522510
**Author for Correspondence*

ABSTRACT
Newly born Andhra Pradesh state aspiration are completely / wholly reached on the establishment of capital region – Amaravathi which plays a key role in the entire state's development. As a known fact, state is endowed with all resources both surface and ground water resources. The proposed capital region is locating almost midst of the state and well opted for the establishment of capital. Amaravathi is climatologically good and geologically strong. All the previous conditions like cyclone frequency, flood occurrence, and seismotectonic activities in the past were taken into considerations. But more conscious is needed while developing Amaravathi as capital.

Keywords: *Lithology, Lineaments, Geomorphology, Natural Disasters and Social Problems*

INTRODUCTION
Andhra Pradesh is one of the best agrarian states in India. Physiographically it is situated with plateau, hills and plain regions.
Plateau region is best for mineral resources, hills are covered with forest resources and sources for streams and small rivulets and plains are rich with agricultural yields. The unplanned division of all these natural resources creates it as deficient resources state.
The newly formed Andhra Pradesh geographically having a vast coastal line of around 972 km running form Srikakulam to Nellore district and has four districts with arid climate.

Study Area
Amaravathi is one of the Mandal in Guntur district encircled with Mangalagiri, Amaravathi, Tadepalli, and Tadikonda mandals and adjacent to river Krishna.
The geographical coordinates of study area are 16° 22' to 16° 34' N latitudes and 80° 23' to 80° 39'E longitudes. The study area map is shown in Figure 1.

Climate
Guntur district climatologically sustained with average rain fall of 853 mm (CGWB report), Temperature of maximum 48.5 ° C to minimum 16.8 ° C and Relative humidity varies from 80 % to 30 %. Krishna district have rain fall of 1034 mm. (Agriculture dept.) Temperature of maximum 47°C to minimum of 15°C and average relative humidity of 78% [1].
Amaravathi region is situated in Guntur district and adjacent to Krishna district. As a whole this region has good climatological condition. The total precipitation is occurred in Southwest Monsoon, North East monsoon periods.

Geology
Guntur district is underlain by various geological formations of different age groups ranging from Archaean to Recent. The Archaean basement complex comprising the granite-gneisses, Schists, Khondalites, Charnockites and basic dykes of dolerites form the predominant rock types in the central part. The fringe of the Archaeans in the central part is represented by Cuddapah basin, namely Nallamalai group of Upper Cuddapahs. In a sequential order, the younger Kurnools occurring in the Cuddapahs and those in the western parts of the district are thrust over by the Cuddapahs and these in turn by the Archaean granite-gneisses.

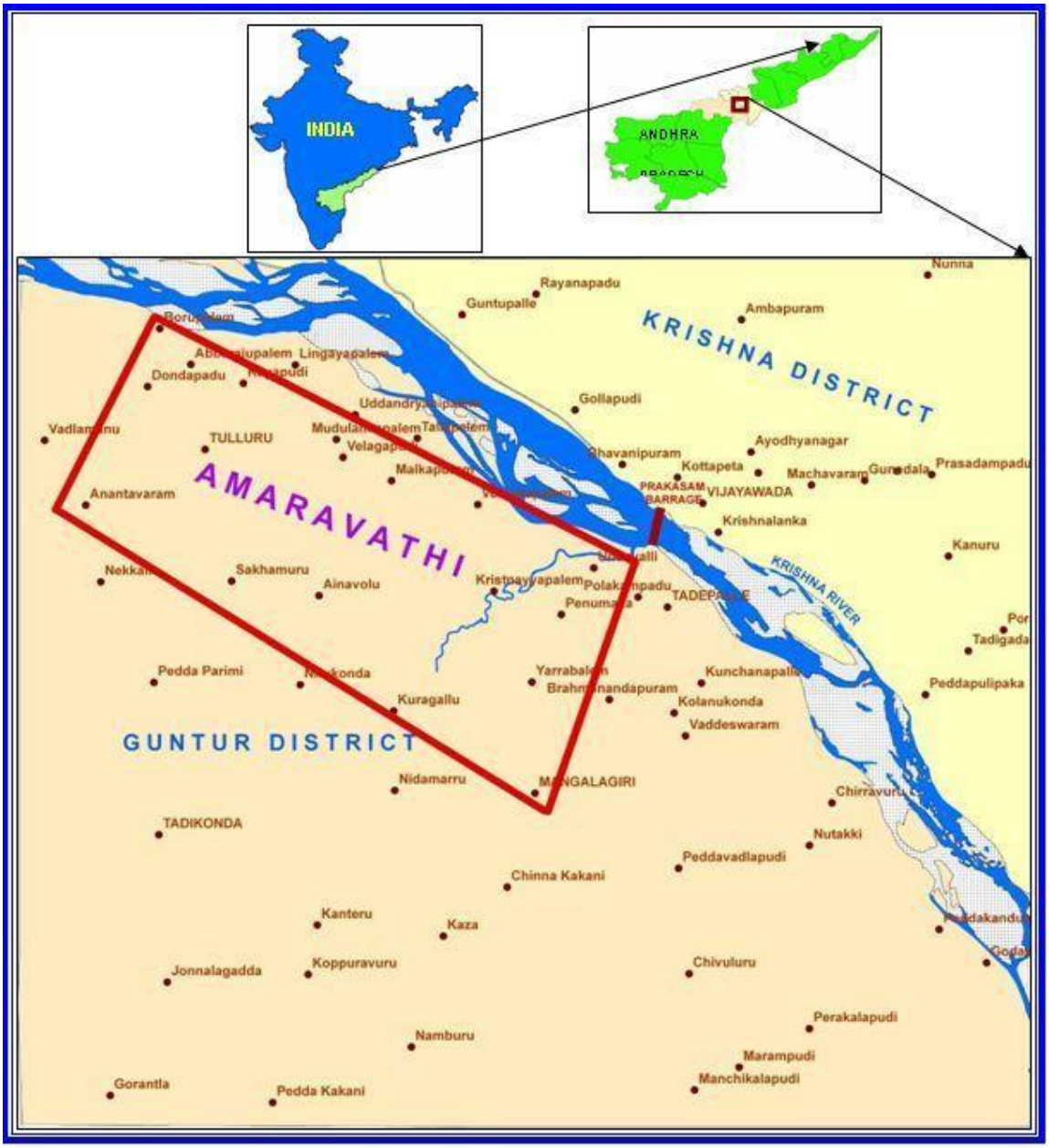

Figure 1: Location map of study area

The Upper Gondwana group of sandstones and shales out crop are seen at places between Guntur and Tenali. The youngest rock types of the district appear to be of Mio- Pliocene age followed by the alluvial deposits of Recent to Sub-Recent age. Krishna district underlain by the Eastern Ghats Supergroup comprising Khondalite and Charnockite Groups is exposed in the central part of the upland area. The Khondalite Group of rocks are seen as prominent hill ranges (strike ridges) south of Vijayawada, extending towards north and northeast. They consist of quartz, k-feldspar, and garnet sillimanite, graphite, with or without corundum. In the northeastern part, a number of calc granulite and quartzite bands are present, within khondalite. Acid and intermediate varieties of charnockite with patches of pyroxene granulites/metagabbro (north of Krishna River in the Kondapalli hill ranges) and minor magnetite-hypersthese-quartz granulite extend SW of Kondavidu hill ranges. Layered igneous rocks comprising anorthosite, gabbroic / noritic anorthisite, leucogabbro/noritic gabbro and pyroxenite, associated with

chromite ore occur as impersistent bands withn charnockites. The rocks of Khondalites, charnockite groups and the layered complex show foliation trending dominantly N-S with local swerves to NE-SW and NW-SE. The rocks of the peninsular Gneissic Complex are mostly in the form of migmatised gneisses with enclaves of older metamorphic rocks, such as amphibolites, pyroxene granulite and actinolite schist. The grey granite gneiss, which is mostly confined to the western part, is always well banded, the bands being alternately light and dark in colour. The gneissic rocks are intruded by dykes of dolerite, pegmatite and aplite.

The rocks of Archaean age are overlain by Proterozoic cover sequences of Cuddapah Supergroup and Kurnool Group. The contact between the older crystallines and the younger sediments is marked by a pronounced unconformity known as the Eparchaean Unconformity. The Cuddapah Supergroup is represented in the area by Cumbum Formation (Shale, phyllite, dolomite/limestone, quartzite). The Kurnool Group comprises Banaganapalle Conglomerate/ Quartzite and Narji Limestone. Micaceous quartzite of Mulug Group of Pakhal Supergroup occurs as discontinuous outcrops east of Nandigama. The pakal Supergroup is considered to be the time-equivalent of Cuddapah Supergroup. Rocks of Upper Godwana Group of the Godwana Supergroup, comprising Tirupathi Sandstone, Gollapalle/Chintalapudi Sandstone and Kamthi Sandstone are exposed north, northwest and east of Nuzvid. These rocks trend NE-SW with 200 dip towards SE. Unconformably overlaying the Godwana rocks is a small patch of Rajahmundry Sandstone, occurring NE of Nuzvid. The sandstone is brick red in colour and contains nodules of clay.The Krishna River built up its delta, south of Vijayawada. It flows southwards up to Avanigadda, where it bifurcates into two channels, the main channel continue to flow southwards upto its confluence with the sea near Nagayalanka and the branch at Avanigadda flows eastwards up to its confluence with the sea near Hamsaldeevi (Ground Water Brochure, 2013). So, Tulluru has a good basement with excellent lithological formations.

MATERIALS AND METHODS

Methodology

The present study needs the detailed literature on this region pertaining to various scientific, technical, cultural and socio-economical conditions. The information collected from the detailed reports like CGWB, Govt.of A.P., topographical information from Survey of India toposheets on 1:50000 scales, geological information from GSI maps and IMD records explains the natural disasters occurrence such as cyclones and their impact, information from daily news papers and monthly journals. For integrating all these collateral data the most suitable technology i.e. GIS was adopted.

RESULTS AND DISCUSSION

a). *Cyclones*

Generally, the tropical cyclones occurred in pre-monsoon, monsoon and post monsoon periods. The table.1 shows the cyclones crossed in costal districts of Andhra Pradesh.

Table 1: Cyclones crossed Andhra Pradesh coast

S.No	Date	Place	S.No	Date	Place
1	29-10-1948	Krishna	12	02-11-1987	Nellore
2	21-10-1949	Krishna	13	12-11-1987	Guntur
3	14-05-1969	Guntur	14	05-11-1989	Nellore
4	03-11-1976	Krishna	15	05-05-1990	Krishna
5	15-11-1977	Krishna	16	06-11-1996	E.G.Dt
6	05-05-1979	Prakasam	17	14-10-2001	Nellore
7	24-11-1979	Nellore	18	17-09-2005	Srikakulam
8	16-10-1982	Nellore	19	13-11-2008	Nellore
9	03-10-1983	Visakhapatnam	20	17-05-2010	Guntur
10	11-12-1985	Nellore	21	20-11-2013	Krishna
11	15-10-1987	Prakasam	22	23-11-2013	Krishna

As per the data Guntur district affected by cyclones rarely to Krishna district. It may be happened due to topographical condition of that district. In general Cyclones formed due to imbalance between forces particularly pressure gradient force. These are intensified by getting the moisture and lead to increase its intensity. Its path is North West in northern hemisphere. In SW monsoon period cyclones are form above 16°N latitude and crossed across Odisha and northern Andhrapradesh, while in NE monsoon cyclones are formed below 15°N and crossed in Northern Tamilnadu and southern Andhra Pradesh. Frequency of the cyclones crosses various districts of Andhra Pradesh as shown in figure 2.

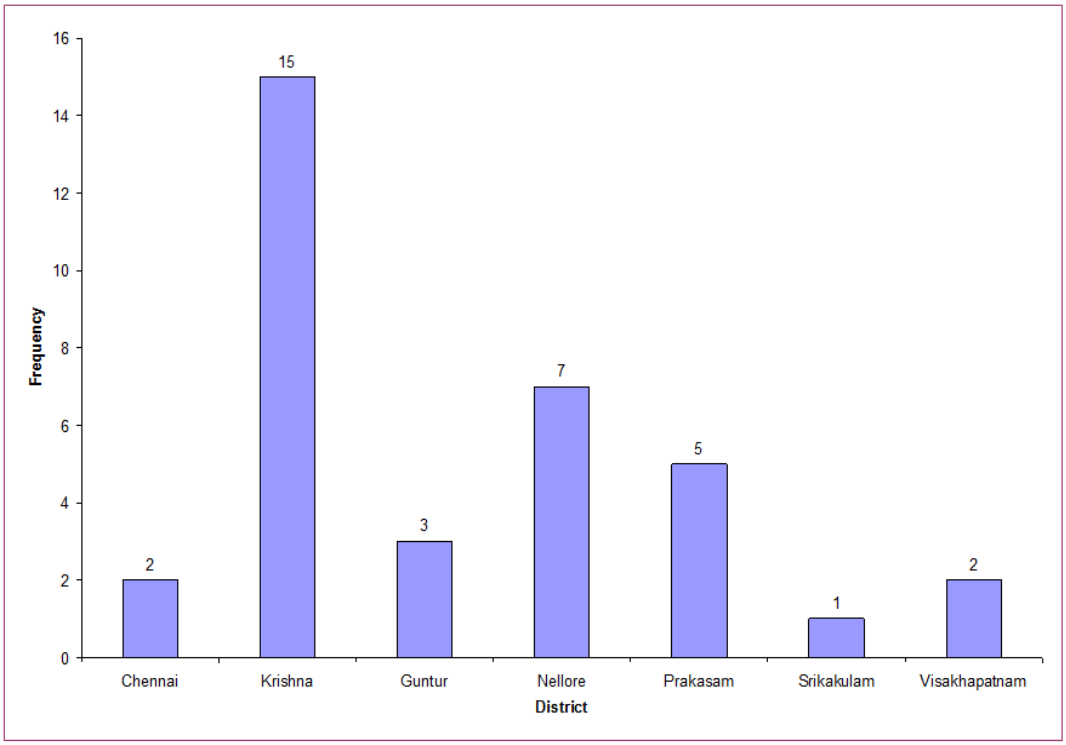

Figure 2: Frequency of cyclones crossed in coastal Andhra Pradesh

b). ***Floods***

Guntur district is severely affected by floods due to heavy rainfall occurred by cyclones. Lithology and morphological conditions of the region playing the primary role. In the past epoch only two storms were cross the shore in Guntur district and intensity of the flood is also a considerable issue during cyclones. Study area consists of dendritic drainage originated from hill ranges of North West and South West regions.

These streams are fed only by southwest monsoon and tropical cyclones. A well-known stream Kondaveeti Vaagu passing a distance of 50 km is flowing from Parecherla Hills which located aloft of capital. This stream flows aggressively, even small, when Palavaagu, Peddamadduruvaagu and Rottelavaagu join. More than 3500 acres of cultivation land and roads inundated every year because of floods caused by Kondaveetivaagu (Sankara, 1993). Government spent lakhs of rupees to control the flood of the stream. The experts suggesting the government from past 20 years for the construction of reservoirs and check dams on those streams instead of spent money for flood control. These structures not only reduce the floods but also provide drinking water.

The experts suggested a three phase method to riddance the flood by Kondaveetivaagu is now ready to implement to elude the usual menace to new capital of Andhra Pradesh.

1st Phase: The water which rained in the hill region should be collected at the foot of the hills by digging of tanks. So, ground water potential will rise in the region and diminution of flood is also to be achieved.

2nd Phase: the water which flows over the bunds of tanks and pass down wards is to be caught and stored in the reservoirs and supplied can be for domestic purpose and also for irrigation. Wideness of Kondaveetivaagu Programme is on pipe line decided by the government in the past.

3rd Phase: The Central Government decided to develop the National Waterway – 4, which is in progress. If the water that crosses the previous phases is directly linked to the National Waterway – 4, the flood impact can be averted completely.

Structures

The study area exhibits moderate structural condition by various lineaments in NW, SW & SE parts of and a major shear is situated in south to north east regions. The structural map of the study area is shown in figure 3.

Regarding the seismic activities, of earthquake data Andhra Pradesh is collected and analysed. The data is shown in Table 2. During the past 200 years the land was vibrated for four years between Guntur and Tenali in 1959, 1963, 1995 and 1997 with an intensity of 4.3 on Richter scale. The average intensity and the frequencies of the seismic activities of Andhra Pradesh State are shown in Figure 4. The data reflects the occurrence of earthquakes in Ongole district with high frequency of 20 with an average intensity 4.04. The maximum intensity recorded on 27-03-1967, is 5.4. In case of Guntur district, the intensity is 4.3 with a moderate frequency 11.

The surrounding areas, particularly Krishna district, tremors are occurred with an intensity of 3.7 with very less frequency of 2.

However, detailed seismic studies are to be carried out to know the present status of the seismic activity in and around the capital region.

Table 2: Seismic events in and around the capital area, Andhra Pradesh

S.No.	Place	Date	Intensity	S.No.	Place	Date	Intensity
1	Ongole - Kanuparti	18.10. 1800	4.3	19	Ongole	25.10.1976	3.5
2	Guntur	21.07.1859	4.3	20	Darsi - Ongole	25.05.1977	3.5
3	Guntur	02.08. 1859	3.7	21	Chirala	2.11. 1981	3.5
4	Guntur	09.08.1859	3.7	22	Ongole	18.08.1986	3.5
5	Ongole	12.10.1859	5.0	23	Ongole	19.08.1986	3.5
6	Krishna	24.07.1861	3.7	24	Ongole	03.12.1987	4.0
7	Krishna	13.01.1862	3.7	25	Ongole	03.12. 1987	4.0
8	Vinukonda	6.01.1867	3.7	26	Ongole	14.11.1992	3.6
9	Ongole	11.03.1867	3.7	27	Guntur	24.05.1995	4.0
10	Ongole	13.10. 1956	5.0	28	Ongole	21.10.1995	3.9
11	Ongole	12.10.1959	5.0	29	Addanki	04.08.1996	4.1
12	Ongole - Guntur	08.10.1960	4.3	30	Guntur	14.04.1997	3.8
13	Guntur	05.12.1963	3.7	31	Ongole	04.08.2006	3.4
14	Ongole	27.03.1967	5.4	32	South coast of AP	16.12.2006	3.5
15	Vinukonda	11.08. 1967	3.5	33	Sattenapalli	29.10.2012	3.9
16	Vinukonda	06.01.1967	3.7	34	Ongole	06.06.2013	2.9
17	Ongole	28.07.1971	4.3	35	Guntur	22.05.2014	-
18	Ongole	28.11.1974	3.9				

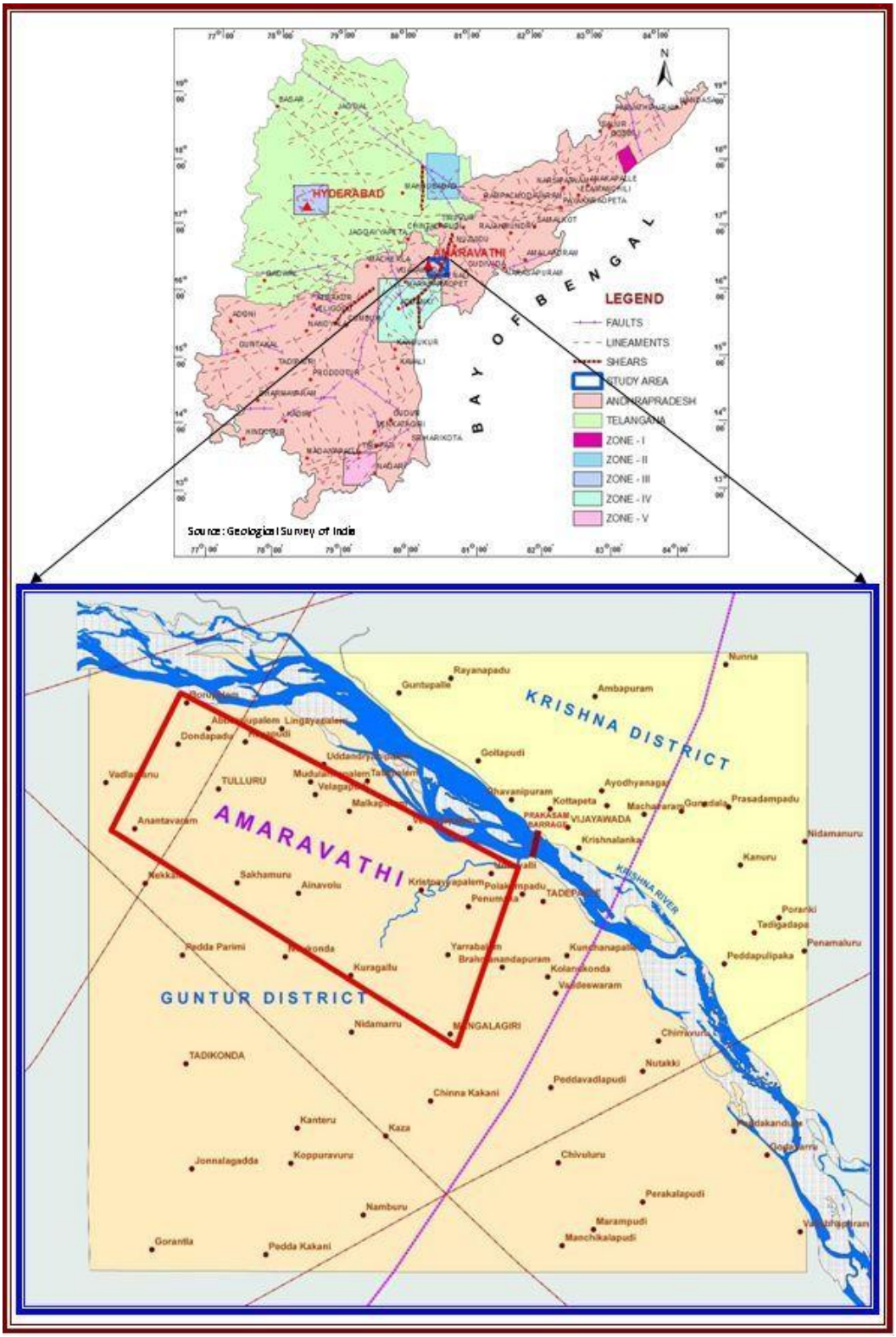

Figure 3: Structure map

There is no immediate danger from the earthquakes to the capital area. However, a keep observation is necessary on seismic activity in the surrounding areas. It is because the past Bhuj earthquake and recent

Nepal earthquakes, both cautioning even the distance places. The Nepal earth quake caused the damage in the certain states like up, Bihar etc.

The two lineaments, one extended from Khammam to Coastal region and the other near Ongole. Another huge fracture is to be studied carefully from time to time parallel to Eastern Ghats also need for observation. The Government is has to take the necessary step to establish a laboratory to measure the seismic activity regularly

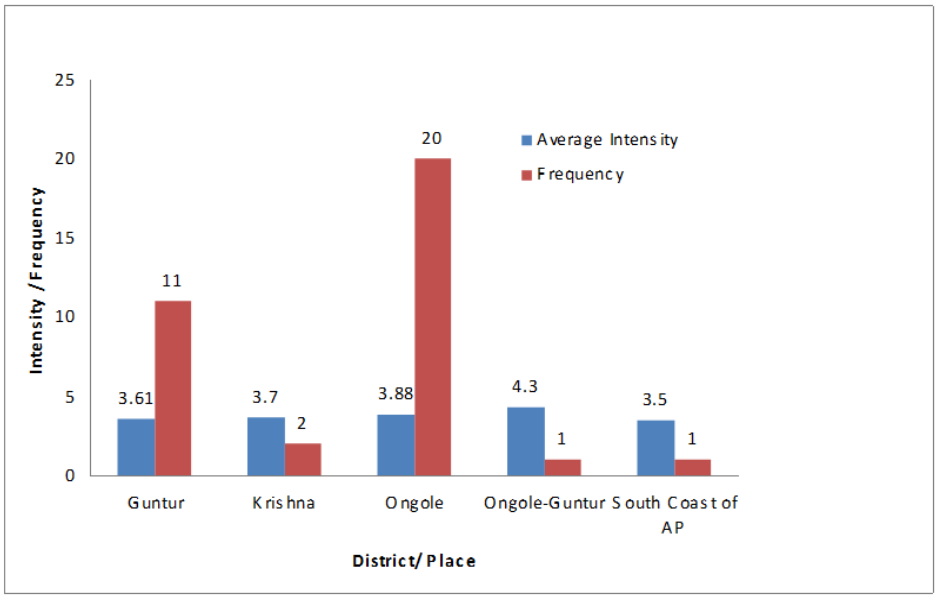

Figure 4: Average intensity and frequencies of tremors

The proposed the sky scrapers and industrial constructions increase a lot of pressure at the subsurface. With the increasing population, water table may deplete these factors enhance the chances of occurring vibrations. So, the Government should take the necessary precautions avoid the building up of pressure and water table depletion.

Awareness Programmes

Creation of awareness among the public also useful in this regard.

GW Condition

The state Ground water Board established four piezometric stations in the capital region at Rayapudi, Penumaka, Mangalagiri and Tadikonda. More stations are to be established in remaining villages. Periodical monitoring of water table is necessary. During the 2014 pre-monsoon depth water table is 4.71m Penumaka at 1.01 m Mangalagiri and 2.51m Tadikonda. As per the standards of WHO, the water contains more than 1000 Total Dissolved Salts is not suitable for drinking. The levels of TDS in the ground waters in Penumaka at 576, Mangalagiri at 962 and in Tadikonda at 3861 are observed (Ground Water Brochure, 2013). The pollutants / residues generated either from anthropogenic activities or from land use practices can cause severe damage to the ground water and shows its impact on capital. Suspended dust particles of air in Vijayawada and Guntur more than 60 micrograms per one square metre observed and scare to imagine the intensity of pollution level. Further the Government expecting multi-fold social problems increase of population as such there will be a threat from the population. Hence water testing laboratory should be should be established in the capital area.

Social Problems

Besides; there is no limitation for societal problems and chance of risen road accidents, family disputes, physical attempts, robberies / thefts, bad habits, cheatings and terrorism in the capital region. Majority of the villagers is the capital region. If the Government efforts to develop the skills for the farmer community successful, he is a solution for same residents. Relied on agriculture and the farmers now

focusing on alternative sources. Now the people of the area enjoying the luxurious life because of money exchange in the matter of land will shows its bad impact on lifestyle and health. Disputes for property among the families, physical harassments and attacks on ladies may also rise. So, a mechanism should be developing to promote moral values among the people.

Precautionary Measures

At most care should be paid while taking the decisions for the establishment of capital where the tremendous changes going to be placed. The experts able to construct the wide roads and skyscrapers but not the broaden to the minds of the people. Change their minds in a short span. The determined goals will be fruitful when the people have patriotism, humanity and discipline. If the government behaves without a constructive manner the situation may hand out and the capital may be the house of problems. Proper and efficient management is required to face the natural disasters when they occur. Need to implement the discipline in the bloods of state civilian and it is clearly observed in advanced countries like U.S. to develop the Amaravathi region, a separate methodology is required, proper management is to be implemented to get the success when population is limited and implement the methodology and management without fail. If the civilians of capital regions adapted to these changes thus future generation can do. Besides; the postings should categorize to the honest and sincere officers without any pressure on them, they will contribute definitely their services to the development of that region. The historical developments of great cities will be demonstrated to the locals through soft skill are most important to educate them for the development of capital region. Then only the capital city will be ideal for the nation and a page which is waiting to write.

Conclusions

The area Amaravathi, which is suggested for capital of Andhra Pradesh, is highly potential to set up capital. All the aspects, which related to nature, especially cyclones & floods occurrence and earthquake frequency are not as much of favorable but not a peril in condition to Amaravathi. The basic requirements like transportation, drinking water, water for different needs such as agricultural and industrial needs are good in nature. The central government is also focuses on the development of water ways all along the coasts that connects the rivers is definitely a favorable condition to the Amaravathi. Societal benefits by creating employments to the rural people of Amaravathi and its environs should be considered. Although precautionary measures and suggestions from the experts should be taken while developing the Amaravathi as capital for the state of Andhra Pradesh.

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