



Degrade Of The Forests And Its Distribution, Resources, Their Sustainable Management And Its Impact On The Natural Environment Of Visakhapatnam District, Andhra Pradesh, East Coast Of India.

Ravikumar Kandula¹, Mani Kumar Babu.M², Perala Sudheer Paul³, Raja Babu.A⁴, P Arjun²

1. Dept. of Geology, Samara University, Ethiopia, Africa.
2. Dept of Social work, Andhra University, Andhra Pradesh, India.
3. Dept. of Environmental Science, Andhra University, Visakhapatnam, India.
4. Dept. of Geography, Andhra University, Visakhapatnam, India.

Abstract

Visakhapatnam district is rich in forest wealth and having valuable natural resources and play a major role with their flora and fauna in the life of human beings. Forest resources constitute one of the most prominent geo-ecological features in the world. Presently the forests provide the raw materials over the 5,000 products worth about 23 million dollars and also support industry which employs 1.3 million people but the most unfortunate setback came in the form of commercial exploitation which resulted in mass destruction of forest cover year after year. The Forests have important protective as well as productive function not only supply of timber, fuel and a variety of other products but also have a moderating influence against floods and erosion and help in maintain soil fertility. The Destruction of forests are damages in all-natural resources. The forest resources sustainability and its maintenance are very important in all development countries in the world. The Forest are non-renewable resources so have to maintain the proper way for sustainability for long period, most of the land in Visakhapatnam region was covered with hills and its cover forest environment. This is indicating the rainfall and humidity with temperature levels are unique in this environment. The types of forests are classified into semi evergreen, moist deciduous, dry deciduous, dry evergreen, thorn forest and Savannah types and different kinds of species living in these forest environments. The most unique area in this district is Paderu region, here the tropical forest covered 85% of the total forest area in this region, and the next higher percentage of forest is tropical dry deciduous type occupied 40% in the area. Forest degradation methods, forest distribution, deforestation and conservation of forests are studied in this paper.

Key words: natural resources, forest, degradation, deforestation, conservation, distribution, forest environment.

Introduction

In Visakhapatnam district the total forest area is covered 441,166 hectares against the total geographical area of 1,116,100 hectares forming about 40 percent are highest in this region. The luxuriant and extensive forests in Anantagiri, Chintapalli, Minumuluru and Sileru areas present to good sight and panoramic view to any tourist or naturalist. More than one third of the area is covered by forests, passing inland from the coastal plain, one comes across a series of distinct geographical areas each is characterized by a different type of vegetation. The study area is divided into three forest divisions in the Fig-3 as per the altitude and rainfall distribution which include Narsipatnam Paderu and Visakhapatnam. Division wise distribution of forest depends on types of altitude, rainfall and soil conditions. The distribution of vegetation in relation to climatic type in the district is shown in Table 2. The vegetation is sparse along the coastal plain and it is very dense in the hilly region. All the stations from coastal plains exhibit semi-arid climate (D), with low amount of annual rainfall which support sparse vegetation, whereas the interior plains with dry sub humid climate (C) produced moderate vegetation. The hilly region covered higher amount of annual rainfall more than 1000 mm and moist sub humid climate (C2) it supports dense vegetation and it was mixed with semi evergreen species are found in the Chintapalli, Sileru, Anantagiri, Narsipatnam and Chodavaram ranges. The forest growth in the district not only supplies timber and fuel but also prevents erosion of the rocky hilly slopes. The spatial distribution of different types of forests in the study area are shown in Fig-2.

The semi evergreen forests are limited and account for 7.66 percent whereas moist deciduous forests occupy 145,605 hectares and accounts for 30.97 percent, followed by dry deciduous with 21.02 percent it shows in Fig-1. Semi evergreen forests spread over 36,016 hectares and dry evergreen forests extend over 43,453 hectares and occupy 9.24 percent. Thorn forests contribute 16.44 percent of total area followed by Savannah forests with 14.66 percent. These forests covered area are irregular and very open, varying considerably in condition, composition and density of the group. The species that commonly occur are Terminalia tomentosa, Pterocarpus marsupium, Anogeissus latifolia adina cordifolia etc. the timber forests are found in the Chintapalli reserves. The growth varies in density and quality according to the nature of the soil and steepness of the hill slopes. Fuel forest which covers most of the area lie at the foot hills in the lower slopes. Thorn forests contribute 36 percent of total forest area. The species met with are Soyimida febrifuga, Mababuxifolia, Albizzia amara, Albizzia lebbek. Dichrostachys cinerea and Acaica, sundra etc. Bamboo forests exist in all the ranges plentifully over a major portion of Narsipatnam range. The main species of all forest types are presented in Table-1. these forests can be divided into (i) National type which yield large quantities of timber and are found in Narasipatnam and Chintapalle ranges (ii) Protective type which are inaccessible and their protection is of paramount importance; and (iii) Local type which supply timber and firewood to meet the requirements of the local people.

The Narsipatnam division exhibits a good variety of forests which are situated at elevations between 130 mts and 1529 mts, the average annual rainfall of 1000 to 1200 mm together with red, red sandy loamy soils contribute to the development of reasonably dense forests. The foot hills and plain portion which receive less rainfall support open type of deciduous or thorny scrub forests. There are six types of forests identified from this division which include 1. Tropical semi ever green forests, 2. Tropical moist deciduous forests, 3. Tropical dry deciduous, 4. Tropical dry evergreen forests, 5. Thorn forests and 6. Dry savannah forests shows in Fig-4: Tropical semi ever green forests in Narsipatnam division extended over an area of 20,329 hectares shows in the photo-1. This type is small in extent occurring in localized pockets along perennial streams and valleys where climate conditions are favorable with plenty of rainfall above 1200 mm per annum. The height of the crop is varying from 20 to 30 mts. These forests represent the highest floristic evolution under favorable edaphic and climate conditions. This type occurs in patches in the tracts of Chintapalli reserve forests, Sileru, Pedavalasa and Lothugedda ranges. Moist deciduous forests occur in areas with rainfall over 1000 mm and altitude above 600 mts in the hilly tracts of Sileru, Chintapalli and K.D Peta ranges in photo-2 The height of the line is over 20 mts and the soils are deep loams with thick layer of humus. In the Fig-2 shows the healthy forest cover is found in the western part of Koyyuru, G.K. Veedhi, Chintapalli, G. Madugula, Paderu, and in the northeastern part around Anantagiri region. The extent of degraded forest area and scrub land is relatively higher, when compared to the healthy forest cover. Under transformation of forest due to anthropogenic activities, healthy forest area has been converted into degraded forests or scrub lands later it gets transformed into land with or without scrub area. The extent of forest area is relatively low along the coastal plain and interior plains. However, small patches of healthy forest cover are found in the mandals of Narsipatnam, Nathavaram, Anadapuram etc. The extent of crop

land is more along the foot hill zone at interior plains and coastal plains shows in Fig-2. The forests in the study area are categorised into two types, deciduous forest (photo-1 & 2) and degraded/scrub forests. Deciduous forests can be subdivided into moist deciduous and dry deciduous both the types of forests, moist deciduous as well as dry deciduous are represented as single category as deciduous which is shown in the Fig-1. And also, both scrub and degraded forests are shown under single category. Based on champion and seth's classification of forests.

Methodology

The information is gathered from the division of Forest and the District Administrative Office and various sources like ITDA and so forth, the examination depends on the geographical guides from the study of India, National Atlas and Thematic Mapping Organization Kolkata. The computerized information acquires from the National Remote Sensing place Hyderabad and State Remote Sensing Application Center Andhra Pradesh. We can utilize the far-off detecting and GIS innovation for create and get ready guides and connection concentrates through the field visits of the examination region. The land use/land cover example of an area is a result of normal and financial variables and their usage by man in reality. Land is turning into a scant asset because of enormous agrarian and segment pressure. Henceforth, the data of land use/land cover and opportunities for their ideal use is fundamental for the determination, arranging and execution of land use plans to fulfill the expanding needs for essential human necessities and government assistance just as secure of the woodland climate. This data additionally helps with observing the elements of land use coming about out of changing requests of expanding populace and become a focal part in current procedures for overseeing normal assets and checking natural changes. The progression in the idea of vegetation planning has enormously expanded examination ashore use/land cover change subsequently giving a precise assessment of the spread and wellbeing of the world's woodland, field, and farming assets has become a significant need. Survey the Earth from space is presently critical to the comprehension of the impact of man's exercises on his common asset base after some time. In circumstances of quick and regularly unrecorded land use change, perceptions of the earth from space give target data of human usage of the scene. The satellite information has gotten fundamental in planning the Earth's highlights and frameworks, overseeing characteristic assets and contemplating ecological change.

Remote Sensing (RS) and Geographic Information System (GIS) are now providing new tools for advanced ecosystem management. The collection of remotely sensed data facilitates the synoptic analyses of Earth -system function, patterning, and change at local, regional and global scales over time such data also provide an important link between intensive, localized ecological research and regional, national and international conservation and management of biological diversity (Wilkie and Finn, 1996). Therefore, attempt will be made in this study to map out the status of land use land cover of Visakhapatnam district a view to detecting the land consumption rate and the changes that has taken place in this status particularly in the built-up land so as to predict possible changes that might take place in this status in the coming years using both Geographic Information System and Remote Sensing data.

Results and discussions

In the study area the Dry deciduous forests are widely distributed and the rainfall varies from 600 mm to 1000 mm the height of the crop is 10 m to 15 m, the density and homogeneity vary with depth of the soils. Tropical dry evergreen forests occur in the plains towards coastal areas with rainfall of 750 mm and no organic matter. The crop is open, irregular and never attains a height of more than 8 mts it is in Payakaraopeta and adjacent areas. Thorn forests occur in the plains with the annual rainfall of 500-600 mm and the soils supporting this type of vegetation are with little or without organic matter. The Paderu division an altitude varying from 750mts to 1150 mts with higher altitude the rainfall also increases and hence higher type of ecological formations are seen and the foot hills which receive low rain fall bear open type of forests and the hills receive an average rain fall of about 1000 mm to 1200 mm and the forests are mostly moist deciduous and some forests existing on deep soils formed by the decomposition and disintegration of igneous rocks are of superior deciduous type. There are two main types of forests in Paderu division which include tropical moist deciduous forests which spread over an area of 89,157 hectares Moist deciduous forests are very similar to the climax moist deciduous. These forests are of secondary origin due to shifting cultivation and grazing and distributed in Paderu, Araku and Pedabayulu regions, and dry savannah forests extend over 15,654 hectares shows in percentage in Fig-4(a).

In the study area the dense dry deciduous to moist deciduous forests are found that is 1. Tropical semi

evergreen forests occur in a much-localized manner in small pockets at valleys and near perennial streams where the climatic conditions are favorable for flourishing of evergreen species, with abundance of moisture coupled with plenty of humus it occurs in Ananthagiri, Vantlamamidi areas it has been observed along the road from Kasipatnam to Ananthagiri the average height is about 18mts. The approximate area of forests is 15,687 hectares.

2. Tropical moist deciduous forests occur in regions with rainfall of 1000 mm and above and altitude of 600mts and the trees height varies from 13mts to 20mts, the soils are deep 15-25cms and rich with humus. Teak plantations are existing in Chodavarm and Ananthagiri areas and it covers about 11,087 hectares.

3. Tropical dry deciduous forests the upper canopy is uneven and not dense and open, forming a mixture of deciduous trees these are occur in moist deciduous forests the height of trees generally varies from 10 m to 15 m. The number of species is much less and a few tend to predominate over others in selected areas owing to soil peculiarities or biotic interference. The lower canopy also consists of deciduous species at very few places some semi-evergreen shrubs are also present but they are confined to the moist sheltered pockets only. These forests are easily accessible and subjected to heavy biotic pressure these are secondary in nature, contain immature and young crop it covers about 53,174 hectares

4. Tropical dry ever green forests occur in the plains towards coastal areas with rainfall of 750 mm and below and on impoverished soils with no organic matter and the top soils are practically nonexistent. The soils supporting such vegetation are generally red gravelly or eroded laterite. The crop is open, irregular and never attains a height of more than 8 mts it can be seen in Payakaraopeta and adjacent areas of this division and it extends over 14,321 hectares.

5. Tropical dry thorny forests are found as intermixed with tropical dry evergreen without clear and distinct line of demarcation between these two types. The tropical thorny forests are characterized by the presence of low thorny species. The soil supporting this type of vegetation is shallow, compact with more percentage of morram. It is noticed in Yelamanchili and Visakhapatnam ranges of this division it extends area of 37,152 hectares.

Savannah forests Some of the hill tops over 1000 m altitude in the hilly regions have no vegetation except tall grasses. It resembles Savannah vegetation like patches there are stunted growth trees. The soils are shallow weathered laterite and bauxite zones can be seen. These bauxite zones with tall grasses are found just below Dharakonda region in the north west of the district. These open grass lands with sparse stunted trees and shrubs on the hill tops presenting baldy appearance with the stoppage of tree growth of the dry deciduous forest along the cover edge of the top. Such type of vegetation is unique by itself with short stunted trees of Terminalia chibula, Pterocarpus marsupiu, Gardinina latifolia etc. mixed with dense ground cover of phoenix humilis and grasses. Such a community along these bald hill tops has close affinity with the bauxite deposits. While extracting bauxite deposits, the environment could be greatly disturbed for which necessary precautions have to be taken to minimize such disturbance. Savannah forests extend over 15,654 hectares in the forest ranges of Paderu, Pedabayulu and Araku and an area of 53,275 hectares in Sileru, Chintapalli, Pedavalasa and Lothugedda ranges.

Sal forests are available in Jalaput and Duduma blocks (Machkund river basin) Sal occurs in small patches. The distribution of these forests is limited to small extent. Because of Podu cultivation, natural growth of Sal trees has been hampered. But Forest Departments are trying their best to reforest the areas with Sal seedlings where ecological requirements of Sal are favorable.

Bamboo forests are occurring extensively in all the deciduous forests as enriching the economic value of the forests and in good proportions in Ananthagiri, Vantlamamidi, Madugula, Tenugupudi, Medivada, Sileru, K.D. Peta, and Narsipatnam areas. The species of this vegetation include Dendrocalamus stricturs, Bamboosa arundinacea and Dendrocalmus hamillonii. Dendrocalmus stricturs grows to height of about 20 mts and most valuable for pulp wood and other domestic requirements. In the study region along the coast the vegetation type is casuarinas plantations, coconut palms, cashewnut and Acacia plants it is cleared for aquaculture and protect for coastal areas from climatic hazards like cyclones.

Deforestation/degradation of forests in the study area.

The exploitation of forests during earlier times it was balanced through a natural growth process because the forest cutting was done for personal or community use only and with the expansion of agriculture, forest lands have been cleared. The More forest destruction has been done after industrial revolution and urbanization in the study area. The pressure of industrialization, urbanization, construction of roads, dams, reservoirs and increasing demand for agricultural products has led to significant reduction of natural forest in many regions. Over exploitation of forest resources brought imbalances in ecological system. The first National Forest Policy of India declared in 1952 emphasizes the need to maintain one thirds of the hilly regions in the country under forest

not only to meet the requirements of the people but also to maintain ecological balance.

The deforestation is a major problem everywhere in spite of Government acts for protection of forests in the Visakhapatnam district has been declining fast. In the recent decades due to Podu/shifting cultivation shows in Photo-5 & 6 are also impact on the forests, and indiscriminate grazing, unchecked smuggling of forest timber and forest fires both natural and manmade are also impact on the degrade of the forests. The total forest area of the district is 441,166 hectares. Deforestation due to Podu/shifting is maximum in the hilly region. The forest area under cultivation in the hilly zone is 44,200 hectares followed by foot hill zone where the deforested area for cultivation is 2,580 hectares. The total deforested area in the district comes about 48,484 hectares. The study reveals that degradation and deforestation are at high rate in the mandals of Araku and Paderu shows in the Photo-3&4. There is an increase in area under degraded forest. The depletion of forest cover in the study area is mainly due to the practice of cultivation by local tribal and also mining activity in the midst of forests to some extent. Hill slope/terrace cultivation is also responsible not only for deforestation but also excessive soil erosion. The practice of monoculture is also responsible for the reduction in biodiversity. Encroachment of forest area by local tribal people and illicit felling are other causes of deforestation. Deforestation and degradation (Photo-7 & 8) are at a rapid scale in the district. Hence, necessary steps are to be taken for proper management of forests and to maintain ecological balance and environment quality.

Impact of deforestation on the natural environment

Deforestation has become a threaten on the form of increase of temperature, lesser precipitation, increased rate of soil erosion, increasing frequency and volume floods, Loss of soil productivity, Extinction of several species, Non-availability of several essential forest products, and Imbalance in ecosystem and etc., The harmful effects of deforestation are so much that all over the world people and authorities have realized that forest resources must be conserved properly in order to protect the ecosystem. The forest is a national resource and a social asset. It yields a great social profit which lies wholly outside the realm of business. It properly used and put on a sustained-yield basis, it will be one of man's greatest resource, and conservation of forest is the only alternative. The Forests are fast disappearing due to over exploitation in some parts of the district. All most all the reserved forests in the hilly zone are secondary in nature as they are subjected to podu/shifting cultivation. The Loss of forest cover impact on soil erosion, floods, and landslides, silting of rivers and drying up of springs and also impact on forest resources such as timber, fuel, fodder, medicinal plant etc.

The most important contribution of forests is climatic amelioration and maintaining water balance besides conserving soil and moisture. Forests influence the wind, temperature and humidity. Deforestation will increase the levels of carbon dioxide in the air and also reduce the oxygen levels, ultimately affecting the quality of air. Vegetation plays very important role in recharging atmospheric oxygen and recycling the carbon dioxide through the photo synthetic activity of plants. Besides, trees have the selective absorption capacity of liquid, solid and gaseous pollutants, thereby preventing atmospheric pollution and health hazards to human and animal life. Noise pollution in urban areas can be reduced to 10 decibels if there are green belts. Deforestation accelerates the Green House effect which causes the increase of temperature. Scientists believe that deforestation has contributed to the current global warming of the earth's atmosphere, partly caused by an increase in levels of CO₂. Trees are one of the main agents for removing co₂ from the atmosphere, giving out oxygen in return. The future of the planet earth depends on the concentration of carbon dioxide and other trace gases. The higher concentration of CO₂, an important greenhouse gas will be reduced through intensive afforestation programs. Trees at their own-sacrifice contribute to the existence and perpetuation of all kinds of life on this planet.

The role of vegetation/forests in conserving the environment, preserving the water-shed and regulating the water-flow and water-yield has been recognized from times immemorial. Besides reducing soil erosion, forests through the leaf litter and humus on the forest floor offer mechanical obstruction for the surface run-off, reducing the velocity in case of accelerated water erosion, at the same time, absorbing more water to sink into sub-soil and available in future as sub-soil moisture to plants and as ground water to meet water-needs of all humans. The quality and quantity of surface and ground water resources mainly depend upon the vegetation cover (Bahuguna, 1986). The environment is more stable in a forested catchment, due to reduction in silting of water channels and water reservoirs resulting in increased stability and controlled water-flow, thereby reducing flash floods and loss to property and life, by preventing change in water courses. Reduced siltation directly increases

the water holding capacity of irrigation and hydel reservoirs, resulting in more water yield for irrigation and power generation. The nature and quality of soil mainly depends upon the vegetation cover. The soils will be exposed to the action of wind and water, if vegetation cover is removed. The National Commission on Agriculture estimated about 150 million hectares of land in India is affected by soil erosion (Agarwal 1989). Climate is the main factor determining the type of plants that can grow in an area and the micro-climate of any forest zone is determined by prevailing vegetation. The effects of forests on climate are greatest in the area, the trees occupy and they are roughly proportional to the density of cover. The Widespread removal of forests can be change in species composition or conversion of forests for other types of land use and also the alters surface heat and water budget may affect regional microclimates.

Management and Conservation of forest resources

The forest management is the key to all conservation efforts, the following consideration that is Survey of forests, Categorization of forest, Economic use of forest, Administrative setting for forest management, Training programs for persons engaged in forest conservation activities, Use of forest land as tourists centers, Social and Agro-forestry, Development of new techniques for the conservation of forests, Research for efficient use and conservation of forest, and Policy-decisions and their proper implementation is helpful for the conservation and management of forest resources. presently the demand for timbers, fuel-wood, paper, pulp in the construction field and synthetic fibers in the world, forests have been exploited rapidly and other factors like fire, insects, disease and wind-storm which are also responsible for forest depletion to a great extent. There are several forest diseases resulting from parasitic fungi, rusts, mistletoes, viruses and nematodes which cause the destruction of trees. The forests should be protected either by use of chemical spray, antibiotics or by development of disease resistant strains of trees. Recently the importance of forests has been realized and different scientific policies have been adopted in different countries to stop the exploitation and destruction of forests and to attain the maximum possible satisfaction from the forests by making their use rational and by conserving them. One of the greatest enemies of forests is forest-fire. Each year forest-fires in the world wide and sweep over large areas. This great waste can be, almost wholly prevented if adequate attention is given to safeguarding the forests from fire. Another way of conserving forests is the prevention of waste in lumbering and in preparing the lumber for use. Still at many places much of the waste material is burned which can be used for fuel and some in making small articles like toys, laths and handles for tools. Proper Utilization of Forest Products is required. Generally, forests have be cut for logs and rest of the tree-stump, limbs, branches and foliage, etc., left out in the forest as worthless debris. Further waste occurs at the saw mills. There is a need to use all this waste material. Now several uses have been developed and products like waterproof glues, boards etc., can be obtained.

The following steps should be taken for the conservation of forests. cutting should be regulated by adopting methods like: (i) clear cutting, (ii) selective cutting, and (iii) shelter wood cutting. The clear-cutting method is useful for those areas where the same types of trees are available over a large area. In that case, trees of same age group can be cut down in a selected area and then marked for re-plantation. In the cutting purpose only, the mature trees are selected for cutting these forests can be managed in such a way that a timber crop may be harvested indefinitely year after year without being depleted. This technique is called the 'sustained yield' method adopted by many countries of the world this concept dictates that whenever timber is removed, either by block cutting or by selective cutting, the denuded area must be reforested. This may be done by natural or artificial methods. Similarly, any forested land which has been destroyed by fire or mining activities should be reforested. In rugged terrain aerial seeding is the method of choice. Besides all this, fresh afforestation programs should be started (photo-9). New plantations will not only increase the forest cover but also help in making up the eco-balance. For afforestation, selection of trees should be done according to local geographical conditions and care must be taken during initial growth of the trees. Most of the present-day agricultural land was once forested and then cleared for the use of agriculture. But now it has reached the stage where further clearance will be dangerous for the entire ecosystem. Shifting cultivation is one of the problems. For the conservation of forest, this should be checked and an alternative system should be suggested to them. Similarly, for the development of villages, towns and cities, forest lands have been cleared and this process continues to this day causing loss of forest cover. This also should be checked and green belts around cities be developed. Similarly, forests can be developed as tourist centers. By using them as tourist centers the country can earn substantial foreign exchange. This practice has been adopted by many countries, both developed and developing. The concepts of 'national

park' and 'game sanctuary' have now become popular and every country has developed its unique forest area as a 'national part'. In India alone, there are as many as national parks. This scheme is a good method of forest conservation.

Forest conservation programmes in the study area

The conservation of forest resources can be done by cooperative efforts of the government, non-government and public through a proper management system in the study region. The Afforestation work has been undertaken by the Forest Department in association with the soil conservation division shown in photo 11 & 12. Under the rehabilitation programme of forests like barren hill afforestation, raising of plantations, raising of nurseries, vegetation fencing and contour trenching also take up. Teak plantation near Chintapalli, Pine and Silver Oak plantations near Araku, eucalyptus in Anjoda, cashew plantations near Jalaput are some of the results of these programmes. The hill slopes at higher elevations in the agency area of the district are found suitable for coffee growth. Coffee plantations are being raised in Chintapalli, Minimuluru, Raghavendranagar and Ananthagiri regions. Infra structure with trained personnel can be developed to organize Biological conservation programs can help the protection of forests. Seminars must be organized and to help to conserve the Biodiversity and create public awareness on 'Nature conservation' and to educate the people about the importance of the forests and need for their protection. One should plan to provide alternate source of firewood, timber etc., to meet the public demand in the study area. Such problems can be solved by intensive social forestry programme, which are being practiced at many places in the study area. Environmental land use zoning, wet land ecosystem conservation, medical flora, ecotourism and related strategies involving the local population. Mono culture is being practiced in some areas by way of planting Bamboo and Eucalyptus after destroying natural thorny scrub and other low-grade forest are supply of raw material for paper mills. The Nature's stability depends on its diversity and diversity supports good life-system. Hence, practice of monoculture should be avoided. It is also essential to safeguard biodiversity by declaring certain selected areas which harbor rare plant species associated with animals, birds and insects as 'Biosphere Reserves'. The sustainable utilization of the species without disturbing the ecosystem has to be developed in the study area.

Reference

Allen, J. and Barnes, D.F., 1985. The Causes of Deforestation in the Developing Countries. Annals of the Association of American Geographers, V. 75., pp. 163-184.

Bahuguna, S., 1986. Deforestation and Its Impact, Seminar on Indian Environmental Problems and Perspectives, Geological Society of India, Bangalore, memoir 5, pp. 167-173.

Chattopadhyay, S., 1986. Trends in Deforestation, Seminar on Indian Environmental Problems and Perspectives, Geological Society of India, Bangalore, Memoir 5, pp. 289-297.

Department of Forest, Visakhapatnam. 2002. Working plan reports for the forests of Narsipatnam, Paderu and Visakhapatnam Divisions.

Dikshit, K. R., 1991 Environment, Forest ecology and man in the Western Ghats: A case of Mahabaleswar plateau, Rawat Publication, Jaipur.

Haripriya, G. S., 2003. Carbon budget of the Indian forest ecosystem. Climate Change, 56, 291– 319.

Jagbir Singh., 2008. Biodiversity, Environmental Sustainability, New Delhi., MD Pub., xii, 340.p Krishna Murthy, A.V.R.G., 1980. Forests and Wildlife in India, Committee on Science & Technology in developing countries, International Council of Scientific Unions Ministry of Environment and Forests., Dehra Dun, Forest Survey of India, State of Forest Report 2003.

Nagaraja, R., 1987. Mapping and Monitoring of forest resources using multidata Land sat Data. A case study of

Ravindranath, N. H., Chaturvedi, Raja Kumar, Indu K. Murthy., 2008. Forest conservation, afforestation and reforestation in India: Implications for forest carbon stocks. *Current science*, vol. 95, no.2

Singh, D.V. and Sikka, B.K., 1994. Forest farming with special reference to social forestry. Mittal Publications, New Delhi.

Swaminathan M.S and Sinha S.K., 1991, Deforestation, Climate change and sustainable nutrition security: A case study of India, *Climate change*, 19, pp.201-209.

Venkata Reddy, D., 1988. Deforestation and its impact on ecological problems with special reference to Western Ghats, *Indian Journal of Environmental Protection*, Vol. No. 12.

Agarwal, V.P., 1990. Forests in India: Environmental and Production Frontiers. Oxford & IBH Publishing Co. Pvt, Ltd. Bombay, Delhi, Calcutta.

Ravi Kumar. K, and D. Deva Varma 2013 Geomorphic and structural features of Gosthani river basin East Coast of India. *International Journal "Asian Academic Research journal of Multidisciplinary" (AARJMD)*, , Volume 1, issue 12 PP no 71-81,.

Assessing fire risk in Guntur district, Andhra Pradesh using integrated remote sensing and GIS. "International Journal of Science and Research (IJSR)" B. Veeraanarayanaa1, Srinivas, K. Ravi Kumar Volume 3 Issue 6, pp.1328-1332.June 2014.

B.Veeranarayana, Kandula Ravikumar, T.Ramesh. 2015, Areal extent of erosion or accretion in and around the Gahirmatha coast NE Bay of Bengal by remote sensing and GIS analysis of multi temporal satellite imagery using temporal data. "International Journal of geo science". *International Journal of Geosciences*, 6, pp: 705-719. <http://dx.doi.org/10.4236/ijg.2015.67057>

Veeranarayana Balabathina, Ravi Kumar Kandula 2019, Statistical Analysis of Grain–Size Characteristics of Streambed Sediments in River Catchments of the Lake Tana Basin, Northwest Ethiopia. "American journal of earth sciences". *American Journal of Earth Sciences*. Vol. 6, No.1, pp. 1-13. <http://www.openscienceonline.com/journal/ajes> ISSN: 2381-4624 (Print); ISSN: 2381-4632 (Online).

Table-1: Forest Species of Visakhapatnam District

S.No.	Vegetation type	Botanical Name	Local Name
1.	Semi evergreen	Michelia champaka	Sampenga
2.	Semi evergreen	Aegle marmelos	Maredu
3.	Semi evergreen	Mangifera indica	Mamidi
4.	Semi evergreen	Syzigium cumini	Neredu
5.	Moist deciduous	Anogeissus latifolia	Chirumanu
6.	Moist deciduous	Terminalia arjuna	Tellamamidi
7.	Moist deciduous	Pterocarpus marsupium	Aegisa
8.	Moist deciduous	Chlorexylon swietenia	Billakarra
9.	Moist deciduous	Albizia odoratissima	Chindugu
10.	Moist deciduous	Schleichera oleosa	Busi
11.	Moist deciduous	Adina cardifolia	Bandaru
12.	Moist deciduous	Dillemia pentagyna	Kalinga
13.	Moist deciduous	Kydia calcycina	Kondapathi
14.	Dry deciduous	Pongamia pinnata	Kanuga
15.	Dry deciduous	Soymida febrifuga	Sometha
16.	Dry deciduous	Lagerstroemia parviflora	Chennangi
17.	Dry deciduous	Diospyros melanoxylon	Tunki
18.	Dry deciduous	Gmelina aorea	Gammudu
19.	Dry deciduous	Sterculia urcens	Kondatumma
20.	Dry deciduous	Xylia xylocarpa	Kondatangedu
21.	Dry deciduous	Cidrella toona	Galimanu
22.	Thorny Scrub	Acacia leucophloea	Tellatumma
23.	Thorny Scrub	Albizia amara	Narlingi
24.	Thorny Scrub	Canthium didynum	Nallabalusu
25.	Thorny Scrub	Zizypus xylophyrus	Gotti
26.	Thorny Scrub	Atlantia monophylla	Adivinimma
27.	Thorny Scrub	Emblica afficinalis	Peddausiri
28.	Thorny Scrub	Feronia elephantum	Velaga
29.	Thorny Scrub	Dicrostachys cinera	Veluturu
30.	Thorny Scrub	Randia dumetorum	Balusu

Table-2: Climatic Types and Vegetation

Station	Climatic Type	Type of Vegetation
Coastal Plain		
1. Elamanchili	Semiarid (D)	Sparse
2. Bheemunipatnam	Semiarid (D)	Sparse
3. Anakapalli	Semiarid (D)	Sparse
4. Konada	Semiarid (D)	Sparse
Interior Plain		
5. Chodavaram	Dry-sub humid (C)	Moderate
6. Narsipatnam	Dry-sub humid (C)	Moderate
Hilly Region		
7. Araku	Moist – sub humid (C ₂)	Moderate
8. Upper Sileru	Moist – sub humid (C ₂)	Dense
9. Paderu	Moist – sub humid (C ₂)	Dense
10. Chinapalli	Moist – sub humid (C ₂)	Dense

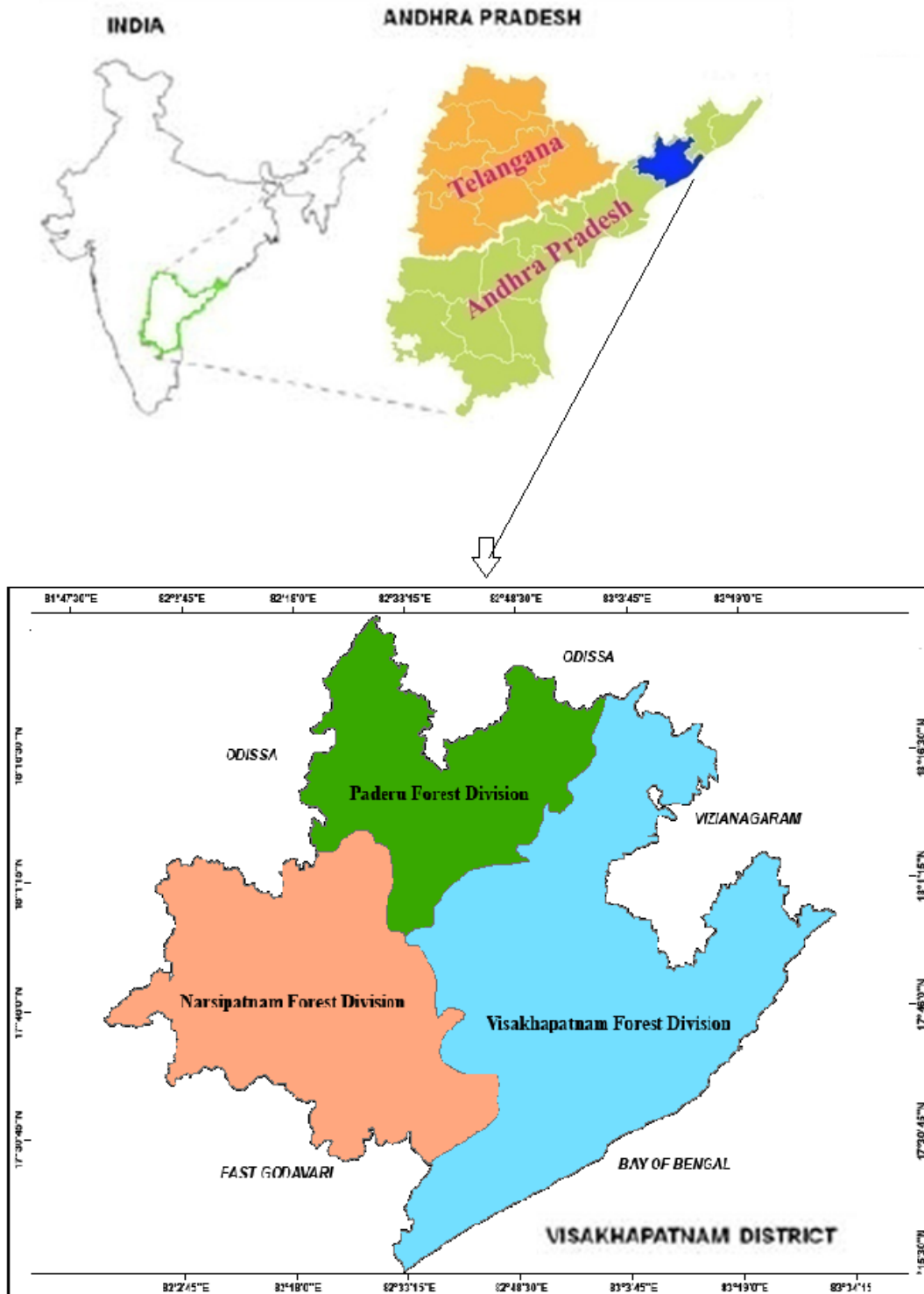


Fig :1 Location map of the study area.

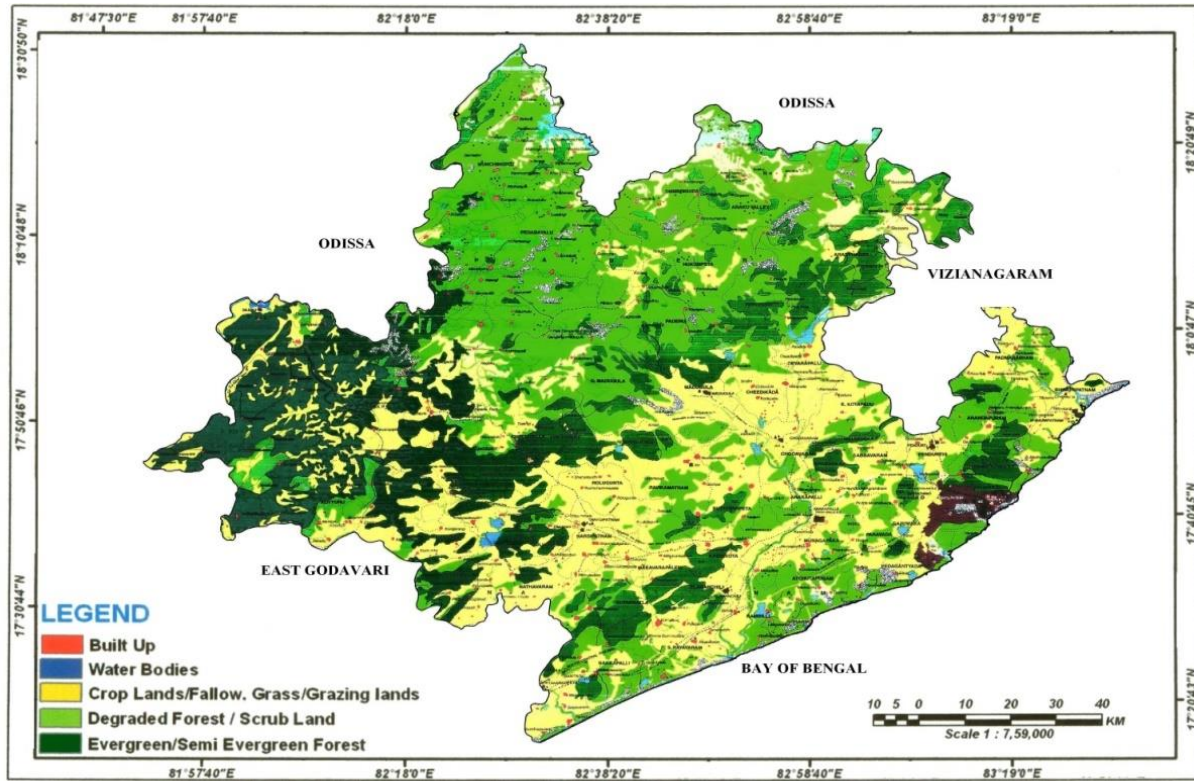


Fig- 2: Land-Use/ Cover of Visakhapatnam District

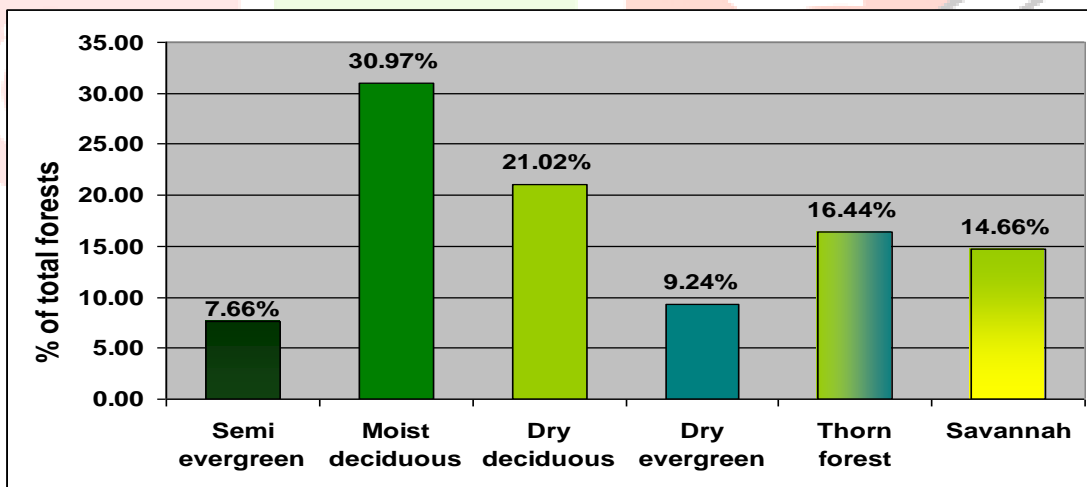
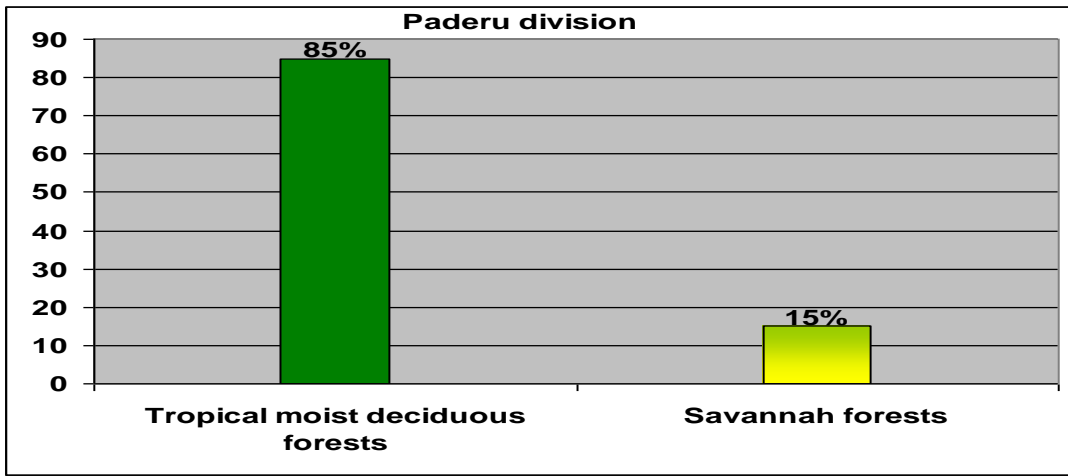
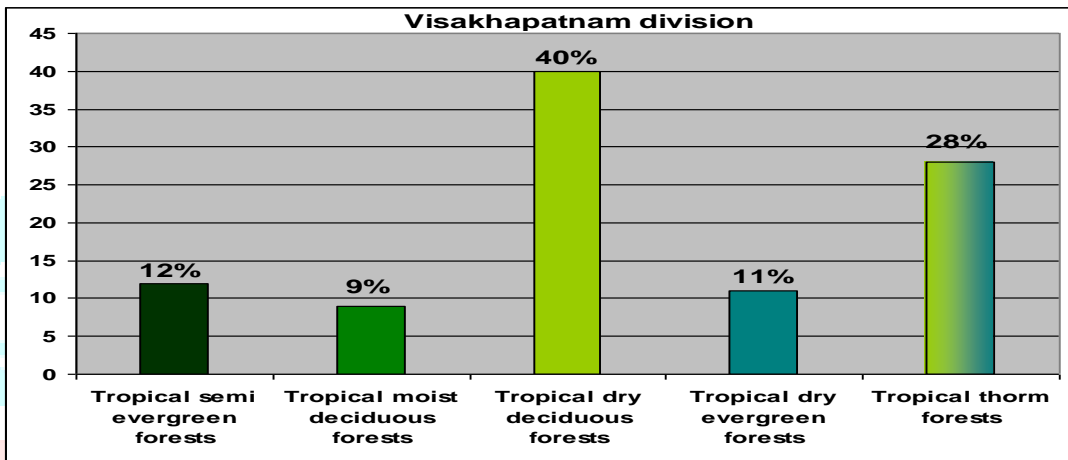


Fig:3 percentage of forests in the study area.

a



b



c

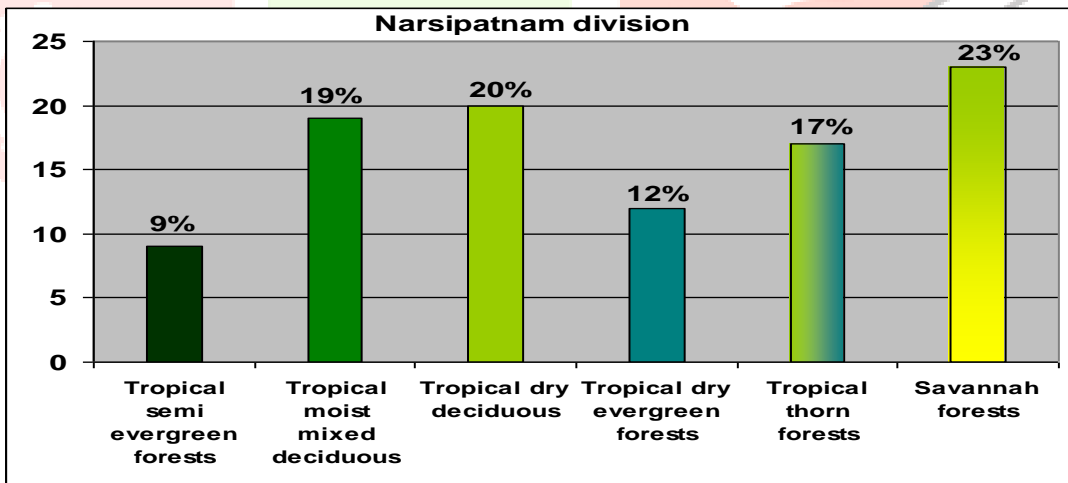


Fig-4 (a), (b), (c) division wise Forest types in the Visakhapatnam district.



Photo-1 Semi-evergreen forests



photo-2 Moist deciduous forests.



Photo-3 Deforestation in the study area



photo- 4 Degradation of forests in the study area.



photo-5 Shifting cultivation on the forest area.



Photo-6 Shifting cultivation on the hills



Photo-7 Degraded forests



photo-8 Degraded forests on the hills



Photo-9 Afforestation on the hilly areas.



Photo-10 Encroachments of tribals into forest area.



Photo-11 Afforestation in the study area (Teak plantation).



Photo-12 Afforestation (Coffee Plantation with pepper as inter cropping).