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Environmental Impact Assessment — A Case Study of Anantapur District

G. P. Obi Reddy and M. Sambasiva Rao

Department of Geography, S. K. University, Anantapur-515 001

ABSTRACT : Accurate and reliable information on the distribution of various earth resources, urbanization, industrialization, etc., form the backbone of Environmental Impact Assessment (EIA) study. The physical and natural resources of Anantapur district has been studied using Landsat Thematic Mapper (TM) band 5 and 7 and IRS-IA (LISS-I) FCC's data on scale 1:250,000. The EIA index of the district has been workedout with the help of natural and physical resource, urbanization and industrialization data. The EIA index values reveals that ill effects of over exploitation of natural resources and environmental degradation zones in the district. This study is highly helpful for further optimum utilization, conservation and management of natural and physical resources and environmental management of the district.

Introduction

Remote sensing technology is an important tool for mapping the physical and natural resources of a region using the Landsat Thematic Mapper (TM) and Indian Remote Sensing (IRS) satellite's data products. Due to the rapid increase in the population and industrialization, the forest, land, water and mineral resources are exploitated unabatedly. The over exploitaion of natural resources led to ecological imbalance in the natural ecosystems and generated more negative effects. The best way to avoid negative environmental impacts and reinforce positive impacts is to prepare Environmental Impact Assessment (EIA) Index maps at the lowest administrative unit like village or mandal and initiate necessary measures for proper planning, conservation and optimum utilization of natural resoruces. The studies of Environmental Impact Assessment and conservation of natural resources of the Vaigai, the Gundar and the Vaippar river basins of Tamilnadu has been workedout by Sambasiva Rao (1990). Similar studies have been carriedout in Cuddapah district of Andhra Pradesh using remote sensing data by Sambasiva Rao and Krishna Reddy (1992).

Study Area

The Anantapur district is a chronic drought prone area and is located in the southwestern part of Andhra Pradesh. It had a total population of 3,069,335 in 1991 and covers an area of about 19,130 sq km. It is located in between 13°41' to 15°15'N latitude and 76°50' to 78°30'E. longitude.

Materials and Methods

The physical and natural resources of the Anantapur district have been studied using remotely sensed data. The land systems, landforms, lithology, soils, hydrogeomorphology, wastelands and land capability of the district have been evaluated based on image charactersitics *viz.* texture, size, shape, pattern, drainage, structure, and tone using Landsat (TM) band 5 and 7, and IRS-IA (LISS-I) FCC's data on scale 1:250,000. Limited ground checks has been carriedout to identify various physical featrues. The soil erosion index and intensity of soil removal has been workedout using Flaxman (1971) method. The water balance book keeping procedure given by Thornthwaite and Mather (1955) has been applied to delineate the water surplus and water deficit zones in the district. Based on the deviation of Aridity Index from normal value, the drought intensity of the district for thirteen stations has been workedout. In the study area the Environmental Impact Assessemnt Index has been workedout at *mandal* level adopting Jenkin's (1992) Evaluation Matrix of Environmental Impact by using soil erosion index, forest degradation, land, water and mineral resources exploitation, saline and alkaline affected areas, drought intensity, urbanization and industrialization are taken as parameters. The final map of the study area has been prepared on 1:1,000,000 scale depicting the very high, high, moderate and low environmentally hazardous zones at mandal level (fig 1).

Physical Resources

Physiography

The physiography of the district has been divided into four major zones, namely granite gneiss landscape, schist landscape, sandstone landscape and limestone landscape. Within these broad zones, hill ranges and isolated hills, undulating and rolling hill slopes, undulating to gently sloping pediments and valleys are observed. The altitude in the district varies from 300 to 800 metres above mean sea level. The slope is less than 2^{o} in northern and northwestern parts of the district. In major parts of the district slope varies from 2^{0} to 5^{o} and it exceeds 20^{o} in a few pockets.

Lithology

Lithologically the Anantapur district consists of granites and gneisses, meta-sediments and meta-volcanics, basic dykes, basic instrusives and basic lave flows, quartzites and dolomites, Tadipatri shales, colluvium and alluvium. The major lithological units of the district are granites and gneisses. The quartzites, dolomites and shales are noticed in the northeastern part of the district. Colluvium is found along colluvial valleys and alluvium along the major river valleys of the Pennar, the Hagari and the Chitravathi.

Land system

The land systems of the Anantapur district are classified into hilly terrain, undulating terrain, rolling plains and fluvial plains. The hilly terrain is found in northeastern, eastern, central

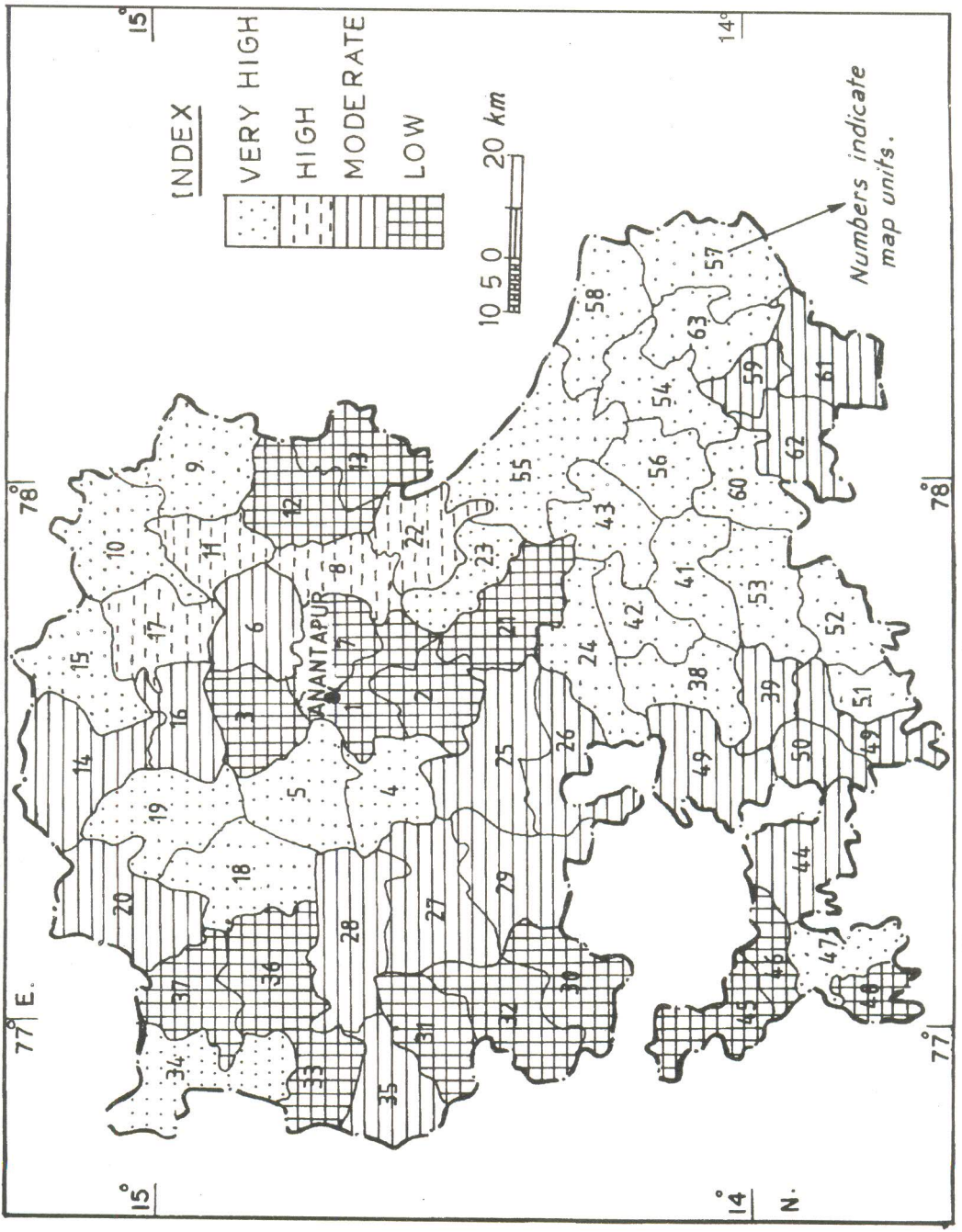

Fig. 1. Environmental Impact Assessment Index of the Anantapur District.

and southeastern parts of the district. The slope in this terrain is high and varies from 10° to 20°. In the central, western and southwastern parts of the district the undulating terrain is noticed. The rolling plains are found in black soil plains in northwestern and northeastern parts of the district. The fluvial plains are found along major river courses of the Pennar, the Hagari and the Chitravathi.

Landforms

The major landforms of the district are classified into denudational, fluvio-denudational and fluvial. The denudational landforms are hilly terrain with ridge and valley topography, residual hills, pediplains and dissected pediplains. The black soil plains are categorised into rolling plains which are derived from *in situ* rocks. The colluvial plains are formed in the undulating terrain of the district by the slow mass wasting processes and are deposited in the narrow valleys. The depth of sediments vary from 2 to 3 metres. The pediplains are formed by the coalescence of pediments and standout as prominent denudational level in the district. In a few pockets pediplains are subjected to severe gully erosion due to mismanagement of land resources. The fluvial landforms consist of old river courses, flood plains, river built plains, fluvial terraces and natural levees. They are located in the valleys of the Pennar, the Hagari and the Chitravathi rivers. The depth of sediment varies from 3 to 10 metres.

Soils

The major soil types of Anantapur district are red sandy soils, colluvial soils, black soils, lateritic soils, *in situ* soils and alluvial soils. The shallow red sandy soils are found on the pediplains and dissected pediplains of the district. The colluvial soils are located in the colluvial valley fills of the district. The black soils are located in the northwestern and northeastern parts of the districts. They are derived from *in situ* rocks. The lateritic soils are located in southern part of the district around Hindupur. The *in situ* soils are found in the hills located on the northeastern, eastern and southeastern parts of the district. The alluvial soils formed by the fluvial processes are found in the river valleys of the Pennar, the Hagari and the Chitravathi.

Hydro-Geomorphology

The hydro-geomorphological units of the district are evaluated based on tonal variations, alignment parallel to hilly terrain or river courses, texture, porosity, permeability, specific yield, ground water level variations and fluctuations, recharge and ground water potential in major land units of the district. The excellent water resources are found in fluvial plains of rivers the Pennar, the Hagari and the Chitravathi. The very good ground water potential zone is noticed in the fluvial terraces in southeastern parts of the district. The good ground water zone is found in colluvial plains of the district. The very fair zone is located in black soil plains. Fair zone is found in pediplains and poor zone is noticed in dissected pediplains of the district. The hilly terrain in the district act as run-off zone and potential wise they are unproductive.

Land Capability

The land capability classification of the district is based on physical aspects like relief, slope, lithology, land systems, landforms, soils and hydro-geomorphology. The land class units are *class I* (fluvial plains), *class II* (terraced plains), *class III* (land under tank, canal or well irrigation other than the fluvial plains), *class IV* (colluvial plains) *class V* (black soil plains), *class VI* (pediplains), *class VII* (dissected pediplains), *class VIII* (hilly terrain with slope less than 10°) and *class IX* (hilly terrain with slope more than 20°).

Natural Resources

The natural resources of the Anatapur district are land, water, forest and minerals. The land resources of the district has already been described. The mean annual rainfall of the district is 558.85 mm, which varies from a minimum of 488 mm in Yadiki station to a maximum of 614 mm in Bukkapatnam station. The total surface water resources of the district is about 10,686 million cubic m. The total ground water potential of the district is about 1054 million cubic m. About 10 per cent of the total surface water resources is stored in the ponds, tanks and reservoirs. Water lost in the form of evaporation and evapo-transpiration is estimated to be 6,962 million cubic m. In otherwords about 67 per cent of the total surface water resources is lost in the form of evaporation and evapo-transpiration, 10 per cent is recharged to ground water and 13 per cent is lost in the form of runoff.

The total geographical area under forest resources is abotu 196,880.97 hectares and covers 10.30 per cent. The forest concentration is high in the hilly terrain of northeastern, eastern and southeastern parts of the district. Under Drought Prone Area programme (DPAP) a sum of Rs. 10.70 million has been spent towards forest development in the district for planting Eucalyptus, Acacia, Dalbergia, Prosopis, Pungomia, Glyncedia and fruit bearing trees like tamarind. In Anantapur district there are about 1200 tanks, irrigating about 35,223 hectares of land. In most of the tanks about 1/3 of the area is left high due to siltation. The high lands are used for cultivation of dry Babul (*Acacia arabica*) plantation. They are also cultivated in the foreshores. The wood can give good timber for agricultural implements and fuel wood. About Rs. 56.48 million has been spent towards pasture development in the district from 1974-75 to 1990-91. *Cenchrus ciliaris* grass variety has been propogated to cultivate in the wastelands, pediplains and dissected pediplains of the district. The forests of the Anantapur district are categorised into class II forests reserved for production of timber and fuel (80,721.19 hectares, 41 per cent) and the rest of the forest land under class IV reserved for grazing and fuel production and class V reserved for grazing in the year 1865. But now we have about 7 per cent (13,781.66 hectares) land under class I and the rest under class IV and V. In otherwords there is a rapid degradation of forests from 1865 to 1991, leaving behind acute drought conditions in the district.

The major mineral resources of the district are gold in Ramagiri *mandal* in the cholites, schists and phyllites along the western part of the Dharwar schists and diamonds in Vajrakarur

pipe rocks. Asbestos, barytes, clay, high grade limestone, calcite, iron ore and steatite are the other minerals. They occur in different pockets of the district.

Ill Effects of Natural Resources' over Exploitation

The steep increase in population from 1,025,322 in 1901 to 3,069,335 in 1991 has increased the demand for food, shelter and energy in the district. The demand for food has paved way for development of major irrigation projects like the Thungabhadra High Level Canal Stage I and State II and medium irrigation projects like the Bhairavanithippa (B.P.) project, Upper Pennar project, Chennarayaswamy Gudi Project (C.G.P.) and minor irrigation projects under tank irrigation. The irrigated area is about 126,944 hectares of land. The land irrigated under well irrigation in black soil plains, and a few low lying lands under *ayacut* areas have been transformed into alkali affected lands. Similarly due to over exploitation of ground water resources in the district the ground water level has dwindled to more than 5 metres.

Due to illicit deforestation and reduction of class II forests in the hilly terrain on southeastern, central and northeastern parts of the district the intensity of soil removal has exceeded 50 cubic m/hectare/year on slope regions, 5 to 15 cubic m/hectare/year in the undulating terrain of the pediplains of the district and less than 5 cubic m/hectare/year in the colluvial valley fills of the district. The erosion index is high in the hilly terrain of northeastern, central and southeastern parts of the district, medium in undulating terrain and low in colluvial valley fills, black soil plains and fluvial plains. There is an increase in the barren land due to rapid deforestation in the hilly terrain of the district. The over exploitation of mineral resources on northeastern parts of the district like asbestos, limestone, barytes, *etc.*, without adopting scientific methods have also paved way for severe erosion and left excavated pits in the district. However in the Anantapur district the process of urbanization and industrialization is poor in view of severe drought conditions and lack of sufficient water resources. The drought intensity varies from 47 to 57 per cent. On the southwestern and northeastern parts of the district the drought intensity is high. It is low in central, southeastern and western parts of the district. The decadal analysis of droughts revealed that the drought intensity is increasing in Yadiki, Hindupur, Madakasira and Uravakonda stations.

Environmental Impact Assessment

The Environmental Impact Assessment evaluation matrix suggested by Jenkin's (1992) has been adopted to assess the impact due to soil erosion, forest degradation, land, water and mineral resources exploitation, salinity and alkalinity affected areas, drought intensity, urbanization and industrialization. Based on the evaluation matrix the EIA index has been worked out. It is found that in fifteen *mandals* the EIA index is very high (Fig.1, Table 1).

In Tadipatri, Yadiki, Gooty, Battalapalli, C. K. Palli, Penukonda, Puttaparthy, Kothacheruvu, Bukkapatnam, Kadiri, Mudigubba, Nallamada, N.P. Kunta, Talupula and Gandlapenta *mandals* the EIA index is very high. The EIA index is high in fourteen *mandals* of the district. They are

EIA Index table

Sl. No.	Map Units	*Mandals*	EIA Index
1	9, 10, 15, 23, 24, 38, 41, 42, 43, 54, 55, 56, 57, 58 and 63	Tadipatri, Yadiki, Gooty, Bathalapalli, C. K. Palli, Penukonda, Puttaparthy, Kothacheruvu, Bukkapatnam, Kadiri, Mudigubba, Nallamada, N. P. Kunta, Talupula and Gandlapenta	Very High
2	4, 5, 8, 11, 17, 18, 19, 22, 34, 47, 51, 52, 53 and 60	Atmakur, Kudair, Narpala, Peddapappur, Peddavadugur, Uravakonda, Vajrakarur, Tadimarri, D. Herehal, Rolla, Lepakshi, Chilamattur, Gorantla and O. D. Cheruvu	High
3	6, 14, 16, 20, 25, 26, 27, 28, 29, 35, 39, 40, 44, 59, 61 and 62	Singanamala, Guntakal, Pamidi, Vidapanakal, Kanaganapalli, Ramagiri, Kalyandurg, Belguppa Kambadur, Gummagutta, Somandepalli, Roddam, Madakasira, Nallacheruvu, Tanakal, and Amadagur	Moderate
4	1, 2, 3, 7, 12, 13, 21, 30, 31, 32, 33, 36, 37, 45, 46, 48, 49 and 50	Anantapur, Raptadu, Garladinne, B. K. Samudram, Putlur, Yellanur, Dharmavaram, Kundurphy, Bramhasamudram, Settur, Rayadurg, Kanekal, Bommanahal, Amarapuram, Gudibanda, Agali, Hindupur and Parigi	Low

Atmakur, Kudair, Narpala, Peddapappur, Peddavadugur, Uravakonda, Vajrakarur, Tadimarri, D. Herehal, Rolla, Lepakshi, Chilamattur, Gorantla and O.D. Cheruva. Moderate EIA index value is noticed in sixteen *mandals*. They are Singanamala, Guntakal, Pamidi, Vidapanakal, Kanaganapalli, Ramagiri, Kalyandurg, Belguppa, Kambadur, Gummagutta, Somandepalli, Roddam, Madakasira, Nallacheruvu, Tanakal and Amadagur. The EIA index value is low in eighteen *mandals* of the district. They are Anantapur, Raptadu, Garladinne, B. K. Samudram, Putlur, Yellanur, Dharmavaram, Kundurphy, Brahmasamudram, Settur, Rayadurg, Kanekal, Bommanahal, Amarapuram, Gudibanda, Agali, Hindupur and Parigi.

Conservation of Natural Resources and Eco-Restoration

The rapid exploitation of natural resources has brought serious implications of soil erosion, micro-climatic changes, increase in saline and alkali affected areas, siltation, deterioration in inorganic and organic matter in the soils, etc. To over come these problems proper conservation of natural resources and physical environment could be carriedout by adopting soil conservation practices, watershed management, control of illicit deforestation, afforestation of degraded forests, land development and management practices, water conservation and management practices, adoption of scientific methods of exploitation of mineral resources, drainingout excess water in saline and alkali affected areas, regular dredging of ponds, tanks and reservoirs, mulching, application of organic fertilizers, addition of required quantity of organic and inorganic fertilizers, pesticides, covering the barren slopes with pastures, construction of check dams and percolation

ponds. The above said practices have to be adopted in each village under the central and state government sponsored schemes for rural and agricultural development. Lastly awareness of the problems and prospects in conservation and optimum utilization of natural resoruces has to be brought among the rural people through media like all India Radio (AIR) and Doordarshan (Television). Non-Governmental Organisations (NGO's) also can bring awareness among rural people about conservation and optimum utilization of natural resources and environmental management in the district.

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References

Flaxman, E. M. (1971). *Soil conservation service,* Technical Service centre, Advising Eng.-op-1, Sediment Yield Predective Equation.

Jenkin, C. L. (1992). Environmental considerations in Tourism Development. *Indian Journal of Tourism and Management.* Vol. **1**, No. 2, pp. 143-163.

Sambasiva Rao, M. (1990). *Environmental Impact Assessment and Conservation of Natural Resources of Vaigai, Gundar and Vaippar river basins, Tamil nadu.* Nature Conservation India. Publication No. 3, pp. 25-34.

Sambasiva Rao, M. and Krishna Reddy P. R. (1992). Environmental Impact Assessment and Conservation of Natural Resources of Cuddapah district, using remote sensing data. *Proceed. National Symp. on the International Geosphere-Biosphere programme,* Anna University, Madras.

Thornthwaite, C. W. and Mather, J. R. (1955). The water balance, publication (in) *Climatology.* Vol, **8**, No. 1, pp. 104. Drexel Institute of Technology, Laboratory of Climatology, Centerton, (NJ).

Present Address of G. P. Obi Reddy, Scientist, GIS Section, National Bureau of Soil Survey and Land Use Planning, Nagpur-440 010.