Sustainble Urban Transport Planning Strategies for Land Use Pattern in Visakhapatnam City

Ganapati Naidu. P [1], Dr. K. Durga Rani [2]
[1] PhD scholar, Dept of Civil Engineering, Andhra University, Visakhapatnam. A.P, INDIA
[2] Professor, Dept of Civil Engineering, Andhra University, Visakhapatnam., A.P, INDIA

Abstract **- Urbanization, one of the important factors in the development of countries, creates some negative impacts on the cities. The rapid and haphazard growth of the major cities in India generates numerous problems in the country. The further growth incorporates the haphazardly developed areas into the city leading to the imbalanced land use pattern. The growth cities normally extend more to the fringe areas and it creates the unplanned development of the cities. The development of the cities in the concentric pattern or radial pattern had raised the challenges for the planning of the cities. Visakhapatnam, the cultural and education centre of Andhra Pradesh, is also facing the problems. In the same context, because of the imbalance land use pattern, Visakhapatnam city is facing problems of unequal distribution of physical and social infrastructure in the city. Urban expansion has brought serious losses of agriculture land, vacant land and water bodies. Urban sprawl is responsible for a variety of urban environmental issues like decreased air quality, increased runoff and subsequent flooding, increased local temperature, deterioration of water quality, etc. Visakhapatnam city exhibits steep decline from 78.97% decadal growth rate in 1991-2001 to 55.42% decadal growth rate in 2001-11. The average decadal growth rate from 1951 to 2011 is 63.78%. Rapid growth of the city is mainly attributed to industrialization of after 1970 and expansion of information technology (IT) sector and educational development in the last decade. Eight land use classes have been identified as Urban (Built-up), Residential, Industrial, Roads and Railways, Agricultural land, Hills & Forests, water bodies, ports and vacant land. Classification accuracy is also estimated using the field knowledge obtained from field surveys. The obtained accuracy is between 80 to87 percent for all the classes. Change detection analysis shows that Residential area has been increased by 6.10%, agricultural area has been reduced by 5.78% and barren area reduced by 2% similarly change detection for remaining areas has been done. The increased urbanization may have several impacts on infrastructure, energy use and economy of the country.**

Key Words **- Urbanization, land use pattern, sustainable development, metropolitan cities, population growth.**

I. INTRODUCTION

Global concerns about climate change, energy use, land use, environmental impacts, and limits to financial resources for transportation infrastructure require new and different approaches to Planning, designing, constructing, operating, and maintaining transportation solutions and systems

Land use characteristics and transportation are mutually interrelated. The use of the term land use is based on the fact that through development, urban space put up a variety of human activities. Land is a convenient measure of space and land use provides a spatial framework for urban development and activities. The location of activities and their need for interaction creates the demand for transportation, while the provision of transport facilities influences the location itself. Land uses, by virtue of their occupancy, are supposed to generate interaction needs and these needs are directed to specific targets by specific transportation facilities.

Land use means spatial distribution or geographical pattern of the city, residential area, industry, commercial areas and the space set for governmental, institution or recreational purposes. Most human activities, economic, social or cultural involve a multitude of functions, such as production, consumption and distribution. These functions are occurring within an activity system where their locations and spatial accumulation form the land uses. So, the behavioral patterns of individuals, institutions and firms will have an impression on the land use.

This paper concentrates on one of such issues of land use. In continuation for the same, one of the fast developing cities, Visakhapatnam has been taken for case study. The future growth of any city normally extends towards fringe areas and it incorporates haphazardly developed areas into the city area. Also, the radial growing pattern of land use of the city and the supporting transport systems raises the problem of the "Ineffective Land Use Pattern" for the sustainable development of the city

II. SUSTAINABILITY

One oft-quoted definition states that sustainable development "meets the needs of the present without compromising the ability of future generations to meet their own needs." (United Nations World Commission on Environment and Development (Brundtland Commission) Report –Our Common Future, 1987). Triple Bottom Line of Sustainability

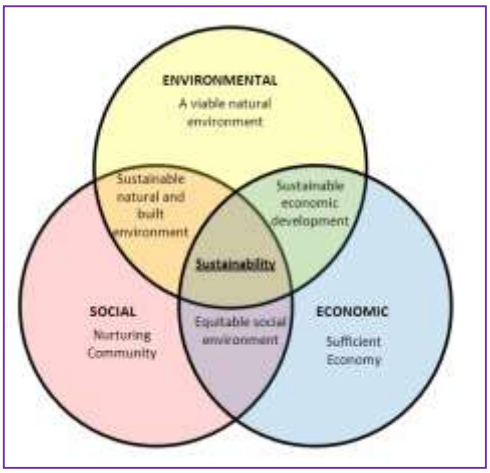


Figure -1 -Triple Bottom Line Approach (source data from CIRIA, 2008)

From the above figure clear that it is generally accepted that sustainable development considers three dimensions that are closely inter-linked and between which trade-offs are inevitable: environmental, economic and social.

Environment — Create solutions that are compatible with - and that can be an enhancement to - the natural environment, reduce emissions and pollution from the transportation system, and reduce the material resources required to support transportation.

Economy - Support economic vitality while developing infrastructure in a cost-efficient manner. Costs of infrastructure must be within a society's ability and willingness to pay. User costs, including private costs, need to be within the ability of people and households to pay for success.

Social - Meet social needs by making transportation accessible, safe, and secure; include provision of mobility choices for all people (including people with economic disadvantages); and develop infrastructure that is an asset to communities.

III. SUSTAINABLE TRANSPORTATION SYSTEM

- Allows the basic access needs of individuals and societies to be met safely and in a manner consistent with human and ecosystem health, and with equity within and between generations;
- is affordable, operates efficiently, offers choice of transport mode, and supports a vibrant economy;
- Limits emissions and waste within the planet's ability to absorb them, minimizes consumption of non-renewable resources to the sustainable yield level, reuses and recycles its components, and minimizes the use of land and the production of noise.

IV. AREA OF STUDY: VISAKHAPATNAM CITY

Visakhapatnam is the largest city in the state of Andhra Pradesh and the third largest city on the east coast of India (after Chennai and Kolkata). It is a port city on the southeast coast of India in the state of Andhra Pradesh and often called "The Jewel of the East Coast" and the "City of Destiny".[With a population of 2,091,811 and occupying 681.96 square kilometres (263.31 sq mi) it is the administrative headquarters of Visakhapatnam district, Visakhapatnam has been recognised as a Global City of the Future by McKinsey Quarterly. Visakhapatnam is ranked 122 in the list of fastest-growing cities in the world.

Visakhapatnam is east of the erstwhile combined state capital, Hyderabad and 781 kilometres (485 mi) north east of Chennai. It is situated in the middle of Chennai-Kolkata Coromandal Coast . The city is home to several state-owned heavy industries and a steel plant, one of India's largest seaports and has the country's oldest shipyard. Visakhapatnam has the only natural harbour on the east coast of India. It is nestled among the hills of the Eastern Ghats and faces the Bay of Bengal on the east. Visakhapatnam is the administrative headquarters of Visakhapatnam district and headquarters of the Eastern Naval Command of the Indian Navy.

Figure -2, Visakhapatnam city Map

Visakhapatnam is a cosmopolitan mix of people from various parts of India. From a population of a few thousand during the 18th and early 19th centuries, the population grew steadily. The city doubled its population from 1990–2000, due to a large migrant population from surrounding areas and other parts of the country coming to work in its factories.

V. LANDUSE WITH GROWING POPULATION

Population Growth Trend and Spatial Distribution: The population of Visakhapatnam city as per provisional figures of Census India, 2011 is more than 2 million. There is a growth of 2 times in the city's population in the last 60 years, from 0.11 million in 1951 to 2.11 million in 2011; the decadal population and growth rate are given in the following table.

Table I: Demographic projections of the Visakhapatnam city.

Year	Total population	Decadal change	Decadal growth rate
1901	40892		
1911	43413	2521	6.17%
1921	44711	12981	2.99%
1931	57303	12592	28.16%
1941	70243	12940	22.58%
1951	108042	37799	53.81%
1961	211190	103148	95.47%
1971	363467	152277	72.10%
1981	603630	240163	66.08%
1991	752037	148407	24.59%
2001	1345938	593901	78.97%
2011	2091811	745873	55.42%

Source: Census of India & Provisional figures of Census India, 2011

The graph of demographic growth trend of Visakhapatnam city is showing steep decline from 78.97% decadal growth rate in 1991-2001 to 55.42% decadal growth rate in 2001-11. The average decadal growth rate from 1951 to 2011 is 63.78%. Rapid growth of the city is mainly attributed to industrialization of after 1960 and expansion of information technology (IT) sector and educational devlopment in the last decade.

VI. SPATIAL GROWTH PATTERN OF THE CITY

Visakhapatnam, prior to its constitution as Greater Visakhapatnam Municipal Corporation in 2005 has a jurisdiction of 111 square kilometers with a population of 9.69 lakhs as per the 2001 census while the Visakhapatnam Urban Agglomeration covered approximately 5.3 square kilometers with a population of 13.62 lakhs. The government of Andhra Pradesh has reconstituted the Municipal Corporation of Visakhapatnam in the year 2005 by extending the jurisdiction and by merging the adjoining municipality and panchayats. The reconstituted Greater Visakhapatnam Municipal Corporation has an area of 515 square kilometers with a population of 14.5 million. Thus the GVMC is representative of the urban agglomeration in terms of area as well as population. The Visakhapatnam Urban Development Authority has a jurisdiction of 1701 square kilometers and covers a population of 22.02 lakhs. Table 2 gives the details.

Table 2: Population by Major Geographical Units

S.No	Geographical unit	Area(Sq.kms)	Population(in Lakhs)	components
1	Municipal Corporation Vizag (MCV) – Prior to 2005	111	9.69	M.corp
2	Visakhapatnam Urban Agglomeration (VUA)	503	13.62	MCV, Gajuwaka + 6 outgrowths
3	Greater Visakha Municipal Corporation (GVMC) – After 2005	530	14.5	MCV+ gajuwaka + 32 villages
4	Visakhapatnam Urban Development Authority (VUDA)	1701	22.02	Visakhapatnam dist + part of Vizianagaram district

Source: census 2001

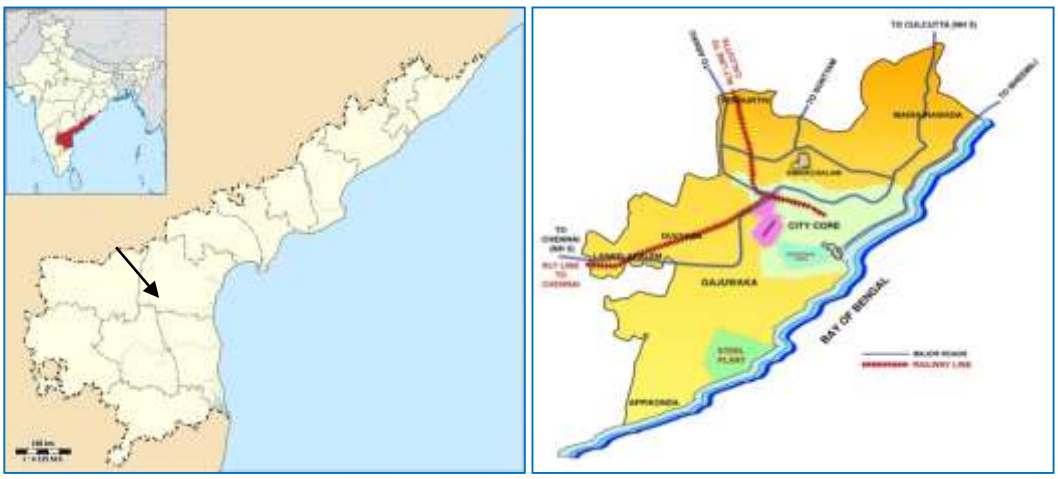


Figure -3, Andhra Pradesh Map

Figure -3, Visakhapatnam city Map

Land-use Maps of Visakhapatnam City

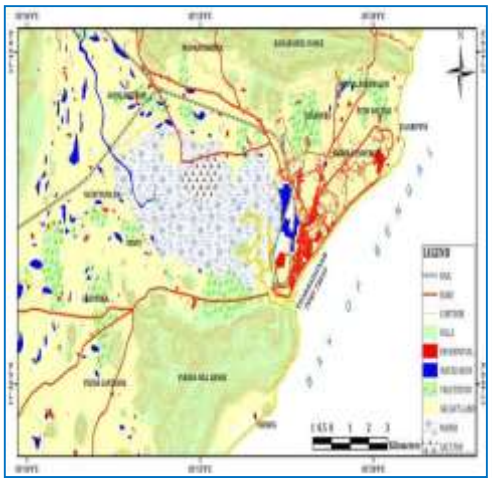
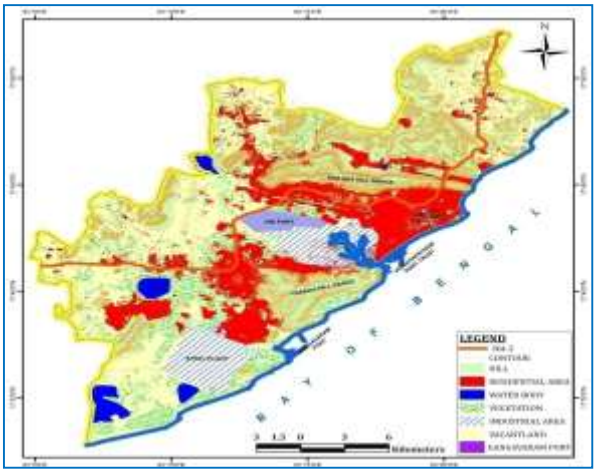
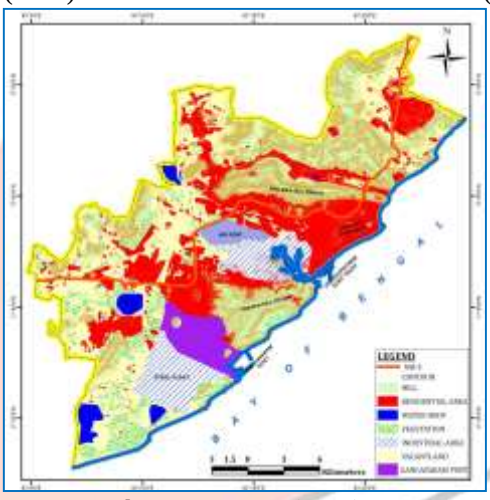


Figure -4, Land use (1941)



Land Use Structure (2003)



Land Use Structure (2009)

All the above satellite images show the increased built up area of the city in the red colour. The development of the built up area as per the satellite image of 2009 reveals increase in built up area and decrease in the agricultural area. Most of the agricultural area at the outer periphery of the city has been converted into the non agricultural area by the real estate developers.

VII. LAND UTILIZATION AND LAND USE OF THE CITY AS PER PLANNING POLICIES

The land use and land cover of Visakhapatnam city during 1941 is shown in Fig-4. The city is bounded by hill ranges on the north as well as on the south and on the west there was vast area of tidal swamp. Until 1940, the general growth of the town was very slow. The total population of the town in 1941 was 70,243 within the municipal area of 15.62 sq.km. There was not much development identified in the town in all land use categories. Residential colonies were confined to southern part of the town and a few colonies extended towards Waltair uplands in the northeast. There were a number of hamlets/villages scattered in and around the town area especially along with the foot hill zones in the north and peripheral zones in the west (Fig-4).

The opening of the harbor in 1933 brought a distinctive change in the cultural landscape of the town. The establishment of Shipbuilding Industry in 1941 and a Naval Base in 1942 added to the growth of the town in the subsequent years. The city has gained real importance from 1970 onwards due to location of many industries which had resulted in considerable spread with the establishment of new colonies in the north, south and southwestern part of the town. Since the growth of the city has been rapid from 1970 onwards, 1970 development in Visakhapatnam was confined to the Port area, getting as a focal point in the growth of the city mainly in terms of industrial development and as a shipyard. Today, the port has emerged as one of the largest in India export mainly consisting of iron-ore, and imports mainly consisting of petroleum products. In the last decade development of residential strip along the coastal stretch is witnessed.

At present, Visakhapatnam is the First largest city in Andhra Pradesh, a sprawling industrial city and one of the emerging metropolises. The spatial growth of the city has been restricted in the North, Yerada hill range on the south, extensive Bay of Bengal occupying the East, Port Swamp area covering 3000 hectares within the city and also defence areas, airport and hills.

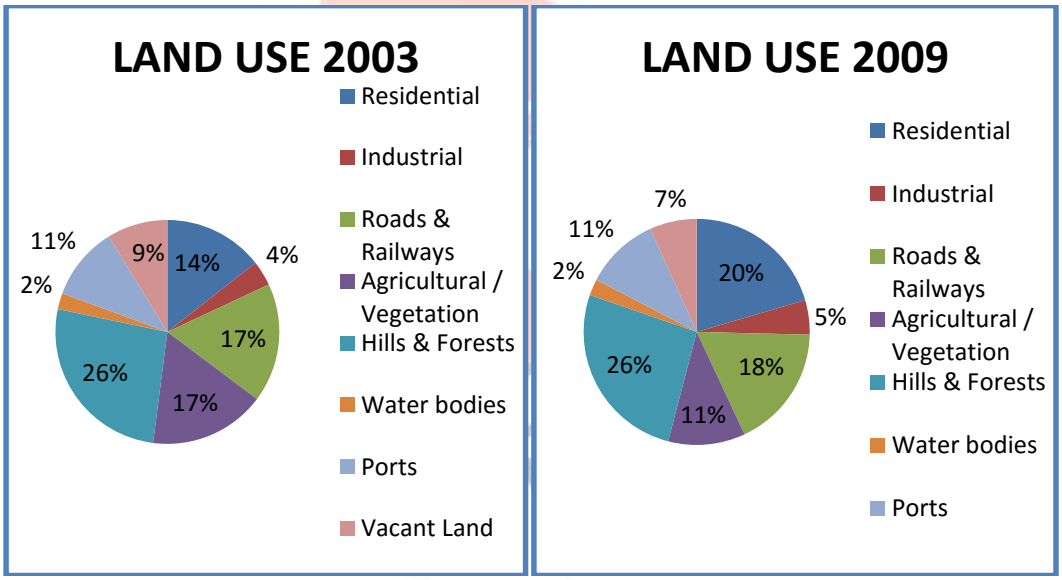
The initial Plan was approved by the Govt of AP to the Visakhapatnam city in the name of General Town Planning Scheme in the year 1970 vide GO.Ms.No: 703 HH and MA Dt: 29.08.70 and the important feature of the plan was to provide a framework for balance growth and development. The plan was devoted not only for physical aspects but also on the social infrastructure including development of good road network

After setting up Visakhapatnam Steel Plant, the city of Vizag experienced spurt in its growth and several ancillary units also have come up in the vicinity of Visakhapatnam Steel Plant. Accordingly the APIIC took initiative in acquiring large chunks of land in the vicinity of Stall Plant to facilitate planned growth in industrial front. The Visakhapatnam Urban Development Authority (VUDA) constituted under in AP Urban Areas (Development) Act 1975 took initiative and prepared Zonal Development Plans for Visakhapatnam city and Master Plan for the entire VMR region which was sanctioned by the Govt of AP in GO.Ms.No: 274 MA, Dt: 23.05.89.

The Visakhapatnam Urban Development Authority revised its Master Plan in 2004 for the target year 2021 with a view to make Visakhapatnam a planned city with sound and equitable planning. Considering the growth pattern the Master Plan, this was prepared for VMR, proposed town ship developments in potential areas.

Table 3: Urban Land use statistics of Greater Visakhapatnam

S. No.	Category	2003		2009		Change in Area 2003-2009	
		area in sq.km	% to total area	area in sq.km	% to total area	area in sq.km	% to total area
1	Residential	76.41	14.42	108.47	20.47	-32.06	-6.05
2	Industrial	19.19	3.62	26.09	4.92	-6.90	-1.30
3	Roads & Railways	91.2	17.21	93.6	17.66	-2.40	-.045
4	Agricultural / Vegetation	89.02	16.8	58.42	11.02	30.60	5.78
5	Hills & Forests	139.03	26.23	138.94	26.23	0.09	0.00
6	Water bodies	12.3	2.32	12.3	2.32	0.00	0.00
7	Ports	56.44	10.65	56.44	10.65	0.00	0.00
8	Vacant Land	46.41	8.76	35.74	6.74	10.67	2.02



With this increased pressure on the land use characteristic of the city, the city is facing different types of threats for the future development.

VIII. CONCLUSION

For the survival of Visakhapatnam city, the sustainable development of the city through the effective land use pattern is really a challenge in front of the governing and implementation systems. The complete balanced development in the physical and social infrastructure of the city will be further a great help for increasing the economic base of the city. Also, provision of potable water supply, solid waste management, sanitation, mass transportation system should be the priorities for the planning agencies.

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