

# Sustainability Indicators: A Case of Surat City

<sup>1</sup>Prof. Pastagia Digant A. <sup>2</sup>Dr. Patel Chetan R.

<sup>1,2</sup>Assistance Professor

<sup>1,2</sup>Department of Civil Engineering

<sup>1,2</sup>SVNIT, Surat, Gujarat, India

## Abstract

India is the second largest urban system in the world that shows the process of evolution, “Urbanizations”. One of the reasons for urbanization is transform of rural area in to urban area. This rapid urbanization leads to unplanned, uncontrolled development in urban area which demands more planning effort to satisfy the requirement of the people. But the urbanization level of developed country is almost stabilised and that with the improved infrastructure and high standard of living. The developing countries are also making same pace and direction as developed countries. But they could not able to make pace in tem of life style and infrastructure provision and that will creating the problems in the urban area in term of pollution, traffic congestion, substandard housing, degraded quality of life, congested residential areas etc. These all addressing the issues of sustainability. To resolve all these issues sustainable development is required. Sustainability indicators are one of the effective tools to measure the sustainability. For the study 101 census wards of Surat city is selected to evaluate the sustainability of Surat city. The sustainability indicator is divided in 3 tier system i.e. social, environment and economic. Based on the composite sustainability index the ward sand all zones of surat city is given sustainable ranking. Sustainability indicators are useful for the decision making and a powerful tool for the planners to plan the future requirements.

**Keyword- Urbanization, Social sustainability Index, Environmental Sustainability Index, Economical Sustainability Index, Composite Sustainability Index**

## I. INTRODUCTION

Urbanization plays vital role in the degradation of any city. Main reason of urbanization is the rapid growth of industries. The developing countries are also making same pace and direction as developed countries. But they could not able to make pace in tem of life style and infrastructure provision and that will creating the problems in the urban area in term of pollution, traffic congestion, substandard housing, degraded quality of life, congested residential areas etc. Population density in urban areas rises day by day but it gives very crucial impact on all the factors like social, environmental and economic factors. These all are the issues of the sustainability. To solve these all issues the sustainable planning is required. Sustainability indicators are the one of the effective tool to measure the sustainability. Here in this study the sustainability indicators are identified base on literature study. The data collection is done based on the variables selected for the indicators. 101 Census wards of surat city is selected as a study area to find out Composite sustainability index. The sustainability ranking is given on the basis of Composite Sustainability Index to the 101 census wards.

## II. SUSTAINABILITY INDICATORS

A broad variety of indicators and indicator sets exist, including those in the field of (sustainable) urban development, but to date no methodical standard has been derived on how to develop indicators. Commonly, indicators are parameters that describe situations or circumstances not directly able to be ascertained. An indicator also can be characterized as “a summary and synthesized measure that indicates how well a system might be performing.” They can measure quantitative or estimate qualitative data, answer different purposes, and be used in different contexts; hence, various indicator types can be differentiated. Since 1992, many sustainability indicator approaches have been developed on international, national, regional, and local levels, both in industrialized and in developing countries. Highly aggregated indices exist beside indicator sets with many single indicators; partly, a few complex key indicators are combined with a large number of simple indicators. The indicator sets of the World Bank and the United Nations aim at a comprehensive, integrative implementation of Agenda. The Urban Indicators Programme (UIP) of the UNCHS (United Nations Centre for Human Settlements) shall support both the implementation of Agenda and Habitat-Agenda. The UN-indicator set and methodological descriptions are expected to be released in 2006. Most of these indicator sets also comprise human health indicators.

The present study is carried out to find composite sustainability indicator for 101 census wards of surat city. The data of each variable is collected by the appropriate source as shown in table no 1.0.

	SUB - THEME	INDICATORS	VARIABLES
SOCIAL	Education	Literacy	Literacy rate
	Equity	Poverty	Percentage of population below poverty line
	Population	Population Change	Population Growth rate
			Sex ratio
	Health	Sanitation	Percent of Population with Adequate Sewage Disposal Facilities
Water		Population with Access to Safe Drinking Water	
ENVIRONMENT	Atmosphere	Air quality	Ambient Concentration of Air Pollutants in Urban Areas
	Waste	Generation and Management	Generation of solid waste and percentage recycling
	Land	Green cover	Percentage of Green space
ECONOMICAL	Economic structure	Economic performance	Average income per capita
		Unemployment	Average unemployment rate
	Consumption and Production Patterns	Energy Use	Annual Energy Consumption per Capita
		Transportation	Distance Traveled per Capita by Mode of Transport

Table 1.0: Indicators Selected for Study

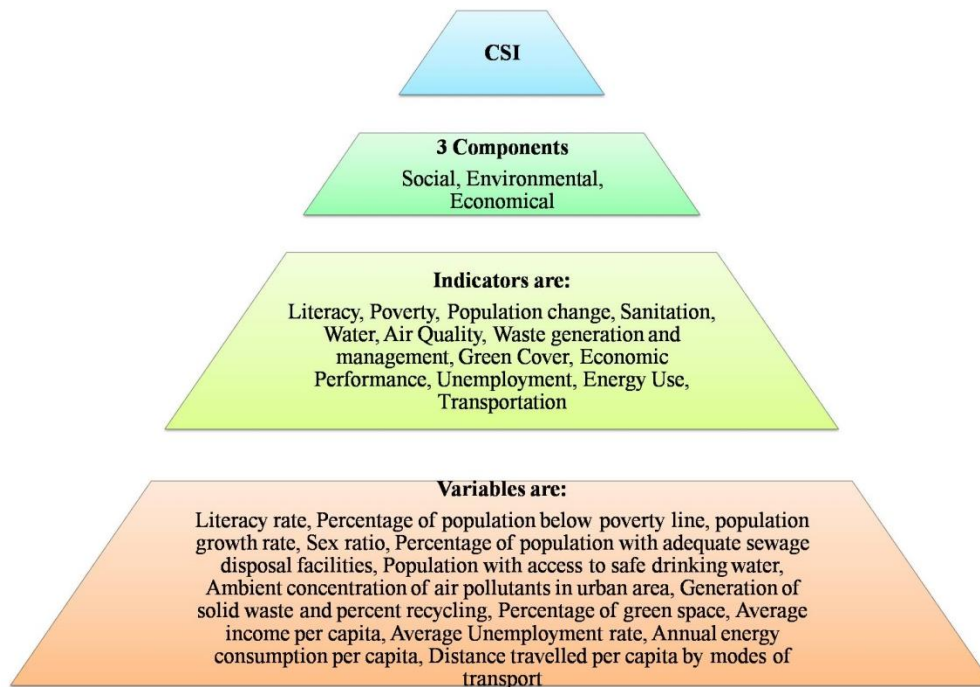


Fig. 1: Hierarchical Network of Variables

The data for all variables are required to collect. The hierarchical network of all variables and indicators are presented in fig. 1.0.

### III. METHODOLOGY TO DEVELOP SUSTAINABILITY INDICATORS

The Index is prepared in three steps:

- 1) Selecting the indicators based on SEE (Social, Environmental, and Economical) framework and collecting data on each indicator,
- 2) Grouping of indicators into nine policy areas/sub-indices,

3) Adding the equally weighted nine sub-indices to form a composite index.

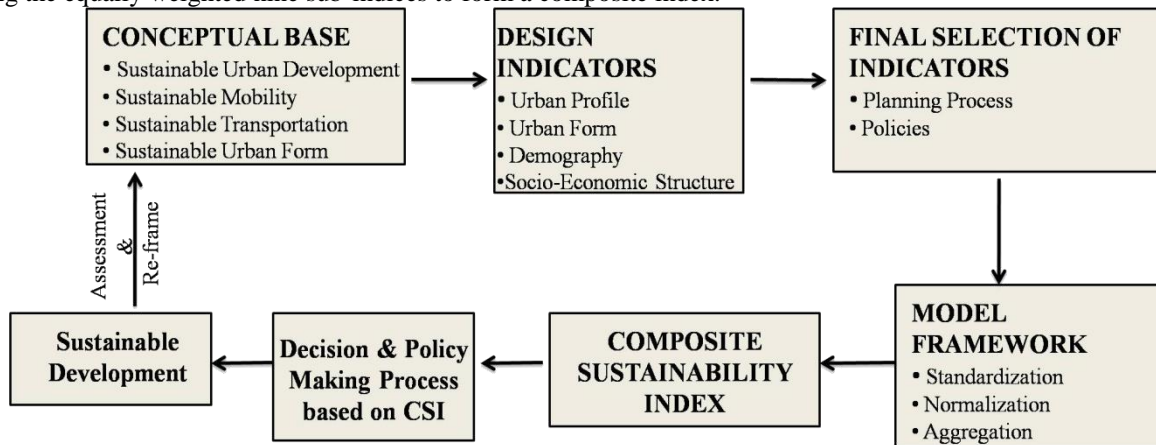


Fig. 2: Frame work methodology

Data were collected from published government sources such as databases of census of India, government surveys (including the Forest Survey of India, National Family Health Survey, Economic Survey), state departmental websites (e.g. transport department, energy department, water resources department), central and state planning and budget documents, State of the Environment (SoE) reports, Central Pollution Control Board publications (National Ambient Air Quality Monitoring, Water Quality Monitoring, Waste Generation), and responses to parliamentary questions.

CSI is the equally-weighted average of 12 indicators. Each of these 12 indicators is in turn the equal weighted average of between one or two underlying variables. Data was collected for each of the 13 variables across the 101 census wards of surat city. The most useful elucidation comes from the 12 indicators since these CSI relatively independent yet vital areas at the policy and action level. The indicators are building blocks of CSI, and they indicate for which factors a ward's score is high or low. The ward's performance in many other indicators such as natural resource depletion, waste generation, energy management and government's initiative has been modest. Since natural resource endowment is difficult to alter in a positive direction, the ward can improve its sustainability index by focusing on two immediate challenges: high water pollution and high population pressure. The five broad policy components in CSI are population pressure, environment stress, environment systems, and environment impact and environment governance. Though not used in calculating the CSI score, they simplify the multidimensional concept of Environmental Sustainability.

#### IV. DATA ANALYSIS

In this section, detailed CSI profile of each ward is presented in alphabetical order. A wards's CSI disaggregated into the relative performance across nine policy sub-indices helps prioritize policy attention by identifying the factors that contribute to the ward's overall sustainability. The nine sub-indices are shown in the column chart in terms of standardized scores on a scale of -3 (least) to +3 (most); 0 means average. Most wards' scores are in the range of -2 to +2. For any given sub-index, the upward going bar is a sign of better than average (of all 101 wards) performance and the bars going downwards show less than the average performance(of all 101 wards). The height of the upward going bar indicates how well a ward has performed compared to others in that particular sub-index. Thus more the number of longer upward bars, better the ward's sustainability in different aspects of environment. Theoretically, it is possible for a ward to have all positive or all negative sub-indices. However the CSI results reveal that each ward has both positive and negative scores, which signify that even wards with overall less CSI have outperformed the higher CSI in certain areas and each ward has something to learn from other wards. The graph with nine sub-indices also illustrates which area needs more urgent policy attention. The sub-indices with negative values are the ones that need urgent policy attention for any ward. In case of wards with most of the sub-indices having negative scores, the ones with higher negative scores are the ones that need more attention. Wards with most sub-indices as positive upward bars, the ones with smaller positive values as well as the negative ones, if any, need prioritization over others.

Surat city is one of the fastest growing city of Gujarat. It is an industrial hub of Gujarat state. Urbanization rate of Surat city is very high. Here in these study 101 Census wards of Surat city is selected for study area. For the census wards data is collected for the base year 2011 related to social, environmental and Economical parameters. Then from the data base the Composite sustainability indicators was found out for the 101 census wards as well as for the 7 zones of Surat city. Following tables show the results of sustainability ranking of 7 zones.

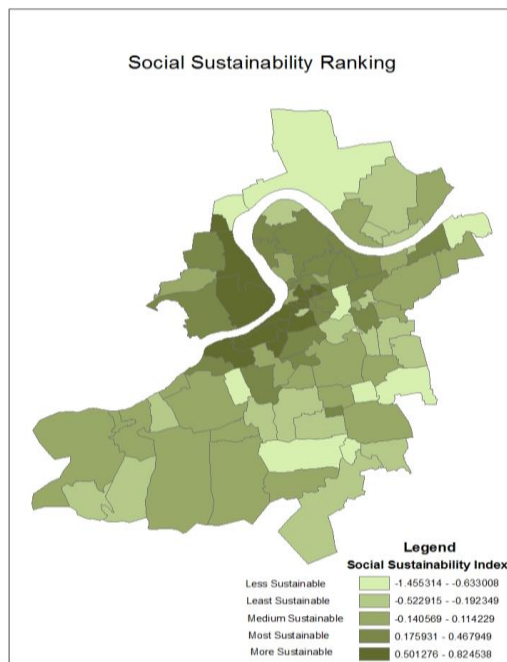


Fig. 3: Map of Social Sustainability Ranking

Zone No.	Zone	Social Sustainability Index	Ranking
1	Central	1.020573374	100
2	South	0.22636961	83
3	South-West	0.03099201	66
4	South-East	-0.004516581	50
5	North	-0.035782837	33
6	West	-0.40259279	16
7	East	-0.835042786	0

Table 2: Social Sustainability Ranking of Zones

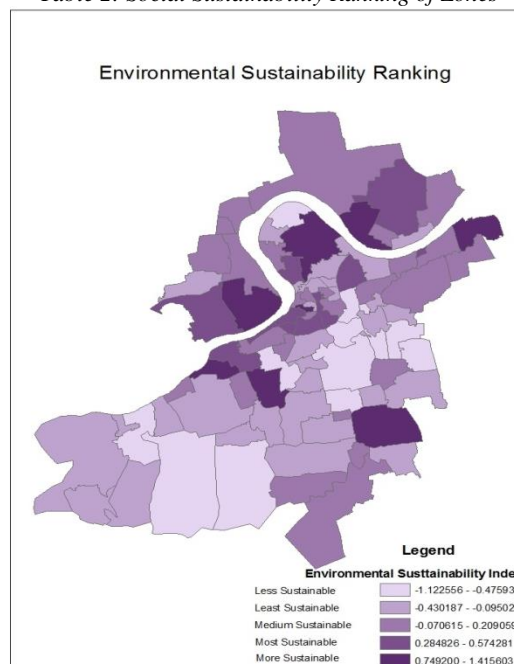


Fig. 4: Map of Environmental Sustainability Ranking

Zone No.	Zone	Environmental Sustainability Index	Ranking
1	West	0.631423592	100
2	Central	0.388412415	83
3	North	0.210773714	66
4	East	0.198437595	50
5	South-West	-0.009617837	33
6	South	-0.33552407	16
7	South-East	-1.08390541	0

Table 3: Environmental Sustainability Ranking of Zones

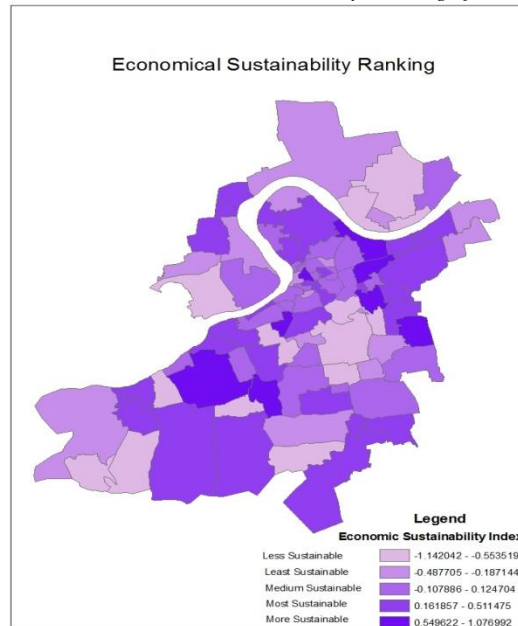


Fig. 5: Map of Economical Sustainability Ranking

Zone No.	Zone	Economic Sustainability Index	Ranking
1	East	0.507063414	100
2	South-West	0.236884523	83
3	Central	0.199221924	66
4	South	-0.054687226	50
5	West	-0.155655726	33
6	South-East	-0.192145727	16
7	North	-0.540681182	0

Table 4: Economical Sustainability Ranking of Zones

Zone No.	Zone	Composite Sustainability Index	Ranking
1	Central	0.536015631	100
2	East	0.223217067	83.3
3	West	0.157068053	66.6
4	South-West	0.151196978	50
5	North	-0.099628522	33.3
6	South	-0.264241602	16.6
7	South-East	-0.703627604	0

Table 5: Composite Sustainability Index Ranking of Zones

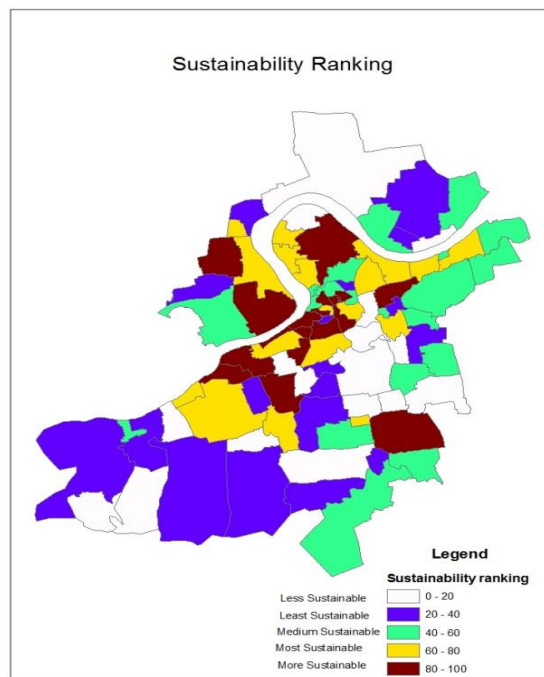


Fig. 6: Sustainability Ranking Of Wards

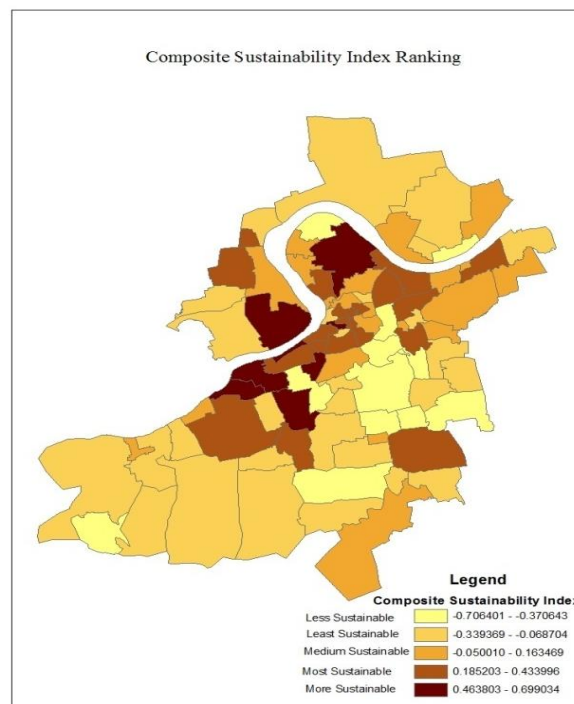


Fig. 7: Map of Composite Sustainability Ranking

## V. CONCLUSION AND PLANNING APPLICATIONS

### A. Planning Applications

Sustainability indicators is the tool by which planner has idea about sustainable development. The composite sustainability index show how better way the available resources are utilized and policy implementation is how effective. These composite sustainability indicators will help urban planner and decision makers to frame policy.

The type of indicator is largely affect the composite sustainability indicators and also the types of development. The present indicators list will be decided based on the critical literature study and policy reports are in developing countries.

1) *Higher CSI means.....*

- Higher initial endowments and/or less pollution and/or slower rate of extension and/or more responsive society or policy.
- Contributing to better potential to maintain its environment in the future while growing.

2) *Lower CSI means.....*

- Less initial endowments and/or more pollution and/or faster rate of extension and/or less responsive society and policy.
- Contributing to greater challenges for balancing growth and sustain its environment.

The following is the flow by which the planner and decision maker can have idea of sustainable development.

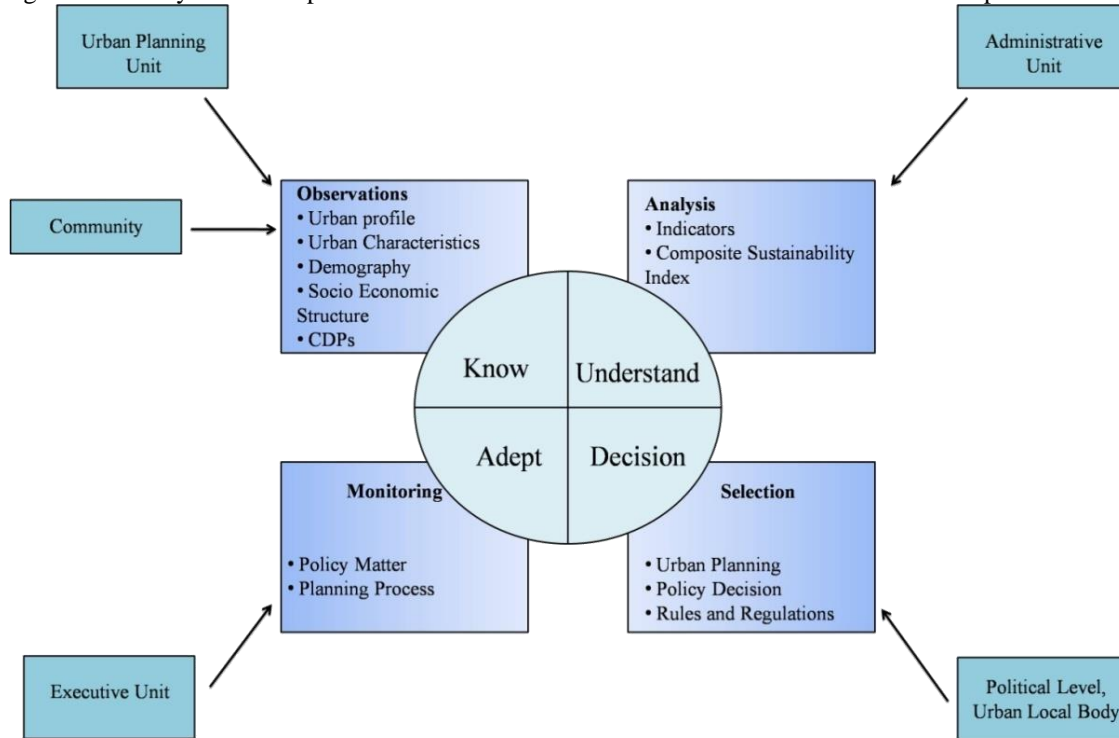


Fig. 8: Flow chart on the process of sustainable cities

The planning process is having known, understand, adept and decision base. The know is the part of the observation from urban areas, analysis is based on the observation which is primary defined as understand. From the analysis the adaption by process of monitoring is carried out and finally the decision based on the monitoring values is considered. In this entire process the urban planning unit and community will play the role in the framework of the observation, the administrative unit and executive unit department will play a role in analysis and monitoring process, and selection of policy matter will be finalized by political level of urban body. This cycle goon changing as the planning will take place and sustainability is checked.

## VI. CONCLUSION

Following conclusions are drawn from the study.

- Central zone stands first in the social sustainability index it shoes that all the social factors like population density, literacy rate are very strong.
- The results shows that west zone stands first in environmental sustainability ranking it shows its pollution free environment, good facilities for waste collection and recycling and larger green space area.
- The results highlight that East zone stands first in economic sustainability ranking because of the higher industrial development.
- From data analysis and study conclusion is made that overall performance wise central zone of surat city is most sustainable zone.
- With respect to surat city the outskirts are like Dumas, bhimpore, gaviar, khajod, etc. Which are less sustainable due to lacking of certain facilities but they have capacity to grow and make themselves self-sustainable.
- Town planner can do the effective use of sustainability indicators to predict the direction flow of future population.
- Sustainability indicators can help to decide the intensity of development required for an area to gain sustainability.

## REFERENCES

- [1] Atkinson A. (1992) "The Urban Bioregion as Sustainable Development Paradigm", *Third World Planning Review*, Vol.14, No.4.
- [2] Amna Salman and Salman Qureshi (1998), "Indicators of sustainable urban development: A review of urban regeneration projects in Karachi, Pakistan", Department of Geography and Geology, University of Salzburg, Hellbrunnerstrasse 34, Salzburg 5020, Austria.
- [3] Adriana A. (2002), "Sustainable Cities or Sustainable Urbanization?" UCL Development Planning Unit in collaboration with DFID and UN-Habitat, London.
- [4] Barton, H., (1995) "Sustainable settlements. A guide for planners, designers and developers", Bristol, University of the West of England and London.
- [5] Burgess, R., Carmona, M. and Kolstee, T. (1997), *The Challenge of Sustainable Development: Neo-liberalism and Urban Strategies in the Developing World*, London, Zed.
- [6] Ban K. (2009), "Planning Sustainable Cities", A Global report on human settlements, United Nations Human Settlements Programme, London.
- [7] Colin F. (1996), "EUROPEAN SUSTAINABLE CITIES", European Commission.
- [8] Commission of the European Communities (1992) "Towards Sustainability: A European Community Programme of Policy and Action in Relation to the Environment and Sustainable Development". COM (92) 23, Brussels 27 March.
- [9] Christian Azar, John Holmberg , Kristian Lindgren (1996), "Methodological and Ideological Options Socio-ecological indicators for sustainability", *Ecological Economics* 18 (1996) 89-112.