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Sustainable Urban Development – Conceptual Approach

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Abstract

Urbanism and urbanization is a complex term in as much as that it is highly diversified in terms of culture, traditions, religion, social behavior and life, size and capacity, supporting infrastructure, governance, administration, planning approach, trade, so on and so forth. The present scenario is highly sophisticated and alarming in the context of growing and continuous expansion of the urbanization world over leading to associated problems and pose threats to social, environmental, and economic. An effort has been made by the authors of the present paper to conceptualize the parameters for environmental sustainability in urban development.

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Introduction

Urbanism is the study of urban areas such as towns and cities in which inhabitants interact with the built environment. It is an important dimension of urban planning which is related to physical design and management of urban structures along with urban sociology which focuses on urban life and culture. In other words, the concept of "Urbanism" represents a way of life that explains the diffusion of urban culture and the evolution of urban society. Some may even classify urbanism as a cultural - social-economic phenomenon that identifies relations between social and technological processes, while others characterize as the heterogeneity of population, specialization of function, anonymity, Impersonality, and standardization of behavior.

Ideal Parameters for Achieving Urban Sustainability

As per United Nations, Department of Economic and Social Affairs, Population Division "By 2050, the world urban population could reach 6.25 billion, 80 percent of whom would live in developing regions, and concentrated in cities of Africa and Asia". In the next one or two decades, the global population is going to experience the brisker pace of urbanization which also pave the way for the absolute decline of the world's rural population for the first time in history (World Economic and Social Survey 2013, 2013) [1]. Fig 1

The main parameter which affects is project location i.e. selecting sustainable sites for development helps to eliminate main problems associated with the nature of the infrastructure and social aspects. An increasing need for the cities based on their particular history, states policy priorities and its targets have to focus on defining what sustainability means to that particular city. Integrated planning helps to achieve these four pillars of environmental sustainability. The four pillars of achieving environmental Sustainability- Human, economic, social, and environmental.

The following domains have a cyclic approach, can achieve sustainability by using proper integrated planning. They are Economy, Environment and ecology, Land use, Society/Community, Climate change, carrying capacity based development planning, Transportation, Governance, etc., they can be broadly classified into 4 heads namely, Economic, Social, Environmental and Planning dimensions

Economic Dimension

The economy is one of the major traditional indicators in assessing urban sustainability. There are three main criteria in the economic dimension that plays a major role in urban planning -Growth, Development &Productivity. Urbanization and economic growth are inevitably linked. Normally economic growth implies a process where rural areas are transformed in urban areas in terms of services, industrialization, residential, and commercial. Cities' infrastructure is much better than rural areas increasing economic growth, transportation links which give greater access to residents to travel conveniently and faster. Also, an increase in trade between different regions helps to boost the business and economic growth of a specific location. The relevant indicators for the economic dimension are reflected in figure 2. The importance of raising productivity in competitive global economies around the globe is recognized by the developing countries (Klein, 2015)[2]. Urban agglomeration also plays a major role in economic productivity (Schumann, 2017)[3]. Each of the indicators can be achieved by improving the measures.

Economic growth can be measured through Annual GDP growth rate; Annual GNP growth rate, Net Export Growth rates, Foreign Direct, percentage of jobs created in the local economy, underemployment/ Employment/ Unemployment rates, etc (Science for Environment Policy (2018) Indicators for sustainable cities. In-depth Report 12, 2018)[4].

Improvement in the quality of the product at an affordable price which is accessible to everyone increases productivity. Likewise, improvement of the environmental and financial condition of the firms, startups, etc increases the sustainability aspect of the development. Innovation growth attracts new investments and business facilities thereby investments and business facilities thereby promoting the local industry. Strengthening employment opportunities by providing skill up-gradation training, green entrepreneurship provides an efficient workforce for the industry. Sustainability community engagement helps the inefficient use of local resources efficiently (Dizdaroglu, 2017) [5]. Fig 2

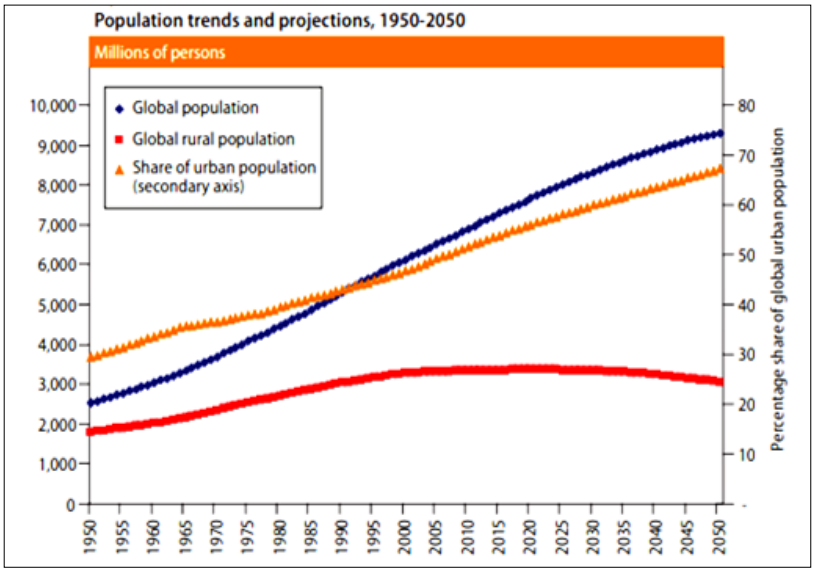

Figure 1. Source: United Nations, Department of Economic and Social Affairs, Population Division (2011; 2012)

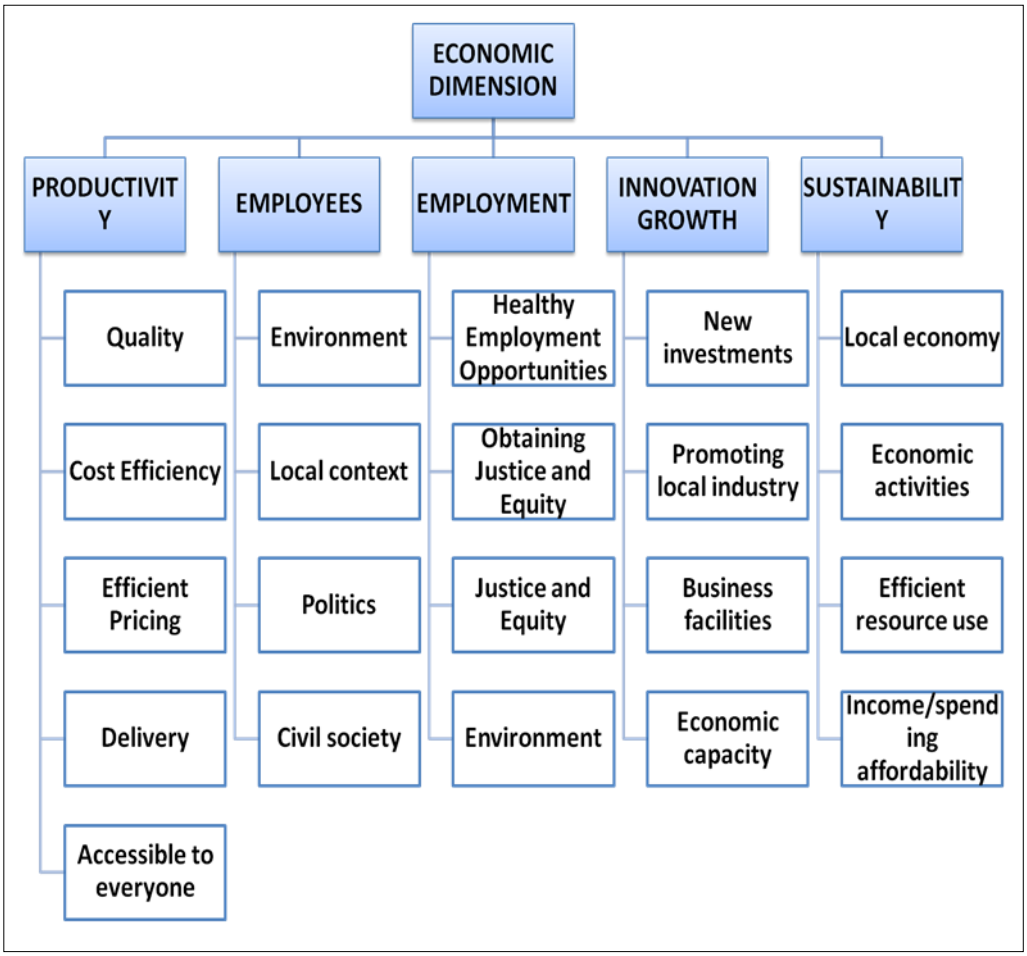

Figure 2. Economic Dimension - indicators and measures

Social Dimension

Within the last three decades, the social dimension is also considered as an important factor in urban planning implementing laws and policies. Social Dimension addresses on well-being and quality of life. Societal organizations have revolutionized demographic structures, empowerment, ethnicity, the way we choose to live, redefining of concepts of an individual, and their social responsibility. The self-explanatory indicators for the social dimension are shown in Error! Reference source not found**.** Considering socio-equity and environmental justice together plays a major role in creating sustainable and well-balanced communities. The major 5 indicators are Health, Education, Equity, Community, and Security. The economic prosperity and healthy environments can be achieved when the cities can provide health and education services irrespective of the income inequalities. Giving a fair chance to all groups of the society such as children, seniors, minority residents, persons with disabilities through mass mobilization campaigns, public participation, etc in the decision-making process helps the society to grow together. To improve the security aspect, public facilities are to be provided in such a manner to face even the adversities for disasters as well. Facilities such as safe waste disposal sites, management facilities are also to be in access to everyone. Public transport should be equitable and accessible for all the residents regardless of their income.

Measures to assess the social indicators are as follows. To assess education, the measurable particulars are the number of schools in the neighborhoods, the percentage of enrolments, adult literacy ratio, etc. For the health aspect, the quantifiable data are life expectancy ratio, percentage of the population with access to health care services, percentage of population access effective sanitary sewage services. The measurable for quality public spaces are the details regarding the condition of facilities such as roads, infrastructure, percentage of green spaces, ration of built – open spaces, etc (Jennifer R. Wolch, 2014)Error! Reference source not found. To know whether the communities are safe and secured, the quantifiable data such as crime rates, risk adaptation capabilities, percentage of evacuation centers, etc are to be analyzed (Science for Environment Policy (2018) Indicators for sustainable cities. In-depth Report 12, 2018) Fig 3.

Environmental Dimension

Urban development interacts with the environmental dimension to a greater extent compared to rural areas. Environmental Sustainability can be maintained by posing strict guidelines in terms of pollution, eco-system integrity, Carrying Capacity, and Bio-diversity. High urban density helps the environment by making public transport viable decreasing the amount of pollution, Environmental friendly structure and public services help to attain & maintain in urban areas. Urbanization living encourages the use of green schemes, green technology, innovation providing a better standard of living, and future development. (Wan, 2012). The broad indicators for environment dimensions are reflected in Figure 4

Micro Environmental Parameters

In addition to the above broad environmental dimensions, the authors of the present paper have defined following micro environmental policy Parameters required to be infused into the process of urban planning in a more scientific and compatible manner.

- Optimization between concreting and non-concreting urban surface area
- Optimization between vertical to horizontal expansion of the city
- Ventilation coefficient
- Heat island effect
- Albedo effect
- Urban Atmospheric stability
- Temperature inversion
- Aerodynamics affects as a wind rose and stability rose diagrams

Optimization Between Concreting and Non–Concreting Urban Surface Area

The urban areas are fast expanding looking to the needs of people, commercial activities, and other

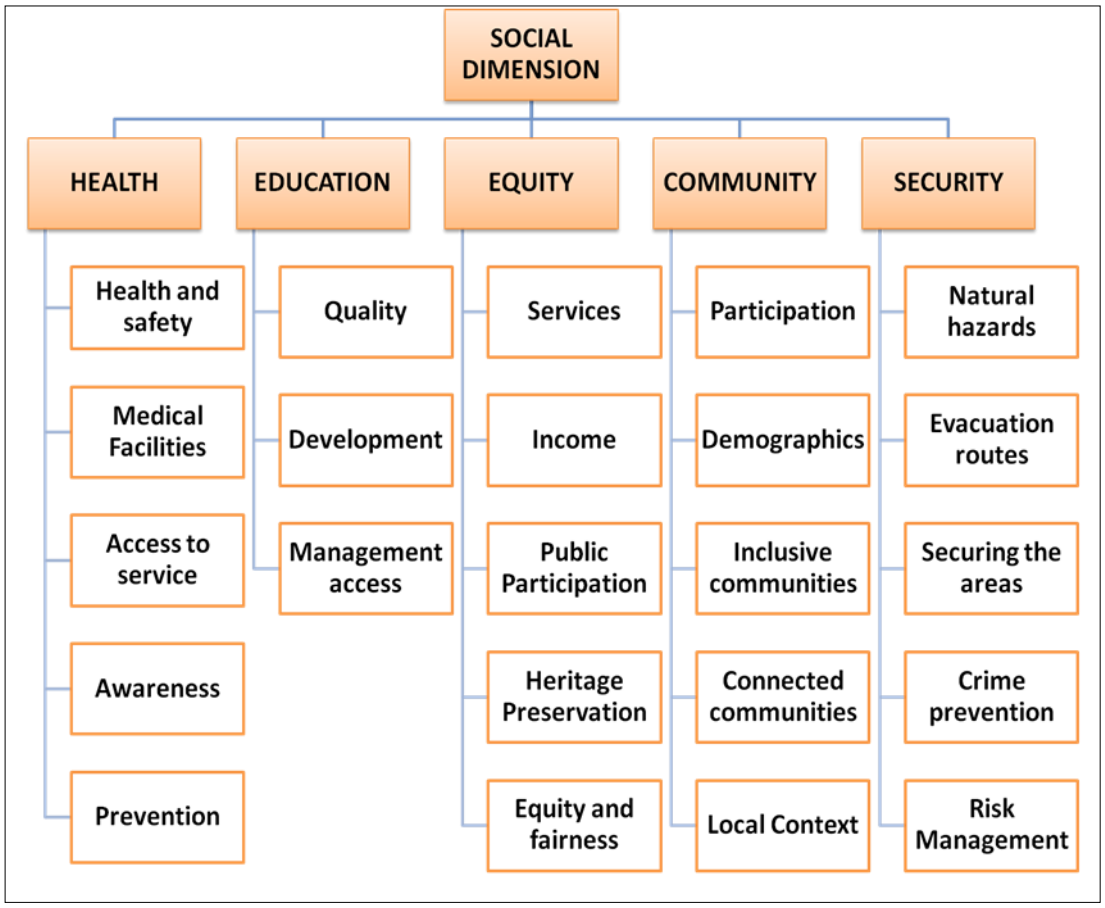

Figure 3. Social Dimensions - Indicators and Measures

amenities. These areas are becoming the jungle of concrete. In the case of a concreting surface, the incoming solar radiation reradiates back into the lower urban atmosphere, making it warmer as compared to the rural or open area where absorption of incoming solar radiation is more than the re-radiation. Once the urban atmosphere becomes warmer, the air pollutants released from automobiles, household fuel burning, and commercial activities get activated due to high heat. Once these pollutants became activated, they are more reactive and impinge on the human body resulting in skin problems. In case these reactive pollutants are inhaled by human beings, they cause multifarious complex diseases.

Moreover, the resulting warmer atmosphere leads to more energy consumption in the urban areas along with more consumption of water which is emerging as a serious threat in big cities. The majority of states in India are facing water shortage, particularly in big cities and towns, where water is being supplied in tankers at a comparatively high price. To address such an alarming issue presently and times to come, optimization between concreting and non-concreting urban surface area needs to be done on the scientific scale by employing highly compatible mathematical and simulation models.

Optimization Between Vertical to Horizontal Expansion of the City

With the fast-growing of urban areas, vertical expansion is getting momentum which leads to high rise buildings and more concrete. These high rise buildings if not planned scientifically, restrict the movement of air on the lower buildings located on the leeward side. Moreover, it provides shadow to the lower buildings restricting the light.

These restrictions lead to higher energy consumption in the lower buildings and also agglomeration of air pollutants on the leeward side to

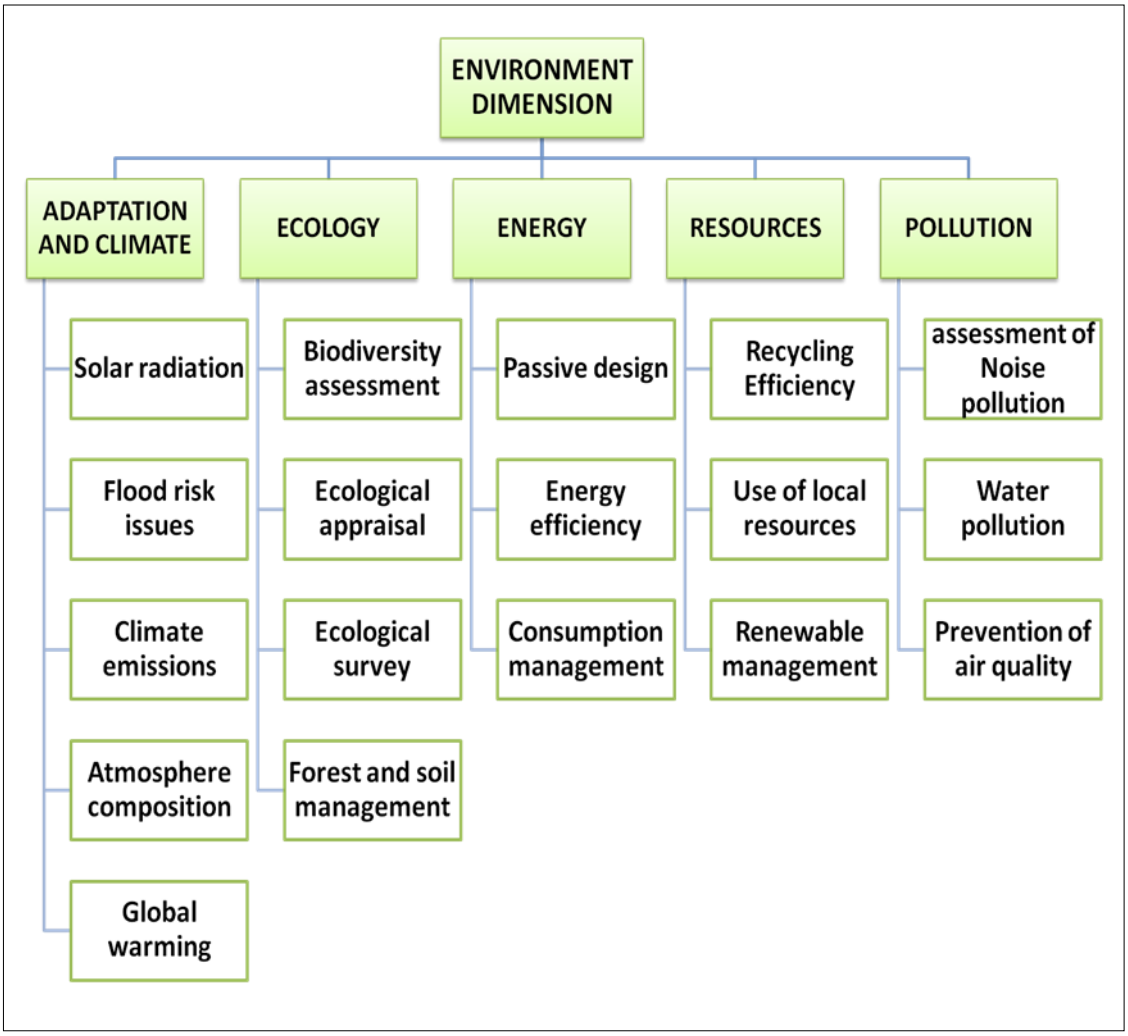

Figure 4. Showing environmental dimensions

impart higher concentration and adverse health effects. Such a vertical expansion without scientific planning may also lead to poor urban ventilation, albedo, and heat island effects. Moreover, vertical expansion leads to high energy and water consumption which necessitates scientific optimization between horizontal to vertical development of an urban area.

To incorporate this environmental parameter into the process of urban planning, mathematical and simulation models may be employed to address this important issue of optimization in the process of urban development

Urban Ventilation Coefficient

Air ventilation of an urban area is a very important part of the dispersion of air pollutants and partly to save energy during summer and monsoon seasons. The more is a ventilated city; the least shall be air pollution levels in urban areas due to higher dispersion and transportation of pollutants. A highly ventilated city consumes less energy and provides better comfort. Presently this issue is being ignored in most of the cities resulting in elevated air pollution levels and consequently diseases. The ventilation coefficients are to be considered at different heights of the urban area with a maximum at the tallest building. A well defined scientific approach with the use of mathematical models would be able to address this parameter in the process of urban development.

Heat Island Effect

The urban areas with higher concreting surface and a higher degree of air pollutant emissions give rise to a higher temperature which transforms into an island of heat. It can be easily witnessed that there is a

significant difference between the temperature profile of the urban and adjacent rural areas. Such a difference has been reported to the magnitude of 3 to 8° c.

This heat island phenomenon would attribute to the activation of air pollutants and subsequently, these pollutants become reactive. Once the air pollutants become reactive and inhaled by human beings, they cause serious health effects. The urban heat island is also attributed to high energy and water consumption. Presently such an environmental issue is not being addressed in the process of urban development and planning. This issue should also be addressed scientifically to minimize the heat island effect during the process of urban planning.

Albedo Effect

Albedo is the ratio of incoming to outgoing solar radiation. This ratio is disturbed in the case of the urban area where concreting of the urban surface is more predominant. This Albedo effect leads to heat island effect, the details of which have already been elaborated.

The use of mathematical models would be able to address this parameter in the process of urban planning by balancing the incoming and outgoing solar radiations. The urban planning should have sufficient open spaces in the form of non-concrete areas like green cover etc at appropriate and scientifically identified places.

Urban Atmospheric Stability

The atmospheric stability is defined as the ability of the atmosphere for the dispersion of air pollutants released from various air polluting sources. The atmospheric stability is further classified under six categories starting from category A to category F. The atmospheric category A represents a highly unstable atmosphere followed by B as unstable, C as slightly unstable, D as neutral, E as stable, and F as highly stable. A highly unstable atmosphere is good for dispersion of air pollutants whereas highly stable is known to have poor dispersion ability.

The urban atmospheric stability should be considered while identifying the location of new urban areas and the expansion of the existing city. Atmospheric stability should be worked out for each city on a time scale. Decisions of establishing new urban areas or expansion of existing cities should be taken after analyzing the atmospheric stability of that urban area or city.

Temperature Inversion

In an ideal atmosphere, temperature decreases with height. However, during winter conditions and where the concrete surface in an urban area is more, the temperature increases with height. This phenomenon is known as a temperature inversion. In such a situation the air above becomes heavier which restricts the air pollutants to disperse resulting in elevated ground-level concentrations of air pollutants.

Such a high concentration coupled with temperature inversion may lead to air pollution episodes or catastrophes. London Smog episode is one such examples of air pollution in which more than 4000 thousand people died.

Every urban authority or planner should work out the frequency of occurrence of temperature inversion over some time. This will help in taking scientific decisions for mitigation when the air pollution levels are very high. Moreover, in the case where the frequency of temperature inversion in an urban area is significant, vertical expansion of the city should be restricted to the desired level.

Aerodynamics Effects Like a Wind Rose and Stability Rose Diagrams

The aerodynamics of an urban area is to be scientifically analyzed. Accordingly, urban planning needs to be optimized in tune with urban aerodynamics.

The wind roses are important tools for overall spatial planning and addressing environmental to some extent. It provides the overall scenario of sectoral winds along with their speeds to facilitate the planners to identify the locations or areas for residential colonies, commercial activities, and industrial areas & so on so forth.

- These roses have the following applications.
- Urban Planning
- Siting of industrial locations including chimney & other air polluting source
- Industrial zoning & industrial estate planning

- Air pollution modelling.
- Disaster Management
- Street layout
- Ventilation of urban, industrial and housing
- Environmental Impact Assessment study.
- Oceanography
- Wind Energy
- Agriculture Engineering
- Ambient Air Monitoring
- Noise Impact Modelling

Similarly, the atmospheric stability roses represent graphically the % frequency distribution of different stability classes in different directions for a specified period and location. The application of stability roses is mainly used in air dispersion modelling which predicts ground-level air pollutant concentrations for a given air polluting source under different stability conditions.

Planning Strategy

There is a great need to have compatible linkages between economic, social, and environmental dimensions along with forwarding and backward integration of each conceptual issue. Every decision and policymaker should have planning tools to integrate land use, infrastructure, transport, governance, and management having regard to economy, social, and environmental dimensions (Compact City Policies, 2012) [7].

There is a need to develop integrated simulation models to take care of all such aspects. If we take urban flooding as an example, increasing growth patterns, due to which the habitations coming up in the low lying regions. Huge constructions and the encroachments on the flood plains and on the drainage channels lead to

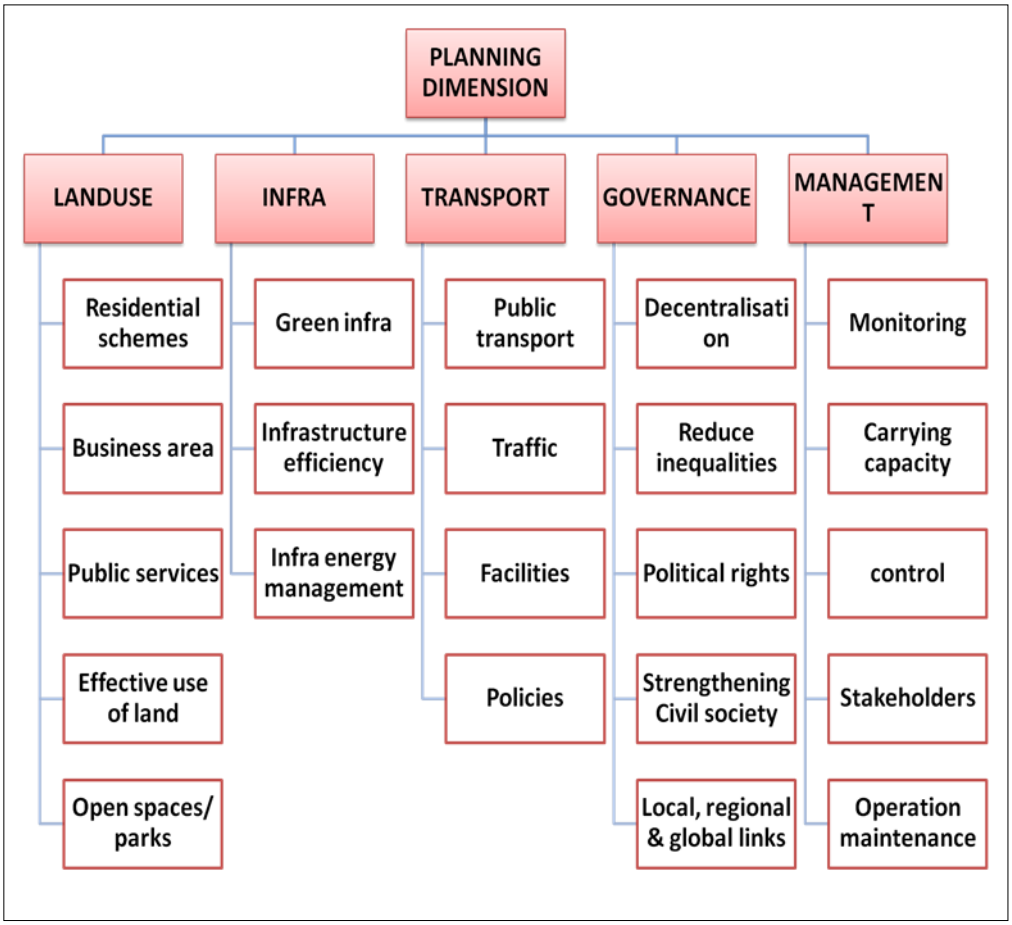

Figure 5. Planning dimension- indicators and measures

massive destruction of the constructions and in many other ways. An effort has been made by authors to explain the planning strategy indicators as reflected in the

Conclusions

Sustainability of the urban sector and its development is a challenging issue. The present urban development in most of the cases is lacking in respect of sustainability parameters as reflected by the authors in this paper. Such important neglected issues lead to social, economic, and environmental imbalance which resulted in multidimensional problems. Fig 5.

Under this context, there is a strong need to carry research and developmental studies by researchers to identify urban problems and causal factors. There is also a need to develop scientifically compatible integrated simulation models having regard to economic, social, and environmental dimensions with space of planning strategy. All such research studies need to be taken up at different urban areas, published and databases developed for the use of other researchers

References

1. *World Economic and Social Survey 2013.* United Nations,Department of Economic and Social Affairs, Population Division.
2. Klein, A. (2015, August 03). How can cities improve their productivity? *Future for Economic Progress* .
3. Schumann, R. A. (2017). The Role of Urban Agglomerations for Economic and Productivity Growth. *International Productivity Monitor, Centre for the Study of Living Standards* , 161-179
4. *Science for Environment Policy (2018) Indicators for sustainable cities. In-depth Report 12.* UWE, Bristol: European Commission, DG Environment by the Science Communication Unit.