

Analysing the importance of Green Infrastructure to bring qualitative sustainable economic development –with reference to developing nations like India.

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ABSTRACT: *Developing nations like India are witnessing rapid growth of urban areas together with increase in population. This growth has put enormous pressure on the scarce resources. The drive to fulfil the economic needs of the population, cities and towns are now the focal point of rapid economic activities, investments and infrastructural activities. This has created a thin line between economic growth and economic development. While growth focusses on income generation, development encompasses qualitative changes. Green infrastructure is considered an alternative technology to maintain the balance between economic growth and development. GI focuses on environmental, ecological wellbeing of the society.*

KEY WORD: *Economic growth, Economic Development, Infrastructural activities, Green Infrastructure*

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I. INTRODUCTION

‘Growth Economics is a major branch of Macroeconomics which considers the problem of economic growth in the economies as long term phenomenon. Extension of growth economics is the is concept of Development economics which is more associated with developing economies. While economic growth is quantitatively represented and measured, development is related to qualitative changes in availability of goods, services, improvements in welfare and consequently rise in the productive capacity of the country. The world commission on environment and development (Brundtland commission) first used the concept of ‘Sustainable Development’ in the year 1987. It defined the term as “meeting the needs of the present generation without compromising the needs of the future generation.” The world development Report 1999-2000 reiterated the importance of sustainability concept for improving the quality of life as principal development goals. Development goals include both socio-cultural as well as clean environmental objectives.

The concept of sustainable development is important for growing nations like India where dualistic nature of society is widely prevalent. Various policies, programs have been adopted for bringing balanced economic growth and development post-independence, yet the urgent need for achieving faster growth has disrupted the balance. While there has been rapid rise of urban culture post liberalization, the rural areas have not been able to match with the growing trend. In pursuit for better economic opportunities there has been widespread migration of people from rural, semi-urban areas to the bigger cities.

II. Objectives of the study:

1. To highlight the importance of sustainable development with reference to emerging economy like India
2. To understand the need and importance of transformational shift from grey infrastructure to green infrastructure achieving sustainable growth and development.

III. Brief Review of literature:

Industrial and technological revolution across the world has provided ample opportunities for investment’s, employment and improvements in the lives of people. Cities and towns have become hubs of economic activities. For countries like India there has been huge shifts of population, from rural to urban areas, to be the part of this development. This process of industrialization has put tremendous pressure on the available resources. India’s urban population is expected to be 50% by 2050. Jessop B (1990) state theory proposed strategic-Relational perspective to resolve the conflict of interaction of government, private agency and public to assess contemporary approach for human centred development.

Widespread propaganda of Green infrastructure began around 2012. Neuman et.al spoke of Green infrastructure as man-made infrastructure designed with the purpose of easing environmental pressures such as flooding and extreme temperature fluctuations. Neuman et.al and Tzoulas et.al emphasized GI as a solution to bring harmonious relation between human and ecological services.

Mac Donald et.al (2005) and Kevin Sullivan (2010) gave the most accepted definition of GI as multi-functional bringing in natural resources in and around urban areas supporting wild life and Biodiversity. US environmental agency (EPA) identified Green infrastructure as contributor of improved human health, air quality and capital cost savings. Rafeq (2006) and Martyna (2013) considered GI as most distinctive concept of sustainable urban development. Perhaps the most balanced approach towards GI has been stated by European Union 2013 where it defined GI as strategically planned network of high quality natural and semi natural areas designed to deliver wide range of eco systems and protect bio-diversity in both rural and urban areas.

GI has been blended with the concept of ‘Smart growth’ encompassing land development and conservative practices given by Banedict and McMohan (2002). Kevin (2010) emphasized on collaborative efforts of communities together with landowners and investors to bring environment protection and thereby improving quality of life. Mell (2010) stated that the benefits attributed to GI needs to take into consideration how people, policy and place are influenced by the three main components of sustainable development-social-ecological and political equity. EPA (2014) considered sustainable communities to be places where the balance is made between economic assets, natural resources and social priorities .Kimmel et.al, 2013 also advocated system perspective that successfully plans and decides vibrant and environmentally sustainable communities by integrating green and grey infrastructure

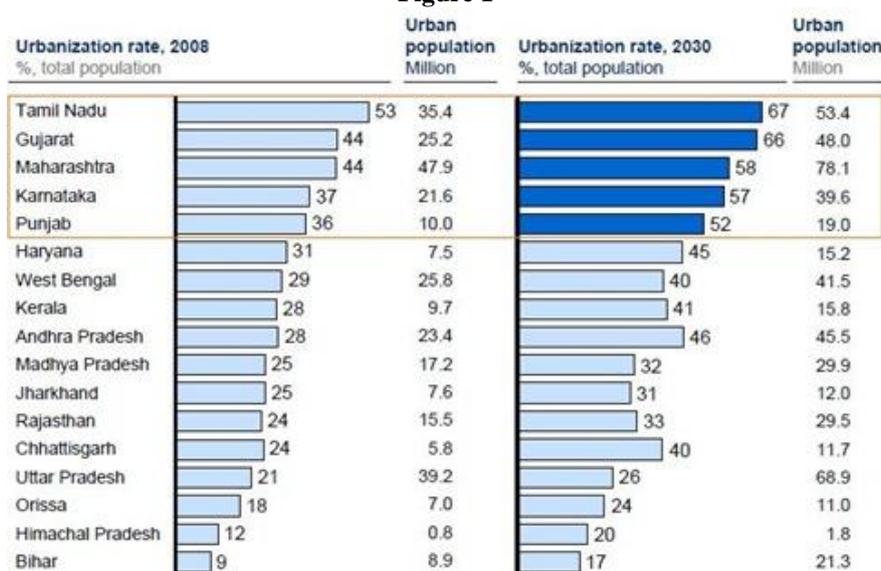
IV. RAPID URBAN GROWTH IN INDIA-NEED FOR SUSTAINABLE ECONOMIC DEVELOPMENT

Popular definition of sustainable development is ‘ meeting the needs of the present generation without compromising the needs of the future generations’, thus widening the concept of Development encompassing the importance of not only meeting the needs of the present but also to ensure smooth living in the future. The need of the progressive society is to develop an environmental friendly social and infrastructural set-up especially for developing nations like India. The excessive and indiscriminate usage of existing scarce resources has compromised the quality of living. India being home to 3.8 billion population is constantly grappling with the issue of efficiently and effectively utilizing the existing scarce resources. This has also been exacerbated with factors like rapid rise in urban population due to social and structural changes .There has been spurt in the migration of rural people to urban areas in search for basic (if not better) standard of living to support their families.

Rapid urban growth has opened Pandora box and has led to complex interplay of development with excruciating use of resources .We are also witnessing dualistic structure with high –end settlements together with unregulated ones. Policy makers and planners therefore has surmountable task of formulating and harmonizing the needs of every section and strata of the society. There should be balance between economic necessities and maintenance of ecological cycle.

According to Mackinsey global institute India’s urban population is rising from 340 million in 2008 and would be 590 million in 2030.

Figure 1



SOURCE: India Urbanization Econometric Model; McKinsey Global Institute analysis

Rapid rise in the urban population is coupled with pressure on both economic and non-economic factors. Economic factors include capital need, organizational and policy support together with technological progress. Non-economic factors on the other hand are social attitude, institutional, political and administrative factors.

Newly developed areas in and around major cities are facing challenges like high-waste production, congestion, improper drainage system due to high encroachments on land for accommodating rising population. The recent case is of unprecedented floods in Tamil Nadu state of India (2017) due to encroachments of river streams and other drainage channels, uncontrolled multiplication of build-up areas.

The concept of sustainable development as pointed by Cairns is 'development which is not just a matter of having plenty of money and is not purely an economic phenomenon. It must embrace all aspects of social behaviour'.

Both quantitative as well as qualitative factors which are needed to ensure sustainable development. One of the major aspects of sustainable development is the provision of a cleaner environment. There is a direct correlation between environment and productivity. Environmental goals encompass the need for efficient exploitation and usage of natural resources. The emphasis is on preserving the natural capital stock of the nation. The burgeoning activities of mankind have led to the extinction of various species and disrupted the delicate balance of nature.

For accelerating economic growth, developing nations are compelled to indiscriminately exploit scarce resources. To fulfil the gap between demand and supply, the natural stock of the nations is excessively utilised and thereby forced to compromise the future needs of the society.

Green Accounting is an acceptable measure of Sustainable development. It takes into account the external depletion of natural resources and warns of future outcomes. It deals with the adjustment of National goals together with preservation of natural capital stock.

The objectives of Green accounting can be summarised as below:

1. Identify the costs necessary to compensate the negative impact of economic activities.
2. To Assess environmental cost and benefits.

Green accounting if adopted and integrated deftly into the economic system would overcome the challenges of urbanisation and achieve sustainable development.

V. INTEGRATING GREY AND GREEN INFRASTRUCTURE:

Grey infrastructure are built-up engineered and physical structures. It includes floodgates, drainage systems, water management –system like canals, dikes, waste-water treatment plants, water filtered plants. These can also be called 'social infrastructure'. The grey infrastructure provides foundation for better living standards and provides impetus to economic growth.

Green infrastructure was first discussed in the late 1990's and implemented in UK, western Europe and North America. GI is a network of multi-functional open and green space in and around towns and cities, the garden trees and the access to and through them, which support wildlife and biodiversity, provide recreation, access and leisure opportunities and create a sense of place" (MacDonald et al, 2005 and Kevin Sullivan 2010). Resources of GI are parks, lakes, Green roofs, street trees. GI's main objective is to restore native ecosystems and prevent overexploitation of resources. Green infrastructure is now seen as a strategically planned step to overcome the shortfalls of Grey infrastructure and provide a natural system, high quality and lower cost infrastructure.

Grey infrastructure is falling short of meeting the needs of the urban population and are unable to protect from extreme climatic changes which are taking place due to overexploitation of resources. Global warming, rising levels of sea level, severe drought and floods situations are signalling towards an urgent need to adapt environment –friendly infrastructure plans. Thus there is a need to integrate grey and green infrastructure to overcome the challenges of rapid climatic and growing needs of the urban areas.

Figure 2: Integrating grey and Green infrastructure.

Grey infrastructure	Green infrastructure
Reservoir, treatment, plants	Water sheds –improve water quality.
Storms, drains and pumps	Storage of storm water and reduce pump requirements
Dams, irrigation, canals	Increase soil water storage capacity.

VI. GREEN INFRASTRUCTURE:

Section 502 of the Clean Water Act defines green infrastructure as "...the range of measures that use plant or soil systems, permeable pavement or other permeable surfaces or substrates, storm water harvest and

reuse, or landscaping to store, infiltrate, or evapotranspiration storm water and reduce flows to sewer systems or to surface waters."

1) Green infrastructure resources

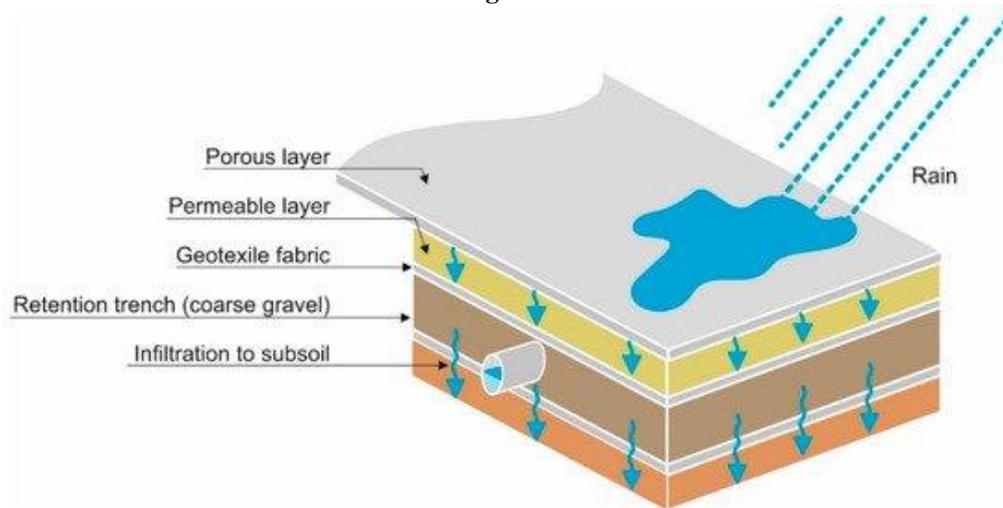
Resources of green infrastructure are parks; lakes, woodlands, green roofs, street trees. It covers housing green spaces, village greens.

Provision of green utility services such as landscape, commercial parks which provides aesthetic quality for urban areas together with societies to reduce air pollution, water congestion, improve waste-management. Green corridors –rivers and canals including their banks, road and rail corridors.

2) Green streets and pavements

To avoid excessive heat especially in the regions with extreme climate like northern parts of India, green lanes with trees around would help in maintaining the temperature. Green permeable lanes and streets would help in proper outlet of rain water which is seen as playing havoc in coastal regions like Mumbai and Chennai. Cool lanes and streets, pavements tend to store less heat and lowers the temperature around

Figure 3



Source: Climate Change and Transport Infrastructures: State of the Art

by Laura Moretti * and Giuseppe Loprencipe

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3) Green walls

It refers to all form of vegetated wall surfaces.(Green roof organization 2008).It performs twin function of absorbing heated gas in the air due to air conditioners (which has now become necessity in the upper income group households) .It also provides aesthetic value to the areas around .

4) Eco-Roof/White Roof –urban heat Management

Areas with extreme weather records very high temperatures during summer .The Northern Belt of India witnesses every year temperature as high as 45 degree to 50 degree. Therefore the concept of white roof in urban areas is another remarkable breakthrough in minimizing high temperature conditions. White roofs are cool roofs painted with either white or reflective materials .These reflective materials used are expected to reduce global heating by 0.4 degree Celsius on an average as per 2010 study of Lawrence Berkley National Laboratory .It is believed that this would offset global heating effect of 1.2 gigatons of CO₂ emissions annually .

The world is grappling with issue of Global warming .The usage of white walls could be considered as an effective step to offset Urban Heat island Effect (UHI).

5) Blue-roof water management

For managing storm water runoff Blue –roof practices has been also considered a novel idea A water proofing membrane has to be installed as a part of the roofing system for blue roof .water is stored temporarily and can be used for landscape irrigation ,direct ground water recharge .

6) Urban forestry

Tree planting is considered an important and simple technique in GI which performs multiple works starting from absorbing air pollutants to that of preventing flooding, manage water quality and minimize urban heat island effect. In fact urban forestry is considered most economical for developing nations like India .Trees can be planted at public places, along streets and lanes and along rivers.

VII. CONCLUSION

Green infrastructure is transformational step towards better quality of living especially for burgeoning urban population. While the need for adequate infrastructure support is indispensable for the economic growth of the nation, to achieve sustainability in development and economic growth there must be fine blend of green and grey infrastructure .Adoption of green technology has become imperative for sustainable living as well maintaining the delicate balance between growth and development for any nation. There is unbridled growth of cities together with need for basic standards of living. To achieve this surmountable task it is essential to adopt and absorb technology which ensures quality of life not only for the present generations abut also for the future –generations. There are challenges of scarce resources, lack of adequate capital, delayed implementation of projects and the will of the authorities and people. However amidst all these hurdles GI would enable both quantitative as well as qualitative growth and development, thereby maintain sustainable equilibrium between economic growth and development.

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