



Review

Urban sustainability indicators: Challenges and opportunities

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ABSTRACT

Urbanization has become one of the most important issues which define the human relationship with the ecosystem. Measuring progress towards sustainable or unsustainable urban development requires quantification with the help of suitable sustainability indicators. There is a general ignorance about contextual meaning and understanding of the concept of sustainability which differs from country to country and economic strata of the society. Our review aims to reduce this challenge by identifying major issues faced in the development and implementation of sustainability indicators in an urban context and suggesting remedial recommendations. We have identified two broad categories of challenges according to their development and implementation phase respectively, and three preliminary criteria in the application of urban sustainability indicators.

1. Introduction

The ecological footprint of cities extends much beyond their administrative boundaries, with the productive and assimilative services of ecosystem facilitating the flow of energy as well as material. The resource base used by urban population is generally found away from its place of consumption. Therefore, biophysical consequences of rapid and uncontrolled urbanization are felt elsewhere. Urbanization is a large proportion of the human population living in cities (Davis, 1955). According to United Nations it is movement of people from rural to urban areas accompanied by three major trends (Mori and Christodoulou, 2012): first, concentration of ‘metacities’, that is, conurbations of more than 20 million people, in the developing countries of Asia, Latin America and Africa (Habitat, 2006); second, presence of more than half of world’s urban population in cities of less than 500,000 inhabitants; and third, 95% of urban population growth in cities of developing countries accounting for about 4 billion people (Habitat, 2006; Mori and Christodoulou, 2012). India and China, in particular, are expected to see an increase of about one-third urban population in the coming decade with rapid urbanization (Shen et al., 2011). Following the aforementioned three trends, urban growth is dynamically balanced between economies of scale and scope, along with diseconomies like environmental degradation and leakages (Munda, 2006). Cities are confronted with the problem of trade-off between positive and negative effects of urbanization with respect to environmental, social and economic aspects (Mori and Christodoulou, 2012). As cities grow anthropogenic assets accumulate while natural assets suffer a corresponding decrease (Bithas and Christofakis, 2006).

This accumulation of anthropogenic assets is the result of growth in economic and social status. Sustainable development has been traditionally identified with three major areas of environmental, economic and social dimensions along with institutional addendum.

Sustainable development must be equitable, liveable and viable (Tanguay et al., 2010). It is considered a weakness that sustainability has a loosely defined conceptual base (Pissourios, 2013), with lopsided progress in the multiple dimensions of sustainability, chiefly environmental aspects. It is claimed by many authors that definition of sustainability transforms itself according to the target area of researchers (Tanguay et al., 2010). According to Turcu (2013), there is generally no universally accepted definition of sustainability. Sustainable development means achieving enduring development addressing human needs and improvement of the quality of life. At the same time, natural resources should be utilized at a frequency and degree that can be sustained by regenerative capacity of the ecosystem.

Mori and Christodoulou (2012) supported nested hierarchical approach for biophysical, social and economic aspects of sustainability. They argued that in the triple bottom line structure social, economic and environmental considerations cannot be treated as parallel. Functioning life-support system, social structures, institutions, and economies depend on each other to keep working. Though they have explained this approach with a limited scope, it is important to mention that nested hierarchy approach considers biophysical limits of the earth as the final boundary which contains and consists of social and economic parameters (Fischer et al., 2007).

Sustainable development definition gives rise to multiple interpretations (Tanguay et al., 2010), with differing emphasis on “what is

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Table 1
Definition of sustainability: Economic, Social and Environmental.

| Theme | Urban Sustainability | References |
|---------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Economic | It should focus on man-made, natural, human and social capital Resource utilisation should not affect future income Intergenerational equity for resources Economic activity should consider ecological basis Intergenerational equity, distributional equity, optimal growth | Hamilton (2006) Moldan et al. (2012) Anand and Sen (2000) |
| Social | Should address the perpetuity of social values, identities, relationships and institutions Common goals and social cohesion Health, education, food, water, housing should be sustained for each individual Actively support the maintenance and creation of skills as well as the capabilities of future generations | Black, 2004; Moldan et al. (2012) Gilbert et al. (1996) Gilbert et al. (1996; Longoni and Cagliano (2015); Moldan et al. (2012) Longoni and Cagliano (2015) |
| Environmental | Social and economic development should have sound environmental foundation Natural resource management should have high priority Tipping points, thresholds (air, water pollution levels), sudden changes should be well understood | Moldan et al. (2012) Moldan et al. (2012); Booth et al. (2016) |

to be developed, what is to be sustained”, the relationship between environment and development and the temporal scale of such development. This means that in order to be sustainable, those resources which can be utilized for development should be identified with their limitations (carrying capacity), along with the natural components or limits that need to be protected or sustained respectively for the proper functioning of ecosystems. Sustainability is a very “loosely” defined term (Pissourios, 2013; Turcu, 2013). The broader concept ideally includes the triple bottom line, however, the concepts get more focused to include mostly environmental sustainability in practice. Sustainability is the most “challenging and controversial” issue with regard to its “interpretation and application” and further when the term ‘sustainable’ combines with ‘development’, its focus changes to economic development rather than overall sustainability (Lee and Huang, 2007). When nations focus on economic development as the main aspect of sustainable development it inevitably drains the earth’s regenerative and carrying capacity. Social influence on the concept of sustainability renders its measurement less objective, limited to a certain scope, with a possible conflict of interests and manipulation by stakeholders. Further, according to Moldan et al. (2012) social sustainability is the most important pillar of sustainable development and yet it is not fully clear as to what it consists of. They question whether it includes growing, or not diminishing, inequality between people or nations, good health or failure of national institutions. Mori and Christodoulou (2012) have identified the triple bottom line as an abstract notion of biophysical, economic and social elements, and intergenerational equity as the fundamental notions of sustainability and Turcu (2013) holds that definition of sustainability is a normative choice rather than a concrete well-defined concept. According to Pupphachai and Zuidema (2017), sustainable development provides a more general direction for evaluating and streamlining policies towards urban function and structure rather than a precise definition. This very fact has resulted in the development of Sustainable Development Goals with 17 broad goals and 169 interconnected targets based on national priorities (United Nations, 2015). Mori and Christodoulou (2012) argued that cities have social and economic impacts on sustainability while they export their environmental externalities to areas out of their boundaries. This notion is very important in assessing the sustainability of urban areas as they extend much beyond their administrative boundary.

Sustainable Development Goals (SDGs) and targets were adopted in 2015 (Kumar et al., 2017b) for the next 15 years with the specific aim of achieving a holistic approach towards sustainable development for both developing as well as developed countries (Griggs et al., 2013). These goals are believed to be more integrated into policy than Millennium Development Goals (MDGs) as nations can prioritize the targets and goals over national scales and local conditions (Le Blanck, 2015) while working with internationally accepted norms. SDGs are accompanied

by concrete indicators and some goals also have a “means of implementation” which includes finance, trade, technology transfer, etc (Le Blanck, 2015). For example, Goal 17 presents a cross-cutting theme of targets which includes finance, trade, multi-national cooperation, and capacity building to facilitate implementation of the other 16 SDGs. These indicators and targets are theoretically aimed to be universal but practically they are not applicable to every country (Hák et al., 2016). Goal 11 of SDG, making cities inclusive, safe resilient and sustainable, addresses urban sustainability and includes the following cross-cutting issues of affordable housing, sustainable transport, human settlement planning and management, green and public spaces, supporting positive economic, social and environmental links between urban, peri-urban and rural areas and developing and implementing, in line with the Sendai Framework for Disaster Risk Reduction 2015–2030, a “holistic disaster risk management at all levels” (United Nations, 2018). Indicators proposed to measure these targets include, but are not limited to, proportion of population living in slums, ratio of land consumption rate to population growth rate, total and per capita expenditure on preservation of natural and cultural heritage, solid waste collected, proportion of local governments that adopt disaster risk reduction strategies according to the Sendai Framework for Disaster Risk Reduction 2015–2030, etc. (Inter-Agency and Expert Group in Sustainable Development Goal Indicators, 2016). SDG targets have emerged from a long process of political negotiations. Sustainable Development Services Network (2015) states that when these targets were assessed for their scientific robustness it was found that only 49 targets out of 169 had a well-developed scientific background. 54% of the targets needed to be more specific in terms of their scope while 17% needed significant improvement (Sustainable Development Services Network, 2015). Lack of implementation, conflict between targets and goals, and between international agreements and political foci, unavailability of data and non-quantifiable targets were the major weaknesses found in the assessment (Hák et al., 2016).

From Table 1 it is clear that all aspects of sustainability arise from human activities, like resource use, pollution, need to understand a system’s capacity, intergenerational equity and tipping points among many others. Since these activities are concentrated in urban areas (Mehta et al., 2016), urban sustainability works as a cross-cutting issue across the environmental, social and economic sustainability. Here space is used to define sustainability (Wang et al., 2016). The inflow of materials and energy resources and generation of wastes should not exceed the city’s capacity for a sustainable environment (Science for Environment Policy, 2015). Economic activity, population growth, infrastructure and services, pollution and waste should be internally limited in the system so that urban system may develop in harmony, internally limiting negative impacts on the natural environment (Hiremath et al., 2013). At this point, mention should be made about

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