



Improving urban metabolism study for sustainable urban transformation



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HIGHLIGHTS

- This paper discusses research and policy needs in the field of sustainable urbanization.
- This paper targets studies for China's rapid urbanization.
- We discuss the research needs for metabolism studies for sustainability of cities.
- The major driving forces in the context of urbanization are analyzed.
- We study the knowledge integration through stakeholder engagement.

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ABSTRACT

It is important understanding urbanization where residents outside of the area come into the urbanized region. Urbanized area is the one facing more environmental problems because of intensive population density amplifying more damage to the environment. This paper targets China's rapid urbanization and discusses research and policy needs in the field of sustainable urbanization. We discuss research needs for metabolism studies for sustainability of cities, major driving forces in the context of urbanization, and knowledge integration through stakeholder engagement.

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1. Introduction

Since the Club of Rome report that economic growth is limited by the exhaustion of resources, sustainable development has mainly been discussed in terms of the environment and resources. The previous debate on sustainable development has focused on developing countries, leading to problem awareness along with an assumption of a rapid population increase and resource use (Managi, 2015). However, serious sustainable development problems at the center of attention in major developed countries and many other countries that have entered a mature phase are associated with population decreases, declining birthrates, and aging populations.

This study represents a significant development from the previous research framework, in which sustainable development is formalized on the basis of country- and world-level relationships (see review of policy analysis at the country and regional level for Somanathan et al., 2014). Currently, it is also extremely important understanding urbanization where residents outside of the area come into the urbanized region, in the meantime there are areas facing much less population than before. Urbanized area is the one facing more environmental problems because of intensive population density amplifying more damage to the environment. Summation of these urbanized cities could be much bigger than impact of several countries. In the same time, high income people tend to stay in urban area who request clearer environment. In addition, more the people stayed in same region, larger the damage they receive such as disaster because of larger economic loss of one big event. These request the needs for environmental and sustainable study for urbanization.

This requires constructing a database and conducting an empirical study in urban level. In addition, the construction of sustainable development index (SDI) that considers not just developed countries but societies with stable or increasing populations and mature societies is going to be increasingly required in the future. Above all, research in the domain of a major region such as urbanized cities such as mega-city in the context of sustainable development is extremely crucial. We are facing the fact that cities are becoming major targets of metabolism study as global impacts of cities have continued to grow.

China, as one of the countries experiencing the speediest urbanization, is becoming a hot spot for urbanization research throughout the world (Normile, 2008). China has the largest population in the world, and it has become the second biggest economy just after the US. For such a populous, economic and political giant, urbanization has made remarkable changes over the past few decades. An annual average growth rate of about 1% in urbanization has been recorded ever since 1980s, which means more than 10 million people migrated to urban areas each year. Social, economic and ecological implications accompanying this rapid shift are dramatic. For example, China is transforming from an agrarian society into a largest urban society (Normile, 2008); it has become world top emitter of CO₂ since 2007 (Guan et al., 2009); only three out of 74 major cities met the national air quality standard in 2013 (Xinhua, 2014), and more than 60% of Chinese cities are short of fresh water supply. Liu (2010); lifestyle change, ecological degradation and biodiversity loss have led to increased human diseases (Yang, 2013). Besides, given China's huge base, any of its internal disturbances could have worldwide impacts. All of these facts make China an ideal and irresistible living laboratory for urbanization research throughout the world (Normile, 2008).

Although there have been increasing research on China's urbanization and its sustainability, a majority of them tackled the issue from a single perspective within certain discipline (e.g. resources science, biogeochemistry, landscape geography, ecology, or epidemiology), and efforts to summarize these research works in a systematic and streamlined way have been rare. In fact, various drivers, pressures, processes and impacts, which are associated with urbanization, are coupled and interrelated to one another. In this sense, a holistic view is indispensable to draw a full picture of China's urbanization and concomitant sustainability issues, in an attempt to shed light on future research directions.

This paper, therefore, targets China's rapid urbanization, summarizes research in previous studies, and discusses research and policy needs in the field of sustainable urbanization. Following sections discuss and research needs for metabolism studies for sustainability of cities, major driving forces in the context of urbanization, and knowledge integration through stakeholder engagement.

2. Metabolism studies for sustainability of cities

Cities are becoming major targets of metabolism study. This is because global impacts of cities have continued to grow (Kennedy et al., 2012). An analysis of urban metabolism consists of quantification of flows and stocks of materials, energy, and water in a city as well as associated flows and stocks outside of the city. This metabolism is caused to support quality of life of people living in the city. Therefore, its metabolic profile can be regarded as an environmental and resource profile of the city because these flows and stocks bring about environmental degradation and resource scarcity as well as secondary resource supply.

Metabolic profile of a city has been increasingly used as a basis for identifying key elements and formulating effective policies associated with major urban issues, including resource and waste issues caused by increased resource demand and waste generation (see Section 3.2.1); water supply scarcity caused by climate change and increased water demand; energy and climate change issue caused by energy consumption and emissions of greenhouse gases; water pollutions caused by emissions of phosphorus, nitrogen, metals, and others; and air pollutions caused by emissions of SO_x, NO_x, particulate matters, and others (see Sections 3.2.2 and 3.2.3). Change in landscapes caused by transfer of large amount of construction minerals and other resources and degraded environmental quality caused by emissions

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