



Exploring the Current and Future Potential of Urban Agriculture in Growing Urban Sprawls of India: Strengths and Challenges

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Abstract The last century has been largely characterised by (among many other things) increasing urbanisation, with cities across the world (including India) expanding in both number and size. Infrastructure growth, expansion of cities and consumption pattern of urban inhabitants are significant having enormous impact on ecosystems and natural resources (especially land, water and biodiversity) within cities as well as far beyond the city boundaries. Growing challenges with respect to sustainability of growing urban sprawls of India and how nutritional security are going to be affected in coming decade has been highlighted in the paper. Urban agriculture (UA) is an important Nature-based Solution that can help the urban locals of growing urban sprawls of the country to reduce pressure on rural and peri-urban areas for sustainable growth of urban areas. UA is decentralised, local food production system for enhancing urban food production to achieve urban food self-sufficiency. UA framework in Indian context depends on physical- and socio-economic factors responsible for current and future potential of UA. UA has to play a pivotal role in future in urban food security. However, the key challenge is to quantify the current and future potential of UA in sustainable growth of mega-cities. Study highlights knowledge gap and need of proactive policy planning for promoting UA to localise and realise Sustainable development goals, especially SDG 2 and 11.

Keywords: Urban sprawls, India, Urban agriculture, Food security, Ecosystem-based approaches

1. Introduction

More than half of the world's population lives in urban areas and the figure is continuously increasing at a rate of 4% a decade by 2050 (Tang *et al.*, 2016). In 1900, only 10% of the global population was living in urban areas, which now exceeds 50% and is expected to further rise up to 67% in next 50 years (Grimm *et al.*, 2008). The global urban population has increased from 746 million people in 1950 to 4 billion in 2015 (more than a fivefold increase), with an expectation to continue growing in coming decades. Low- and middle-income economies are projected to have more than double and triple of their present urban populations, respectively, by 2050 (United Nations, 2015). In developing countries, about 44% of the population is presently dwelling in urban areas, but by 2050, developing countries will have majority of urban residents (Montgomery, 2008; UN-Habitat, 2010). Cities occupy less than 3% of the global terrestrial surface, and account for 60% of water consumption, 78% of carbon and GHG emissions, with 76% of wood consumption for various purposes (Brown, 2001). Global demand for food, freshwater, land and other important natural resources (biodiversity) are continuously increasing to satisfy the need for growing population, especially in megacities. The most daunting effect among these is ever growing food and water demand (Dhyani and Thummarukudy, 2016). Rapid urbanisation is an unavoidable phenomenon, with many negative consequences like dense population growth, change in land use and land cover, huge pressure on ground water resources, vehicular emissions, issues related to waste

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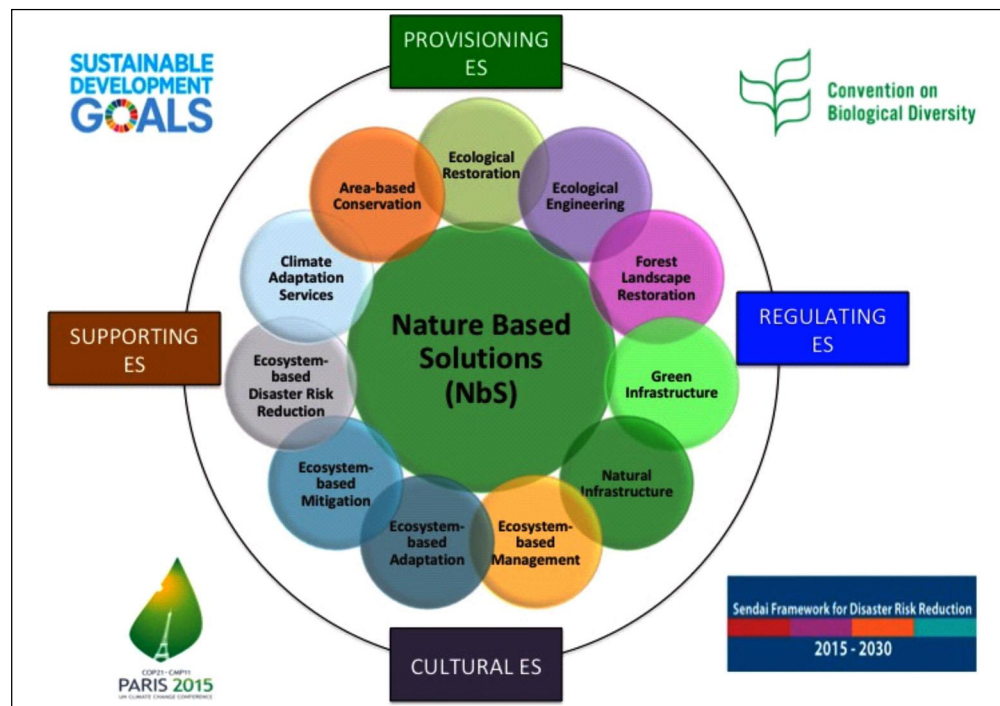
water and solid waste management, environmental problems affecting health conditions and scarcity of natural resources along with loss of biodiversity and Urban green spaces. Disasters in India were earlier predominant in remote and isolated natural pockets of the country. Presently, urban areas are new emerging hotspots of natural as well as man-made disasters due to unplanned development and growth. According to vulnerability atlas of India, 38 cities are located in naturally seismic and sensitive zones making them more susceptible to natural and man-made disasters (Kumar and Walia, 2012). Rapid urbanisation in India has also brought complex transformations to ecology of the areas, economic development and societal issues (DeFries and Pandey, 2010). Urban centres are having unusually large ecological, carbon and water 'footprints' with complicated, prevailing, and often unexpected consequences on ecosystems. Urban areas have their own bearing on people dwelling in rural and peri-urban areas of the country (Nagendra *et al.*, 2013). Indian mega cities like New Delhi, Mumbai, Chennai and Bangalore along with fast growing tier two and tier three cities are also expected to be highly populous by 2030, and will face severe challenges to secure urban food supply and nutritional security.

2. Ecological Footprint of Growing Indian Urban Sprawls

India is expected to face a gigantic increase in urban population, from 377 million people in 2010 to projected 600

million in 2030. India contributes 14% of urban population (Dhyani *et al.*, 2018; Kundu, 2011) in five megacities with over 10 million population and by 2030 is expected to rise to seven megacities (UN Habitat, 2010; Taubenböck *et al.*, 2009). India also has 53 growing urban sprawls with more than 1 million population as of 2011 versus 35 in 2001 (Census, 2011). The spatial extension of 100 top cities has burgeoned by almost 2.5 times to more than 5000 km² (Bhagat, 2011; Sudhira, 2007). The UN data reveal that mega city like New Delhi will host another 10 million people by 2050 (UN Habitat, 2010) with enormous increase in resource demands of the city. Rapid urbanisation and mounting industrial activities are affecting the land use patterns and the production efficiency from the land systems. The depreciation of overall ecological sustainability has been the main grounds of increase in both physical and socioeconomic vulnerabilities across India. Gradually, urban planners, scientists and engineers are recognising the fact that exercising green approaches or a mix of green and grey solutions can improve on climate adaptation and help reducing the situation of natural disasters and disaster frequency and intensity in long term (Dhyani *et al.*, 2018; Dhyani and Thummarukudy, 2016; Dhyani and Dhyani, 2016). Approaches, that use Nature-based Solutions (NbS)/ ecosystem-based approaches for disaster risk reduction and climate change adaptation, are progressively receiving their due attention across global and national policy arena(s)

Figure 1. NbS Involve Ecosystem-Based Approaches that Provide Constant Flow of Ecosystem Services and Fulfilling Promises of International Agreements and National Targets



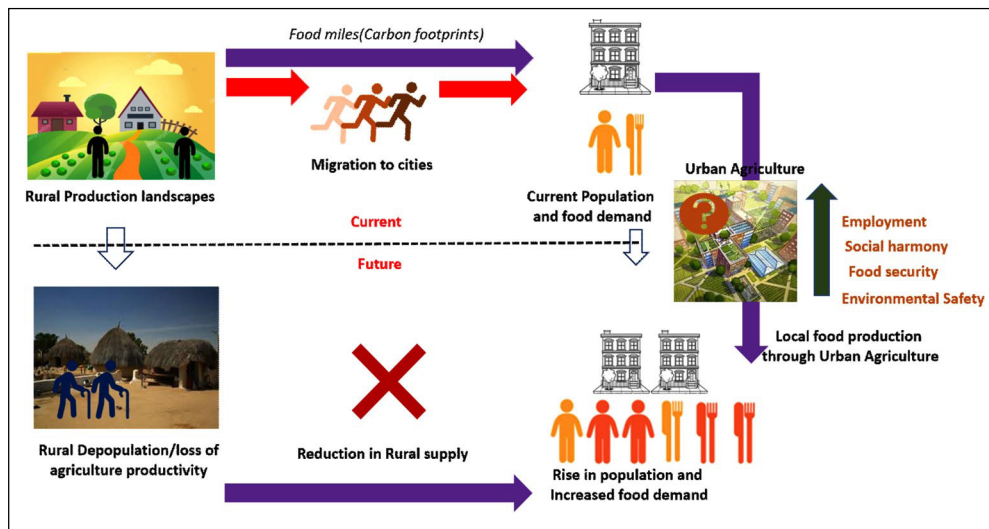
(Kelman, 2015) (Figure 1). Developing resilient ecosystems, practices and societies against uncertainties including food security in urban areas using ecosystem-based approaches as an important NbS, (a no regret approach) with multiple co-benefits is no more a preference but a necessity. Despite, the mounting international backing, the actuality is that ecosystem-based approaches and NbS have yet not been main streamed as fundamental and critical part of climate policy and adaptation practices in many countries including India (Dhyani and Thummarukudy, 2016). With rapid advancement made on theories, strategies and application, it time we take stock of the available success stories and inferences from the growing significance, understanding and purpose of NbS. The impact of urban transformation is perceived to bring in several extreme consequences. It is already stressed that in future, the condition of urban food and nutritional security might be severely compromised due to loss of peri-urban or rural-based food supply chains. Peri-urban and rural-agriculture is already vulnerable due to depopulation, migration, loss of soil quality, loss of ground water and surface water, and loss of agricultural productivity. Between 2001 and 2011, the megacity of the country and capital Delhi’s rural population dropped from 9.45 lakh to 4.20 lakh (Census, 2001, 2011). In last five decades from 1961 and 2011, the numbers of Delhi’s rural villages have dropped from 276 to 112 resulting in city losing its cropped area at 2.28% annually. Between 2000 and 2016, the farmlands under cultivation decreased from 52,816 to 34,750 hectares in Delhi and nearby per urban areas due to uncontrolled expansion of the city (Goswami, 2018). Agriculture being a challenging occupational practice, a meagre 1.31% of Delhi’s workforce by 2011 was engaged in farming and numbers are speculated

to have significantly dropped by 2019. Presently, a lot of migrated people on the banks of flood plain of Yamuna and on the banks of polluted drains and *nallas* can be observed growing vegetables and flowers using sewage and contaminated water but that cannot be considered sufficient, healthy or sustainable urban agriculture (UA) practice.

3. UA: Strengths and Challenges

In a country like India, food and nutritional insecurity has always been considered a rural phenomenon. However, the truth is that the food and nutritional security of urban dwellers is compromised by many factors including non-availability of food, price fluctuations and poverty (Radhakrishna and Reddy, 2004). Mega cities of the country and other growing urban agglomerates are currently reliant on external food supply (partially or significantly) that comes from peri-urban or rural areas far from these city centres. This also serves as one of the limiting factors to sustainable expansion of these cities. Particularly, with rapidly growing population and infrastructure in the urban vicinity, food security in growing sprawls of India will be heavily compromised in future. To address this situation, decentralised/local food production system or UA is gaining momentum to help enhance urban food production and achieve food self-sufficiency (Figure 2). In India, UA is an emerging concept, though home gardens and kitchen gardens have been part and parcel of Indian culture but have lost their relevance in fast paced urban life. UA is an important NbS to ensure food security, considering the rapid urbanisation, economic development and fast expansion of cities.

Figure 2. Conceptual Background of UA: UA Will Play a Pivotal Role in Future in Urban Food Security
Key challenge lies in quantifying the current and future potential of UA in sustainable growth of mega cities.



UA can be defined as any production of crop, vegetables or flowers within cities that uses low external input sustainable and climate adaptive agriculture (LEISAA) that comes in multiple forms (e.g. green space cultivation, rooftop cultivation, urban farm-based cultivation, home gardens and kitchen gardens) (Walters and Midden, 2018). UA, although practiced informally in many cities, has received greater attention in last one decade. UA can be an important practice to achieve urban food security, create livelihood, enhance environmental health, reduce chemical input to agriculture, manage waste and increase urban resilience to external shocks in future. In addition, UA has potential to deliver indirect environmental benefits resulting from reduced food miles, a measure that can contribute to decarbonisation of the planet (Specht *et al.*, 2014). Food and Agricultural Organization of the United Nations (FAO) identifies urban and peri-UA as a practice that contributes to domestic food, nutritional security, employment, improving urban ecology and sanitation, and achieving poverty alleviation for sustainable urban development (Zezza and Tasciotti, 2010). UA or peri-UA can also help to find sustainable solutions to the growing challenge of wastewater and solid waste management in megacities of India in addition to helping alleviate poverty. It is pertinent to explore options and opportunities for UA to develop future scenarios of UA in changing climatic conditions. Though, there is growing interest among urban locals to grow their own food because of increased pesticide and usage of chemical by farmers across the country still the percentage of the urban population growing their own food is miniscule and insufficient. The potential of UA has gone unrecognised (or under recognised) in agricultural policies and urban planning, particularly in future expansion of mega-cities, tier two as well as upcoming tier three cities. It is highly imperative that the concept of urban green spaces and UA to be promoted in growing urban sprawls of India. Thus, exploring the current and future potential of UA can immensely contribute to the current knowledge gaps regarding the concept. Moreover, UA has the potential to directly contribute to localisation and realisation of Global sustainability targets, such as the SDG-2 and SDG-11. Despite, being a fast growing economy India is traditionally known for its agriculture practices and hence, UA can be a welcome step. An important example to cite here is about UA in Japan where it is patronage well by national as well as local governments. About one-third of the current domestic agricultural output in Japan comes from UA (Benke and Tomkins, 2017). However, these

multidimensional benefits of UA are not fully realised and the potential of UA is often hindered by lack of good quality and reliable data. Management strategies and policy interventions to explore integration of UA in urban planning are not in place and therefore, will require policy support and interventions.

4. Conclusion and way Forward

UA is an emerging area for research and developmental professionals to understand the feasibility of UA in growing Indian sprawls. India is culturally rich in its agriculture beliefs and practices hence, it is an important opportunity to learn, adopt and promote UA as an important ecosystem-based approach/NbS for it is effective and efficient understanding and implementation. In Indian context, it will be vital to understand at what extent, UA can possibly contribute to feed the population in these two megacities and what are the physical and socio-economic limiting factors and scenarios that may hinder fostering UA by 2030 and 2050. Policy dialogues and intervention are to be well supported with scientific evidence provided from research to endorse, popularise and realise UA potential in Indian urban sprawls. Required research intervention can help policy makers to understand different barriers and opportunities for sustainable UA in the country in a better way.

5. Disclosure Statement

The authors report no potential conflict of interest.

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