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ROUND TABLE

Potential and relevance of urban mining in the context of sustainable cities

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Abstract The objective of urban mining is the safeguarding of the environment and the promotion of resource conservation through reuse, recycling, and recovery of secondary resources from waste. Urban mining maximises the resource and economic value of the waste streams generated in urban spaces and will be a significant concept in the planning and designing of sustainable cities, making the process consistent with the sustainable development goals. This review article brings out comprehensive information on urban mining as a concept and its relevance to the Indian and international context as a source of secondary raw material.

Introduction

Urban growth in tandem with service oriented societies has led to an increasing demand for material resources such as cement, steel, copper, aluminium, rare earths, and so on. Due to issues related to primary mining, price fluctuation, material scarcity, availability and access, improving the mining of secondary resources has become an obvious need. While the recycling of paper, glass and steel is a known concept, considering urban spaces as a source to recover metals like copper, gold, silver and rare earths is new. Also, in planning sustainable cities, it is essential to connect local material and energy loops, which are adapted to local circumstances to reduce the pressure on virgin resources in production. Urban mining (UM) concerns all the activities and processes of reclaiming compounds, energy, and elements from products, buildings, and waste generated from urban catabolism (Baccini & Brunner, 2012). It considers urban spaces as sources of anthropogenic materials which can be cyclically used, recycled, and reused (Brunner, 2011). Urban

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mining supports countries, especially cities, to reduce the pressure on natural resources and at the same time decrease air and water pollution from the effluents of the landfills. This will help the process of transition to sustainable cities, which in turn will foster the development of many new extraction and processing industries (Jones et al., 2013).

Urban mining and its relevance for India

Resource consumption is increasing rapidly in India due to several interlinked factors: population growth, rapid urbanisation, economic and industrial growth, and rising incomes. While per capita consumption of materials in India is still low compared to the rest of the world, India's total resource consumption is quite high and is expected to increase rapidly as per the given trends. India has already become the world's third largest consumer of materials. If current trends continue, India's material requirements are projected to be 25 billion tons by 2050, with the biggest increases in the shares of fossil fuels, metals and minerals (GIZ-IGEP, 2013).

Urban mining is being practised globally of late to recover resources from anthropogenic mines. In developing countries like India, however, secondary resource is both a challenge and an opportunity, considering its potential towards environmental savings, resource benefits, and deriving economic benefits. Truly sustainable cities would not differentiate between waste and resources and would consider innovative ideas that foster secondary resource utilisation. In India, urban mining could be specifically relevant to the dominant urban waste streams such as electronic waste (e-waste), energy efficient lighting, end-of-life vehicles (ELVs), construction and demolition waste, wherein both the formal and the informal sector currently play a role; therefore landfilling or stockpiling of most of these waste streams usually does not occur. Considering the present focus on sustainable cities, the use of secondary resources is of interest to both the economy and the environment, since it is likely to improve the reduction of CO_2 emissions. However the re- and down-cycling of metals from the formal and the informal sector is poor because the information on metals with regard to kind, process, quantity, and traceability is not easily available, which impacts the secondary resource utilisation potential.

Social relevance

India currently meets most of its material requirements domestically, and domestic resource extraction is likely to increase to meet future demands. While techno-economic constraints have hindered effective utilisation of domestic mineral resources, the environmental and social issues associated with mining are bigger concerns. Many mineral reserves are located in forests, vital watersheds, areas rich in biodiversity and lands inhabited by indigenous people. Environmental degradation, displacement, and loss of livelihood associated with mining expansion have resulted in serious conflicts in many parts of India, and may be exacerbated with expanded mining (CSE, 2008). Further, since mining is an energy intensive industry with a high carbon intensity, a massive expansion of mining may conflict with India's greenhouse gas (GHG) reduction commitments under international climate change agreements.

Resource and economic relevance

At present, around 97% of all materials consumed in India are extracted within India, while only 3% are net imports. However, net imports have increased substantially over the past few decades, at a faster rate than that of domestic extraction. As a net importing country, India had a negative trade balance of USD 161 billion in 2011. Of particular concern is the extremely high import dependence for several vital minerals including 95% for copper, and 100% each for cobalt and nickel (GIZ-IGEP, 2013). Recent experience has shown that mineral import dependent countries are increasingly exposed to serious risks from commodity price spikes, monopolistic and strategic behaviour by exporters, and supply disruptions due to instability and conflict in exporting countries. Since over-extraction and over-dependence on imports both have significant associated risks, it is essential to make resource efficiency a major part of India's economic strategy. In the context of raw material pricing and global commodity prices one has to consider the role of the informal sector in handling waste. A formalisation of these informal waste workers would entail certain changes and would affect raw material pricing; therefore, India has to explore options to keep the recycling industry viable and also for the creation of green jobs. In recent decades, India has made improvements in resource productivity but not as much as leading countries (GIZ-IGEP, 2013); a stronger commitment to resource recovery and reuse is essential to meet future social, economic, and environmental goals.

Policy relevance

India currently has an impressive number of environmental regulations, centred on the Environment Protection Act (1986) as an umbrella act, with Water Act (1974) and Air Act (1981) to deal with increasingly hazardous pollution levels. Moreover, India has an extensive network of institutions (at the national, state, and local levels) that is designed to implement these regulations. Specifically with regard to waste management regulations, the focus of the Government of India (GoI) recently shifted from the "Polluter Pays Principle" to its application by introducing "Extended Producer Responsibility" (EPR). Extended Producer Responsibility as a policy approach not only reduces the environmental impacts of the products put on market but also introduces the concept of the producer being responsible for the entire life cycle of the product. This approach integrates the costs, improves waste management by reducing disposal, increases closed loop economy by ensuring take back and recycling of end of life products to foster urban mining, and reduces the burden on municipalities. Also with regard to the Indian government's focus on smart cities and GHG mitigation commitments, urban mining becomes an important approach to enhance resource sustainability and improved environment protection by aiming towards a resource efficient economy. In addition, India recently launched the Indian Resource Panel (InRP),