Chapter 1

General introduction

1.1 Urbanization and urban and peri-urban agriculture

Urbanization is rapid and historic transformation on a global scale where rural culture is being replaced by urban culture. Migration, which plays a key role in rural to urban transitions, is mainly governed by push and pull factors (Cohen, 2006; Timalsina, 2007; Satterthwaite et al., 2010). Urbanization brings spatial, economic, social, demographic and environmental changes with positive and negative aspects (Weber and Puissant, 2003; Nath, 2007). It creates new infrastructure, development, foreign commerce, employment and basic amenities for health as well as education, but may also lead to social imbalances, poverty and slums, environmental destruction and pollution (Davis, 2006; Azócar et al., 2007; Kundu, 2007; van Veenhuizen and Danso, 2007; Tacoli, 2012).

"Urban and peri-urban agriculture (UPA) can be broadly defined as the production, processing and distribution of foodstuff from crop and animal production, fish, and ornamental flowers within and around urban areas" (Mougot, 2000). The acronym UPA has been introduced by the Food and Agricultural Organization (FAO), and it mainly focuses the intensive production of perishable and highly valuable products in limited space (Nugent, 2000; De Zeeuw et al., 2007). UPA often help to fill hunger gaps by enhancing the access and distribution of food in urban areas (Lee-Smith, 2010). Radical transformation of UPA occurred during the early 1980's in many African countries, especially Nigeria (Kano), Zimbabwe (Harare) and Tanzania (Dar-Es-Salaam) where UPA has become an integral part of the permanent landscape (Smith, 2001; Bryld, 2003; van Veenhuizen, 2006). The driving force behind the transformation in UPA is the increase in urban population and related food demand (Cohen, 2006; Obuobie et al., 2006; Hill et al., 2007; Ward, 2013). Whereas the social, ecologic and economic functions of UPA together with its multifunctions (Figure 1) are often appreciated, the debate about pathogenic diseases and intensive production methods does impede its progress (De Bon et al., 2010; Hamilton et al., 2013).

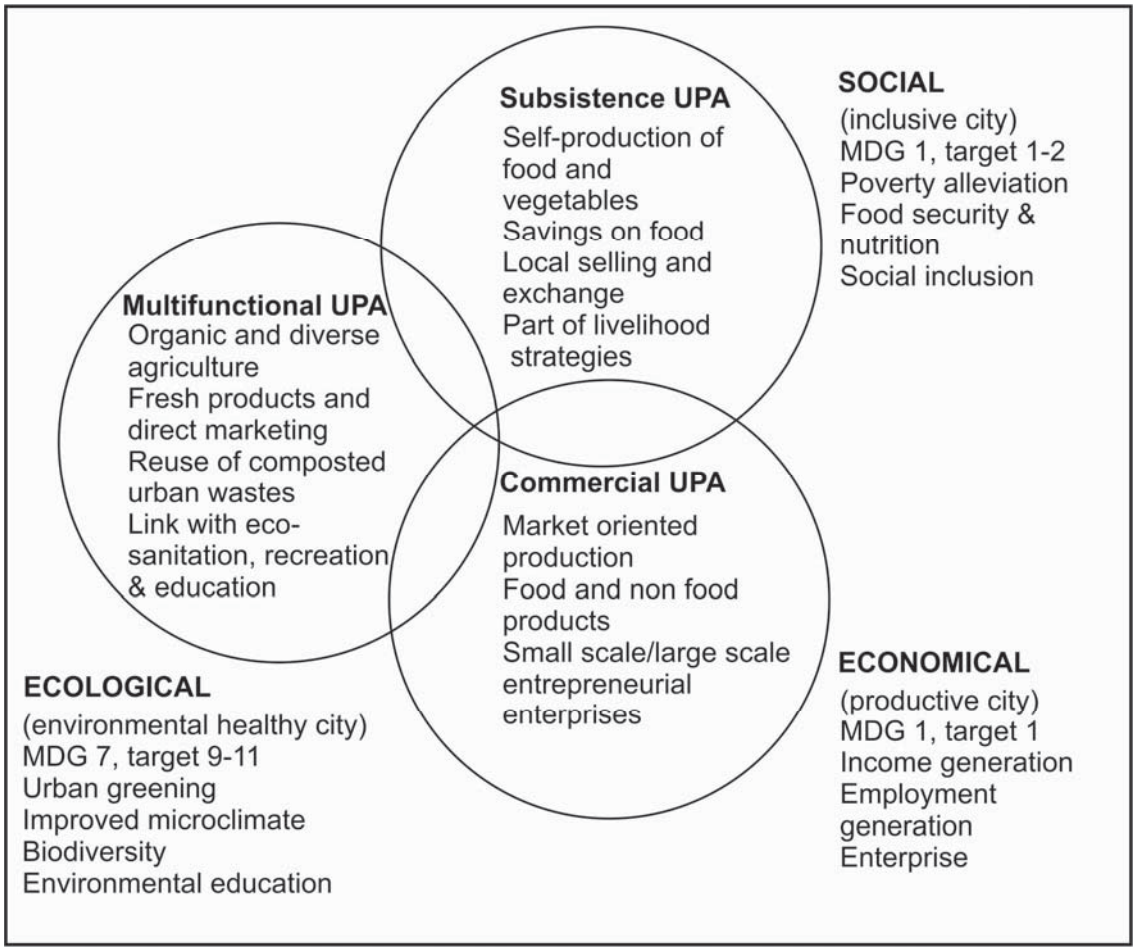

Figure 1. Social, ecological and economic dimensions and various types of urban and peri-urban agriculture (modified after De Zeeuw et al., 2007).

1.2 Urbanization, urban and peri-urban agriculture: Indian scenarios

In 2011 the population of India was 1.2 billion (Census India, 2011) on a land area of 32,87,590 km^2, resulting in a land/man ratio of 0.002 as compared to 0.007 in China and 0.031 in the USA. By 2025 India is expected to be the most populous country in the world, thus bringing down the ratio even further. India's rate of urbanization is estimated to grow by 3.5% per annum. The estimated projection is that by the year 2020, about 50% of the total population of India will live in urban areas. In India one 11.3% of the total population still lives below the poverty line of 1.25 US$ per day (Datt and Ravallion, 2002; Deaton and Dreze, 2002; World Bank, 2012). During the past 50 years, the country's population has doubled, while its urban population has grown nearly five times (Taubenböck et al., 2008; Taubenböck et al., 2009) with the greatest number of megacities in the world (Chakrabarti, 2001; Revi, 2008). It was

also estimated that by 2025, along with the three mega urban regions Mumbai-Pune (50 million), the national capital region of Delhi (more than 30 million) and Kolkata (20 million), the population in 70 other Indian cities will cross the one million mark (Dyson and Visaria, 2004; Revi, 2008).

In India urban and peri-urban agricultural production includes New Delhi (Mekala et al., 2008), Mumbai (Vazhacharickal and Buerkert, 2011; Vazhacharickal et al., 2013), Varanasi (Kumar et al., 2007), Kolkatta (Chattopadhyay, 2002; Mukherjee et al., 2013), Hubli-Dharwad (Bradford et al., 2003), Chennai (Janakarajan et al., 2007) and Bangalore (Ganeshamurthy et al., 2008; Jaganmohan et al., 2012), which is shown in Figure 2. Urban farming is a popular trend among middle class families as a part of rooftop farming or community farming. The practice of urban agriculture in slums suffers from the lack of space, even if some vacant land may be used for this purpose (Ward, 2013). The usage of waste water for irrigating UPA gardens and the presence of heavy metals in the water were reported from New Delhi (Rattan et al., 2005), Varanasi (Singh et al., 2009; Ghosh et al., 2012), Hubli-Dharwad (Hunshal et al., 1997; Bradford et al., 2003), Hyderabad (Sridhara et al., 2008) and Mumbai Metropolitan Region (Vazhacharickal et al., 2013).

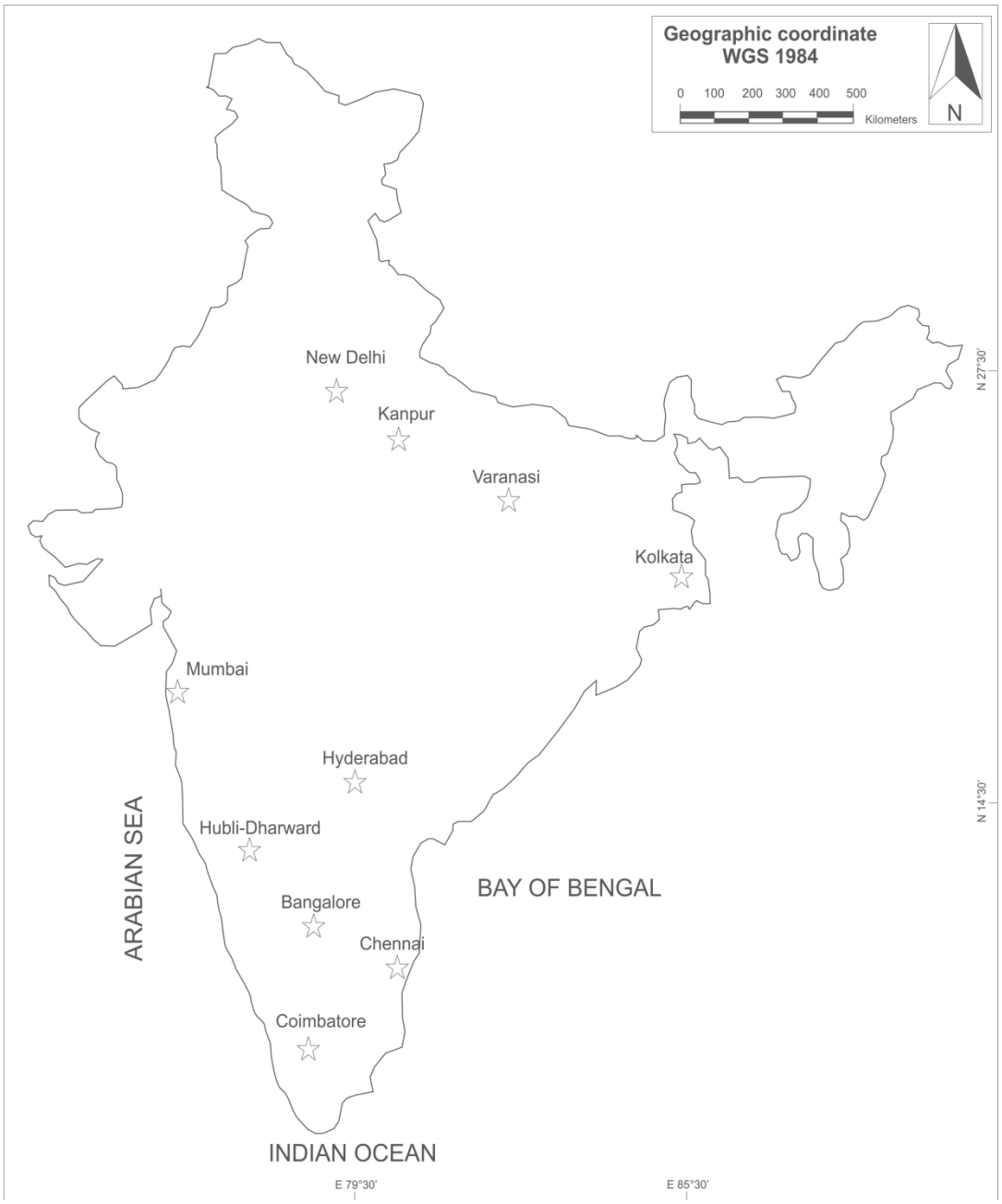

Figure 2. Reported urban and peri-urban agricultural production centers in India marked using a star symbol.

1.3 Urbanization in Mumbai Metropolitan Region

The Mumbai Metropolitan Region (MMR) consists of 21 urban centers and 1,090 villages (Jain et al., 2013) which are under the jurisdiction of the Mumbai Metropolitan Region Development Authority (MMRDA) established in 1975 (Patankar et al., 2010). Migration from northern Indian states to Mumbai increased from 1961 to 2001, and was higher than the migration within the State of Maharashtra. The

influx of migrants from rural and regional centers of India renders the economic growth sustainable and consequently makes the MMR one of the fastest growing regions of India (Desai and Yadav, 2007). People migrate to Mumbai for better employment, but many of them spend their life in the city's sprawling slums and find employment only in the low paid informal sector, unskilled manufacturing or by collecting and selling rubbish (Jen, 2007). Dharavi, which has a size of around 2.4 km^2, is considered to be one of the biggest slums in Asia with 1 million inhabitants (Sharma, 2000; Patel and Arputham, 2007; Patel and Arputham, 2008). Migration and shortage of land due to extreme topography are the main factors for the housing crisis in Mumbai (Desai and Yadav, 2007).

1.4 Urban and peri-urban agriculture in Mumbai Metropolitan Region

Little is known about the various UPA productions systems in MMR. Urban agriculture in Mumbai started with Dr. Doshi's city garden methods suitable to reduced spaces such as balconies and terraces. His methods rely on locally available materials like sugarcane waste, polyethylene bags and household organic waste (Vazhacharickal and Buerkert, 2011) and are targeted towards domestic consumption. Scarcity of land and a shift in the agriculture to the residential areas (McGregor et al., 2006; Schumacher et al., 2009; Lovell, 2010) is a common phenomenon in Mumbai (Mukhopadhyay, 2001; Mukhopadhyay, 2005; Vedula, 2007). The need for housing increases the value of agricultural land in urban and peri-urban areas and leads to their transformation (Bryld, 2003; Singh and Asgher, 2005; Lovell, 2010; Abdalla et al., 2012). Brick kiln industry serves the demand of rapid urbanization and its production was located near the urban area, thus bringing about landuse cover changes in peri-urban areas (Singh and Asgher, 2005). Most of the traditional villages in the MMR are on the verge of extinction due to the increasing size of the urban and residential areas as well as the development of new urban hubs.

1.5 Urban and peri-urban soils

Due to the rapid urbanization the importance of anthropogenic urban soils is getting increasing attention. Anthropogenic urban soils differ in their properties and

pedogenesis compared to natural soils (Brown et al., 2005; Braun et al., 2006). They are influenced by the activities of housing, trading, traffic, production and disposing in addition to artefacts such as bricks, glass, charcoal and other wastes (Lehmann and Stahr, 2007; Steiner et al., 2007; Teixeira et al., 2009). Greater knowledge of urban soils is necessary to assess their ecosystem services to the urban community (Tratalos et al., 2007).

1.6 Research objectives and hypotheses

The objectives of this study were (1) to identify and characterize the different UPA production systems across the MMR; (2) to provide a comprehensive overview on the households, farm and crop management practices and marketing networks; (3) to determine soil fertility and *status quo* of soils' heavy metal signatures; (4) to assess the pollution load index, enrichment factor and degree of contamination of some selected soils.

The study is based on the following hypotheses:

(1) The UPA production in MMR is quite complex and diverse, facing problems regarding land use rights and labor.
(2) The elemental and heavy metals signatures in urban and peri-urban soils are good indicators of soil health, contamination and enrichment.
(3) Total heavy metal and heavy metal accumulated in plants are good tracers of metal uptake by plants.

1.7 References

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