Why Peri-urban Ecosystem Services Matter for Urban Policy

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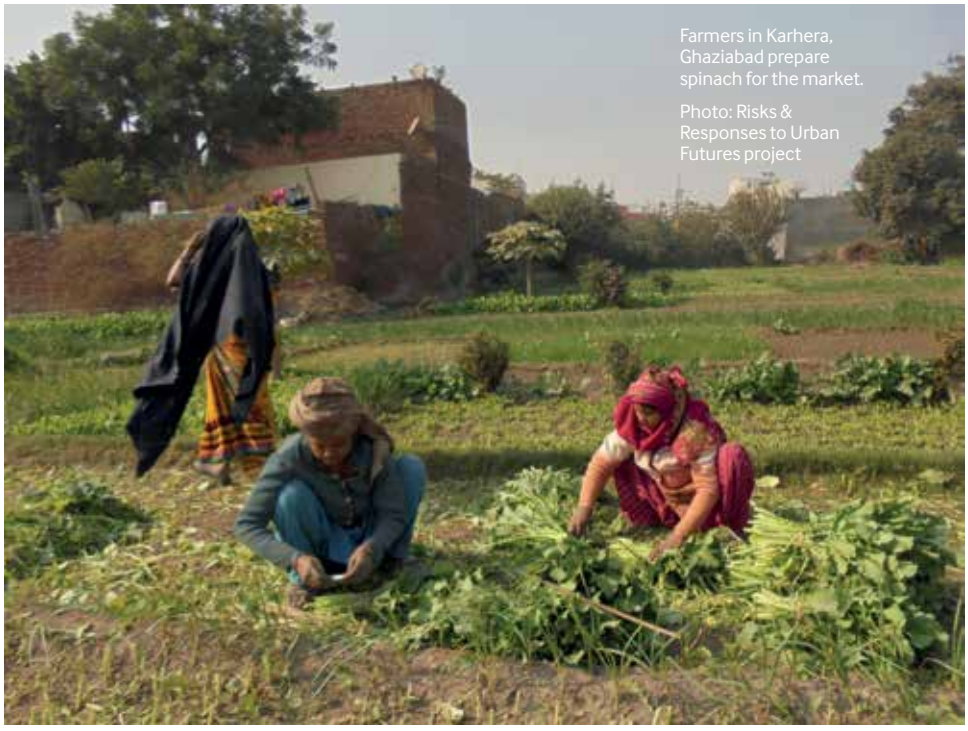
Peri-urban ecosystem services and sustainable urbanisation

This briefing draws on recent research to show how people benefit from ecosystems in and around cities, and how these benefits can be integrated into urban planning and policy.

There is a growing international consensus that cities must form the vanguard in addressing the numerous challenges of sustainable development (ICLEI, 2015; UN, 2016). Sustainability is also an essential ingredient for a globally competitive city. However, in rapidly growing cities of South Asia, governments and international agencies must not simply think of cities as urban islands. Cities must be understood in terms of the processes of urbanisation which unfold across the rural-urban continuum, with environmental processes integral. We argue that failure to do so is undermining the ability to build inclusive and resilient cities.

As rapid urban expansion and redevelopment continue, rural-urban linkages are being transformed. Ecosystem services (ES) are central to this transformation because, as the "benefits people obtain from ecosystems" (MEA, 2005, p. v), they arise from the interaction between people and the multiple ecosystems that intersect as the rural is increasingly influenced by the urban.



Farmers in Karhera, Ghaziabad prepare spinach for the market.

Photo: Risks & Responses to Urban Futures project

The ecosystem services produced by peri-urban ecosystems and through peri-urban agriculture play significant roles in multiple aspects of urban sustainability and resilience, from food security to disaster risk management. Yet the ecosystems upon which these services depend are increasingly under threat and persistently overlooked in policy and planning.

Key Messages

1. To improve urban resilience, city-region planning and policy should recognise the importance of peri-urban ecosystems for functions such as:
- disaster risk management, for example flood control
- reduction of urban heat island effects, air and water purification
- food and water security, and
- waste management.
2. There are potential trade-offs and synergies between peri-urban environmental change and sustainable urban development. To understand how to minimise these trade-offs, and improve the synergies, it is important to take account of the local context and social, cultural, economic and political drivers and dynamics.
3. Peri-urban agriculture is an important example of how neglect of peri-urban ecosystems has led to multiple negative impacts. Industrial pollution and competition for land and water resources have serious impacts on peri-urban agriculture which also undermine food safety, livelihoods and other environmental benefits. Smallholder and tenant farmers are becoming more vulnerable because of changes in ecosystem services (ES), increasing land prices, changing governance arrangements, and changes to power relations and their agency.
4. The preservation of peri-urban agricultural ecosystems is vital not only for peri-urban livelihoods but also for food security (supply, access, quality) for city inhabitants. These ecosystems provide multiple additional environmental benefits, such as flood control, air and water purification and urban heat island reduction.
5. Participatory mapping and long term engagement with peri-urban communities need to form part of a more integrated approach to city region planning which will address multiple sustainable development goals. Such approaches reveal links between environment, poverty and health which are neglected in current planning.
6. New approaches to city region planning that enable decision makers to incorporate multiple forms of knowledge and understand implications of potential planning interventions across scales are vital.
7. The unique governance challenges of peri-urban places, that fall between urban and rural jurisdictions, should be recognized and lessons of successful peri-urban natural resource management be shared.

Peri-urban ecosystem services, agriculture and food security

Peri-urban agriculture (PUA) is one of the activities most directly dependent upon the continuing functioning of ecosystems and the services they provide, such as clean water, pollination and soil nutrient recycling (Jennings et al., 2015), whilst also itself contributing to multiple ecosystem services with benefits for peri-urban communities and the wider urban population.

Different practices in PUA can either undermine or enhance ecosystem services. High levels of pesticide use, for example, affect not only food safety, but also soil quality and a variety of other environmental services. The ways in which PUA is practised also influences the degree to which it can contribute to other environmental services such as nutrient cycling, air and water purification, reduction in urban heat island effects, and flood control (see Dubbeling, 2013; Marshall et al., 1999; Moustier and Renting, 2015; Mukherjee, 2001; Singh and Rai, 1998; te Lintelo et al., 2002).

PUA is vital for the supply of affordable fresh produce to cities, whilst also being a key source of livelihoods (see Marshall et al., 2009). If appropriate support measures are in place, PUA also has huge potential to provide innovative methods for recycling urban waste and delivers numerous environmental benefits, such as flood risk mitigation and reduction of urban heat island effects.

However, rapid urbanisation is threatening peri-urban agricultural livelihoods and the ecosystems that peri-urban production systems rely upon. A direct result of the loss of these peri-urban ecosystems – for which PUA is uniquely positioned to help preserve – is the loss of cities' resilience against flooding, extreme weather, rising temperatures and other food system shocks.

Despite this, the importance of PUA and the threats to PUA from urban sprawl and pollution are often unrecognized (Marshall and Randhawa, Forthcoming). PUA is under

pressure on three fronts: 1) inappropriate planning; 2) the hidden effects of pollution; 3) resource competition. These three factors combine to threaten broader environmental and food security outcomes while also driving PU farmers into unsustainable practices, as they have no other choice for coping with the increasing uncertainty they face.

Limited support for peri-urban agriculture in policy and planning

Overlapping rural and urban administrations and agencies responsible for peri-urban areas tend to operate separately and often in contradictory ways. Policies and urban plans fail to integrate environment, health and poverty issues adequately or take account of the multiple benefits of PUA. Urban planning largely deals with mobility issues and infrastructure development and tends to engage with environmental issues only in terms of establishing 'green belts', 'biodiversity parks', 'city forests' etc. (NCRPB 2005, DDA 2006, GDA 2006). At the same time, weak governance arrangements and lack ot attention on the peri-urban lead to further unplanned pressures on natural resources, and faulire to learn from areas of success.

Pollution and degradation of peri-urban ecosystems

While some of the impacts of industrial pollution in peri-urban areas may be recognised by regulators and civil society groups, there are significant hidden effects on the ecosystem services that support PUA. These have implications for productivity, food safety and other aspects of human health.

For example, a Comprehensive Environmental Pollution Index report (CPCB, 2009) highlighted Ghaziabad in the Delhi National Capital Region as a critically polluted zone. Action was focused on specific pollutants linked directly to human health, without recognising the more complex effects of a wider variety of pollutants on agricultural production and food safety. The relationships between environmental pollution and food need to be explicitly recognised in policy and planning (Marshall et al., 2003).

Resource competition

Pressure on peri-urban water infrastructures increases due to competition from local industries and urban uses, creating immense challenges for the majority of resource-poor peri-urban farmers. Competition for land for formal and informal construction, along with booming informal land markets, drives the loss of agricultural land and increases the vulnerability of tenant farmers. This undermines local innovation in agricultural practices which can only thrive when farmers have secure rights to agricultural land and power to influence the management of natural resources.

The way forward

Our research has revealed numerous opportunities to incorporate planning for productive landscapes into city region planning. We have also developed tools and approaches to support the integration of ecosystem-based approaches into land use and city region planning.

Local and municipal governments have an unprecedented opportunity to achieve multiple sustainability goals and enhance urban resilience by supporting PUA and protecting peri-urban ecosystems from the impacts of urbanisation.

Action among policy-makers and planners needs to aim at long term change in policy and planning practices to tackle the threats to peri-urban ecosystems while also developing direct interventions to mitigate the immediate impacts of those threats:

1. **Re-vision city-region planning and policy from an ES perspective.**

a. Take a regional approach to urban planning which looks beyond a city's urban limits and incorporates ES and PUA into master plans based on land suitability analysis and stakeholder engagement.
b. Integrate urban development policies to address the links between environmental change, health and poverty in peri-urban contexts.

2. **Direct interventions to support peri-urban ecosystems.**
PUA is central because it both depends upon peri-urban ecosystem services while also contributing significantly to multiple other ecosystem services such as flood control and sustainable water management. Supporting PUA includes:

a. Addressing the drivers and impacts of environmental degradation relevant to PUA.
b. Working with PUA communities to monitor pollution and ensure appropriate environmental protection is properly implemented.

c. Conserving natural resources which sustain PUA and peri-urban ecosystems services more broadly.
d. Supporting innovations in sustainable farming practices.

1. Re-visioning city region planning and policy

The re-visioning of city region planning and policy must be underpinned by an understanding of the need to integrate environmental management with considerations of poverty alleviation, health and food security, and to develop approaches to do this that can be responsive to the uncertainties, shocks and surprises of rural-urban transformations.

Taking the example of peri-urban agriculture, the following steps would support the development of such a process:

Integrating PUA into urban planning (including formal and informal agriculture)
Most master plans currently do not include agriculture as a separate category in land use maps, usually marking agriculture as a green belt area. There are a few master plans of cities, including Delhi and Hyderabad, which use the land use category of agriculture, but these plans do not mark informal agriculture on land use maps or zonal maps. The city-region plan should identify all forms of agriculture (both formal and informal) and it should be marked as a distinct land use in the regional map and also in other related urban planning documents (Gupta and Gangopadhyay, 2014; Pearson et al., 2010).

There are some promising policy developments. The Draft Indian National Land Utilisation Policy (2013), which aims to protect land that is required to meet food security, is promising in terms of supporting peri-urban agricultural land use. The PMKSY (Prime Minister's Irrigation Development Plan), which promotes a more integrated and decentralized approach to irrigation planning, includes an objective to explore the feasibility of using treated municipal waste water for irrigation, and a mention of the peri-urban.

The identification of agricultural land in the city-region plan does not suggest a halt to the process of urbanisation. However, planning for the utilisation of agricultural land for non-agriculture purpose should be done on the basis of land suitability analysis. Land suitability analysis using Geographic Information Systems (GIS) has already been recommended in many studies with regard to PUA (Chen, 2014; Dutta, 2012; Thapa et al., 2011). These should include maps which identify suitable areas for agriculture on the basis of environmental resources (such as water and soil fertility). Particular consideration must be taken of any adverse environmental implications of a particular non-agricultural land use for nearby food production, and how this will impact on peri-urban and urban food security and livelihoods.

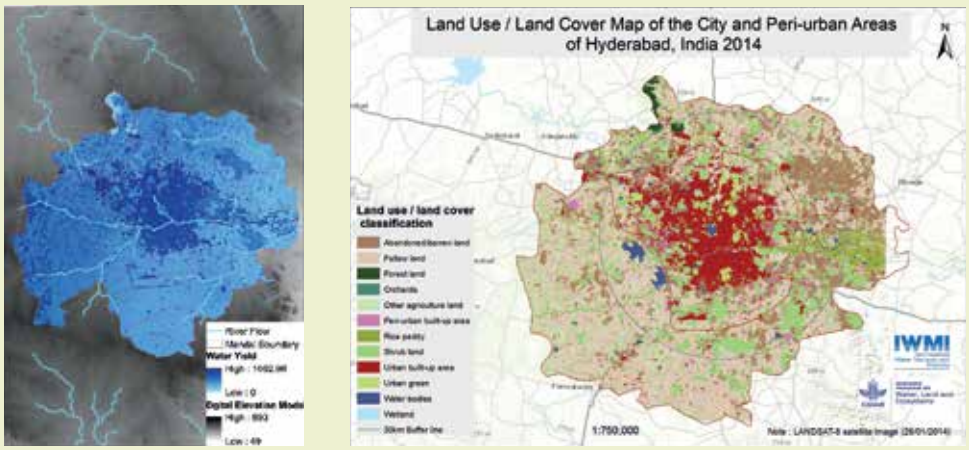
Mapping ecosystem services and poverty alleviation at multiple scales to inform policy and planning

Our research has highlighted the significance of PUA across 6 major cities in South Asia including Delhi, Hyderabad, Bangalore, Varanasi, Kathmandu and Dhaka and has demonstrated the key role played by PUA in livelihoods, urban food provision, other ecosystem services and alleviation of PU poverty.

Our multi-level ecosystem and social mapping approach seeks to contribute to new approaches to city region planning by enabling planners to identify peri-urban areas where environmental degradation is impacting on peri-urban agriculture (PUA) and areas where PUA has the potential to thrive, supported by readily available ecosystem services. In this way, decisions about how to target pollution control and where to preserve PUA or allow urban expansion can be informed by relevant evidence.

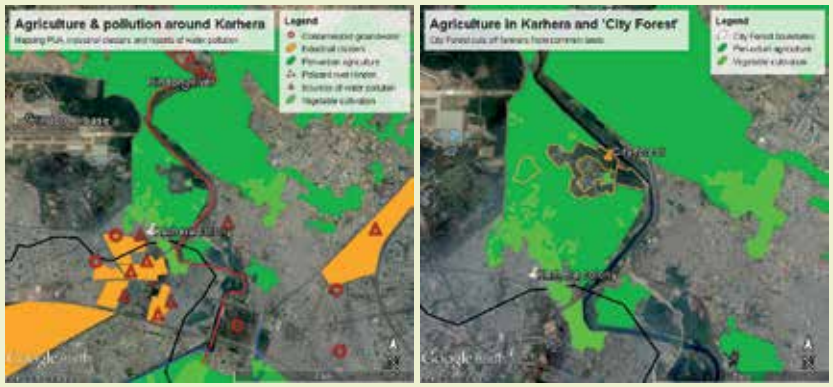
Mapping tools can be used to recognise and demarcate land for PUA, and also to identify priorities for associated environmental management and other interventions. They can help identify areas that may be appropriate to preserve for agriculture based on suitability of the ecosystem services, increase understanding of the relationships between environmental change and poverty and highlight hot spots for intervention. In our research project we used a variety of methods from satellite imagery and census data to community based participatory mapping to produce agricultural related ecosystem service maps and to examine relationships with health and poverty. These approaches also supported dialogue on the social and political barriers and opportunities for managing peri-urban ecosystems sustainability. They highlighted the special attention needed in these areas with complex governance arrangements (intertwining formality and informality, and neither urban or rural).

1. Satellite based spatio-temporal analysis - Mapping areas suitable for agriculture based on ES



a. Peri-urban water availability. b. Changes in agricultural land-use.

2. Mapping implications of environmental pollution and urban greening



3. Community based participatory mapping to understand relationships between ES, agricultural livelihoods and poverty

Working with communities to map agricultural activities, sources and impacts of pollution and ecosystems which support agriculture. Revealing the implications of policy interventions and helping to identify alternatives.

Changing priorities for urban development policies
Policies for urban improvement need to recognise the value of peri-urban ecosystem services over cosmetic urban improvements. Typical urban greening initiatives which promote the creation of peri-urban forest parks can actually be damaging to local ecosystems and livelihoods if they involve the conversion of peri-urban agricultural and common lands. In contrast, peri-urban agro-ecosystems need to be recognised by policy makers and urban planners for the multiple roles they play in supporting urban food security, peri-urban livelihoods for the poor and in providing ecosystem services through water and air purification, flood mitigation and waste re-use which are vital to urban resilience and public health.

Wastewater has a great potential for irrigated agriculture if properly managed (Amerasinghe et al., 2013; Jacobi et al., 2009; Vazhacharickal and Gangopadhyay, 2014). An integrated approach with suitable risk reduction mechanisms (particularly through wastewater treatment as well as bioremediation methods) would improve the efficiency and safety of PUA production systems. The recycling of urban organic waste could also contribute to PUA. If managed properly it would reduce the cost of waste disposal and serves as an environmentally friendly solution to some of the negative ecological impacts of cities (Bakker et al., 2000).

2. Direct interventions to support peri-urban ecosystem services

The activity of PUA is unique in that it both depends on, and can enhance, ecosystems. PUA can thereby enhance not only food security, but also multiple additional ecosystem services which are vital to broader urban resilience and sustainability (De Zeeuw et al., 2011). Therefore, interventions to support peri-urban ecosystem services must have PUA as a core focus.

Tackle pollution from the perspective of PUA
Increased supply of fresh vegetables often comes at the cost of food safety, as crops are often cultivated using high levels of pesticides and in conditions of polluted soil, water and air as a result of polluting industries being located in peri-urban areas. Occasionally, peri-urban vegetable production is banned, marking a confusion between peri-urban agriculture as a victim or a culprit of pollution.

Moving polluting industries to peri-urban areas does not remove the health threats they present to urban residents, but simply changes the route through which those health threats are transmitted (i.e. through the food system). This threat to food safety is often much greater than those associated with the use of pesticides. Interventions can involve cultivation methods that attempt to isolate crops from the sources of pollution implemented – but these are expensive and are often not accessible to the majority of small holder famers. We suggest approaches to work with peri-urban farmers to 1) support farming practices that reduce the uptake of contaminants; 2) use regulation and enforcement more efficiently to tackle the sources of pollution so that PUA can continue safely and 3) to consider peri-urban agriculture when siting polluting industries.

Involve peri-urban communities in environmental monitoring
We suggest that local and municipal governments should work together with PUA communities to improve monitoring of peri-urban industrial pollution and ensure environmental protection measures are implemented properly. Through forms of community based monitoring which collect data about types and levels of pollution and the nature of impacts, real-time information on emerging environmental and health issues can be fed back to public agencies and civil society groups so that they can organize swift and early responses before problems become unmanageable or reach epidemic proportions. This would strongly support the conservation of peri-urban ecosystem services and thereby enhance both the quantity and quality of food supplied to urban residents, improve the health and wellbeing of peri-urban communities and enhance urban resilience more generally.

Conserve local natural resources
Strong measures are needed to conserve natural resources, especially water and land in peri-urban areas. Various types of decentralised technologies can be utilized for management of water in peri-urban areas. These include rainwater harvesting, EcoSan and biofilters (small constructed wetlands) etc. Decentralized technologies not only have the potential to deliver adequate water supply and sanitation in peri-urban areas and lessen environmental pollution, but also can recover significant amounts of resources thereby saving costs and providing valuable inputs in the agricultural sector (Nanninga et al., 2012).

Preserving land for PUA can be challenging, not only because of the pressure for urban development, but also because of the complex arrangements for land use in PUA. As land values rise, landowning farmers are increasingly motivated to sell or build on land to gain profits that could radically improve their livelihoods and living standards. However, as many peri-urban farmers are landless tenant farmers, rising land values only increase their vulnerability as they become more likely to lose their livelihood. Simply restricting land-use to agriculture would then impose a financial cost on landowning farmers. Some form of compensation would need to be provided by the state farmers for loss of land value in order to secure their agricultural livelihoods and also the livelihoods of migrant farmers.

Support innovations in farming practices to reduce food safety risks
Peri-urban agriculture is often impacted more severely than rural agriculture by pollution. Heavy metal contamination of soils and air from industrial pollution, residue from increased pesticide use, high nitrate concentrations from overuse of fertilisers and other industrial sources, biological pathogens from misuse of organic wastes all contribute to a series of negative impacts on yield and quality of crops, health of farmers and safety of consumption (de Bon et al., 2015; Singh et al., 2009).

There are steps that can be taken to reduce the risks of contamination for both farmers and consumers of foods grown in peri-urban areas. Innovations in agricultural techniques also offer high-yielding alternatives to conventional farming which are less susceptible to contamination, less dependent upon chemical inputs and make productive use of solid and liquid organic urban wastes.

Uptake of heavy metals from soils by crops can be minimised by treating soils with lime, applying manure and using clean or carefully processed water for irrigation instead of raw wastewater to limit contamination (Singh et al., 2009). Adoption of and training in integrated pest management (IPM) techniques and appropriate barriers, shelters and greenhouses can help mitigate against pests and diseases and reduce reliance on pesticides (Altieri et al., 1999). Growing crops beyond a minimum distance away from roads and industrial sources of air pollution can reduce the risk of heavy metal contaminants on crop surfaces as well as limit the effects of air pollution on crop yield and vulnerability to pests. Careful treatment of wastewater and solid organic wastes can kill pathogens while enhancing the quality of organic fertilisers generated from recycled wastes (Nikiema et al., 2014). Techniques such as 'organoponics', which originated in Cuba, can bypass the threat from contaminated soil and made productive use of recycled organic wastes. Organoponics can be set up on top of any type of land – whether contaminated or not, soil or concrete – as they consist of an independent growing media made from composted organic waste held in raised beds and irrigated with drip systems (Novo, 2003; Thomas, 2014).

However, these type of interventions need to be considered in terms of how accessible they are to the majority of poorer small scale farmers. There is, for example, the need to think carefully about the role of exclusive organic food supply schemes which tend to produce costly food and benefit a few. The choice of options appropriate for a particular city region should be informed by a better understanding of the relationships between peri-urban ecosystem services, food security and poverty.

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Further resources

Project website: steps-centre.org/project/urban-futures
Digital story and photo book: steps-centre.org/2016/blog/what-does-the-future-hold-for-delhis-urban-farmers
Land use maps: waterdata.iwmi.org/applications/espa

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