

INDIA'S

Peri-urban crises

The lack of an
eco-systems approach



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This research study titled “India’s Peri-urban Crises: The lack of an eco-systems approach” has been undertaken by Gorakhpur Environmental Action Group (GEAG) under the Asian Cities Climate Change Resilience Network (ACCCRN) initiative of The Rockefeller Foundation, USA. The Rockefeller Foundation launched the ACCCRN in 2008 to help cities strengthen their capacity to prepare for, withstand, and recover from the projected impacts of climate change. Today, ACCCRN is a leading regional network connecting professionals and communities across Asia to build inclusive urban climate change resilience (UCCR) that focuses on poor and vulnerable people affected by climate change. GEAG being an ACCCRN partner has implemented various pilot interventions in eastern India on ground issues pertaining to urban climate change resilience planning, peri-urban agriculture and ecosystems for enhancing urban resilience, and disaster risk reduction. This document partly draws on studies by GEAG of the impacts of rampant urbanisation, generating the phenomenon of ‘peri-urbanisation’ in few Indian cities.

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List of Abbreviations

| | |
|---------------|--|
| ACCCRN | Asian Cities Climate Change Resilience Network |
| AES | Acute Encephalitis Syndrome |
| BRD | Baba Raghav Das |
| CRZ | Coastal Regulation Zone |
| DPR | Detailed Project Report |
| FAO | Food and Agriculture Organisation |
| GDA | Gorakhpur Development Authority |
| GDP | Gross Domestic Product |
| GEAG | Gorakhpur Environmental Action Group |
| GIS | Geographical Information System |
| GVMC | Greater Visakhapatnam Municipal Corporation |
| HRVA | Hazard Risk Vulnerability Assessment |
| IGAS | Integrated GIS based Analysis System |
| JE | Japanese Encephalitis |
| LEISA | Low External Input and Sustainable Agriculture |
| MLD | Million Litres Per Day |
| NE | North East |
| NTPC | National Thermal Power Corporation |
| NW | North West |
| RF | Rockefeller Foundation |
| SE | South East |
| SLDs | Shared Learning Dialogues |
| STP | Sewage Treatment Plant |
| SW | South West |
| SWM | Solid Waste Management |
| VMC | Visakhapatnam Municipal Corporation |
| VPT | Visakhapatnam Port Trust |
| VUDA | Visakhapatnam Urban Development Authority |

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Unplanned development leading frequent traffic problem in Gorakhpur

INTRODUCTION

UNPRECEDENTED URBANISATION

India witnessed unprecedented urbanisation between 2001 and 2011. The National Population Census of 2011 reported a higher absolute increase in urban population than in the rural areas. The rural-urban distribution was 68.84 per cent and 31.16 per cent respectively in 2011. The level of urbanisation increased from 27.81 per cent in 2001 Census to 31.16 per cent in 2011 Census and the proportion of rural population declined correspondingly from 72.19 per cent in 2001 to 68.84 per cent in 2011 (Chandramouli, 2011). The annual urban population growth rate was 2.76 per cent, nearly the same as in (2.73 per cent) as reported in 2001. The urban population of India was 377 million with 31.16 per cent of the total population living in urban locations. The decadal urban population growth rate during 2001-2011 was 31.8 per cent, 1.8 times the combined urban and rural growth and 2.6 times the rural population growth. The number of towns rose from 5,161 in 2001 to 7,935 in 2011 adding 2,774 'new' towns (Chandramouli, 2011).

The change in the population composition has been accompanied by major changes in land-use patterns with the appropriation of agricultural lands and rural commons as well as water bodies for construction of houses, malls, entertainment parks and roads, often in blatant violations of rules and regulations. The urbanisation processes have involved large influxes of rural populations into towns and cities as well as the spread of the urban into rural areas, a phenomenon called peri-urbanisation, with major implications for providing infrastructure and other civic amenities in urban areas (Bhagat, 2011; Ahluwalia, 2011; Kundu, 2011).

Transformation of agricultural and other lands and water bodies has severe adverse impacts on the ecosystems and the lives and livelihoods of the people dependent on them. Urbanisation

affects land changes through the transformation of urban-rural linkages. The problems of urban sprawl, loss of open vegetation and a general decline in environmental quality can be generally attributed to increasing population concentrating more people on less land even as the total land devoted to urbanisation expands (Dutta, 2011). These impacts are exacerbated by archaic policies that do not go beyond considering the differences between the urban and the rural as a question of numbers of people and geographical spaces. And as often happens, by the time the realisation dawns about the perils of altering the eco-systems and the consequences on lowering the resilience to climate change, it is too late to bring about a reversal.

This monograph partly draws on studies by the Gorakhpur Environmental Action Group (GEAG)

of the impacts of rampant urbanisation or the spread of the urban into the rural, generating the phenomenon of 'peri-urbanisation' in two Indian cities: Gorakhpur and Visakhapatnam. At the outset, it needs to be pointed out that these cities were deliberately chosen given that peri-urbanisation and indeed urbanisation is locale specific but bounded / defined by the agro-climatic zones. Gorakhpur lies in middle Gangetic plain region while Visakhapatnam is located in eastern coastal plain and hills region but has four sub-ecosystems within the city. These are hills, upland tracks, rolling plains and the coast. GEAG has worked in Gorakhpur for decades and specifically executed a project on peri-urbanisation under the aegis of Asian Cities Climate Change Resilience Network (ACCCRN) supported by The Rockefeller Foundation (RF). The data for the Gorakhpur study was collected overtime using GEAG's archives and also using secondary sources and some new insights from the field. For Visakhapatnam, a quick rapid appraisal visit was made to conduct interviews of key persons, shared learning dialogues (SLD)s with affected communities as well as get a quick first hand understanding of the ground realities.

The monograph is divided into 9 sections. Section 1 lays the ground by trying to conceptualise the peri-urban. In section 2 we highlight some important characteristics of peri-urban areas. Measuring peri-urbanisation is in itself a very challenging. This is discussed in section 3. Section 4 suggests a possible solution to the problem of measuring peri-urbanity by using GIS tools using the case study of Gorakhpur. In section 5 we delineate the major crises of peri-urban areas using examples of Gorakhpur and Visakhapatnam. Sections 6 and 7 elaborate on an eco-systems approach to resilient urbanisation and the role of eco-systems services in these processes. Section

8 discusses the diminishing ecosystem services in Gorakhpur and Visakhapatnam, especially the adverse impacts on the poor. Chapter 9 is the concluding one where the argument that India needs a holistic eco-systems based development strategy is re-iterated.

1. CONCEPTUALISING THE PERI-URBAN

The term peri-urban is yet to enter the official discourse. None of the documents perused, including the master plans of the two cities mention the term. A few officials in Gorakhpur and Visakhapatnam had a rough idea of the concept though, taking it to imply the surroundings of a city or the intermediate zone between the urban and the rural areas.

A rough working conceptualisation of the peri-urban is the area lying between the municipal limits and the city development boundary as reflected in the relevant master plan. This can be problematic as often, like in Visakhapatnam, villages are found within the municipality itself. Also, like in Gorakhpur, there are many villages just a few meters outside the Gorakhpur Development Authority (GDA) boundaries that show all the characteristics of those within the boundary. Typical examples are Mahewa, now a municipal ward and Sahjanwa that is outside the GDA boundary but otherwise no different from the former. Indeed, how do we treat urban villages? Also can we have rigid definitions of the peri-urban, based on legalese? This could be problematic, especially in identifying the peri-urban, as shall be discussed later.

As such, direct attention to peri-urban areas is lacking, at least in the discourse of officials and policy makers in developing countries including

India. The inherent dynamism in such transitions is little understood even as the artificial distinction into rural and urban prevails. Generalisations are made from ecological, environmental as well as socio-economic processes from other production systems leading to a queer amalgam of the rural and the urban in analysing peri-urbanity. Even when the solutions are known, structural weaknesses in the economy deter effective implementation (FTI,1999).

Multiple understandings and definitions of the concept of the 'peri-urban' prevail in the academic literature. Conceptually, it is seen as the transitional zone between a sprawling city and its rural surroundings, neither rural nor urban in its outlook and characteristics (Dutta, 2011; Prakash 2012). Not definable clearly, given the contextual and situational specificities involved, it remains a fact that in most parts of the world, peri-urban spaces are rapidly expanding and being occupied by increasing numbers of people (McGregor et al, 2005). Analyses of peri-urban contexts do not provide the basis for a unified understanding of urban sprawl (laquinta and Drescher, 2001). Such attempts to seek a unified understanding can be counter-productive based as they are on binary classifications (rural and urban) with a mediator (peri-urban) thrown in.

Existing conceptualisations of the peri-urban, in general, do not follow a consolidated approach that integrates historical and contemporary development processes, ecosystem dynamics, changing socio-economic and gender relationships. They provide either a geographical (or land-use) categorisation or a social relations perspective. Sharp dichotomous classifications assume that rural livelihoods are agriculture, horticulture and animal husbandry based while the urban is associated with manufacturing, services

and commercial activities. But even in contexts where activities can be described as either urban or rural and are spatially separated, there is always a continued and varied exchange of resources, including labour, capital as well as cultural, between urban and rural areas (Mitra, Wajih and Singh, 2015).

The sectoral interaction consists of rural activities taking place in urban areas and services taking place in rural areas, or even the peri-urban flows to and from rural industries that are spatially concentrated around urban areas (Tacoli, 1998). Peri-urban areas are thus typically characterized by uncertain land tenure, inferior infrastructure, low incomes, and lack of recognition by formal governments (Hogrewe et al, 1993). So, providing only a place based definition provides an incomplete picture of what peri-urban areas are like. The incongruence in the urban and rural definitions is also a reflection of the diverse geographic contexts of these places. Rural is not only defined relative to its urban counterpart, but also relative to the specific political-economic, ecological and social-cultural context in which such spaces emerge (Lerner and Eakin, 2011).

Narain (2010) argues that peri-urban is better understood in terms of its characteristics; a mix of agricultural and non-agricultural land uses, flows of goods, services and resources between villages and urban centers and a social profile that is very heterogeneous and in a state of flux. Some of the literature on peri-urbanisation process attempts to define 'mixed' rural–urban interfaces, and to construct a new understanding of social reality which undermines the notion of rural livelihoods being separate from urban. Lerner and Eakin (2011) portray the peri-urban space as a 'space' in itself, enveloping dynamic interactions between population and the landscape and their associated

land uses and livelihoods, supporting the notion of a vibrant flow of agricultural goods and ecological services both within peri-urban zones and between peri-urban and urban core areas.

Peri-urban boundaries are forever shifting, followed by extending urban areas engulfing the interface in route. Due to rapid urban growth, city peripheries undergo multiple transformations – physical, morphological, socio-demographic, cultural, economic and functional (Dupont, 2004, Brook and Davila, 2000). These transformations cause this area to experience high spatial uncertainty resulting in undesirable, complicated land use/land cover necessitating the protection of land –use patterns and common property resources that are diverted to other activities and purposes (Narain, 2009; Narain and Nischal, 2007).

2. SOME CHARACTERISTICS OF PERI-URBAN AREAS

Peri-urban areas of cities experience significant land transformation, due to expansion of the urban core. The resources and energy required for the rapid expansion is actively supplied by peri-urban areas at the cost of their natural/ semi-natural land-cover, which under this pressure gets disintegrated. Managing the environment of this interface has significant implications, for sustainability of urban and rural development, since the ecological, economic and social functions performed by and in the peri-urban interface affect both city and the countryside (Narain, 2009; Allen, 2003). Moreover, the current top-down policies for land acquisition by the land authorities in developing cities do not consider social equity and environmental integrity (Narain, 2007). Under these circumstances, adapting to climate change or resilience to it gets undermined,

rendering the city, the peri-urban areas as well as the poorer populations very vulnerable. Thus in Gorakhpur water logging due to haphazard construction in the peri-urban areas is a recurrent phenomenon, leading to a host of water and vector borne diseases. In fact, in Gorakhpur, the dwellings of the Dalits of a peri-urban village Chakra Doyam are inundated by siphoned sewage water of the city a major part of the year causing enormous hardships. Skin infections, diarrhea, jaundice, colitis and cholera are rampant especially among children. The embankment constructed in colonial period to keep floodwater out of the urban wards leads to waterlogging for more than three to four months. Sometime small children drown in these waters leading to clashes between villagers and urban ward residents¹. (Mitra, Wajih and Singh, 2015).

In Visakhapatnam the fisherfolk are finding it difficult to eke out an existence thanks to the violation of coastal regulation zone (CRZ) laws by builders, military as well as industrial units. A substantial amount of sewage is dumped in their habitat. In fact, some 55 ha of mangrove habitat in the peri-urban areas, so vital as a buffer against cyclones are depleting fast (BOX 1).



Discharging untreated waste water into the River Rapti, Gorakhpur

¹ This is an old but ongoing case. GEAG has made numerous efforts to ameliorate the conditions, including making a short documentary (Tales of Gorakhpur) and various representations to the authorities but to no avail.

BOX 1: Impact of CRZ violations in Visakhapatnam

Due to severe CRZ violations within the city in terms of pumping of ground water from bore wells, several groundwater resources especially near the Lawson's Bay area have turned saline. (Special Correspondent, 20 March, The Hindu, 2014). CRZ norms are mostly violated by the construction of hotels, like in the RK Beach area and apartments along the coast. In 2007, the Andhra Pradesh High Court ordered the removal of constructions violating the CRZ but there has hardly been any action. Many big hotels are trying to regularise their properties. Efforts are on to relax the CRZ norms to facilitate beachfront construction (Special Correspondent, 2 June, The Hindu, 2017). Aquaculture farms along the coast have put up concrete structures and electricity lines in the prohibited zone along the shore. Around 55 ha of mangrove habitat falls under the Visakhapatnam Port Trust (VPT) area which extends up to the Visakhapatnam Airport. Dredging by the VPT to stop the airport from flooding, the mangrove cover has depleted by 50 per cent (Senthil, D, 2009).

Haphazard and unregulated construction not only consumes precious land resources, but is largely responsible for the high costs of infrastructure and energy, congestion of transport networks, the increasing segregation and specialization of land use, and also degradation of the environment. All these elements tend to draw a city away from the model of sustainable development, and undermine certain traditional features, such as its compactness and diversity (Camagni et al, 2002). Accurate and timely information on the status and trends of peri-urban ecosystem has been attracting increasing attention recently (Díaz-Caravantes et al, 2011). Unfortunately, due to the lack of basic knowledge and timely information of the urbanisation process and its long term ecological impacts, urban and regional planners in developing countries have not been able to analyse consistently, much less manage and restore the ecosystems in peri-urban areas. Part of the problem lies defining, identifying and measuring peri-urbanity

3. CHALLENGES OF MEASURING PERI-URBANISATION

Measuring the phenomenon of peri-urbanisation in a particular locale is a major challenge. Contemporarily, peri-urbanisation is based on the inclusion of rural areas into a town/city's master-plan for inclusion/exclusion with the

urban boundaries in a finite future. Master plans remain official documents with limited access in the absence of will to put them in the public domain and generate awareness among citizens. However, the distinction still remains a binary construct in the official data. Just to take an example, while the national population census records an unprecedented urban growth, it is not readily possible to analyse at the national level. The Census 2011 recorded 3.72 million urban cultivators in 2011, a sharp rise from the 2.6 million in 2001. Correspondingly, the agricultural labourers rose to 7.3 million in 2011 from 4.3 million in 2001 in the urban areas. This has been accompanied by a sharp fall in the rural agricultural workforce between 2001 and 2011. There were 124.7 million cultivators and 102.4 million agricultural labourers in 2001. In 2011, there were 115 million cultivators and 137 million agricultural labourers (Chandramouli, 2011). This shows that while a lot of displacement of cultivators is happening (making them agricultural labourers), peri-urbanisation is changing livelihoods and lives. Similarly, the Agricultural Statistics of India, brought out annually by the Ministry of Agriculture, does not even give the details of urban agriculture, perhaps assuming that all agriculture is necessarily rural.

Measurement issues get compounded by the time-lag in the official data as well as the data not

being easily available in the public domain. Thus a master plan is drawn up at a particular point in time but the land conversion goes on and is not recorded as such. The official data often show the change in the land use far lower than what is observed visually. Thus in Visakhapatnam, analysis of the land use changes based on the master plan data shows just a minor decrease in the open/unbuilt area: 9.5 per cent over 19 years (8.49 per cent agricultural lands) belying the opinions of locals as well as visual observations (cf Table 1)

Table 1: Land Use in Visakhapatnam, 2002-2021 (in ha)

| S. No. | Land Use | Area 2002 | % | Proposed Area 2021 | % |
|------------|--------------------------|-----------|--------|--------------------|--------|
| 1 | Residential | 14339.45 | 8.33 | 20944.01 | 12.17 |
| 2 | Commercial | 352.26 | 0.20 | 958.89 | 0.56 |
| 3 | Industrial | 7855.01 | 4.56 | 11344.42 | 6.59 |
| 4 | Public & Semi-Public | 1707.39 | 1.04 | 2830.02 | 1.64 |
| 5 | Recreational | 548.05 | 0.32 | 816.88 | 0.47 |
| 6 | Transportation | 8661.35 | 5.03 | 11308.54 | 6.57 |
| 7 | Agricultural/Vacant Land | 99680.60 | 57.92 | 85074.75 | 49.43 |
| 8 | Hills/Forests | 30251.75 | 17.58 | 30215.35 | 17.56 |
| 9 | Water Bodies/Rivers | 8614.13 | 5.01 | 8614.14 | 5.01 |
| Total Area | | 172100.00 | 100.00 | 172100.00 | 100.00 |

Source : Compiled from Visakhapatnam Master Plan, 2021.

It is obvious that data for Table 1, based on the master plan prepared in 2007, must have been collected in the late 1990s. The city planners perhaps did not envisage the rapid growth that took place subsequently. The area of the Visakhapatnam Urban Development Authority (VUDA) remains at 1721 sq km while the Greater Visakhapatnam Municipal Corporation (GVMC) territory extends up to 540 sq km. With the merger of the Anakapalle and Bheemunipatnam (Bheemilli) municipalities and villages (K. Nagarapalem, Kapuluppada, Chepaluppada, Nidigattu, JV Agraharam, Thadi,

Salapuvanipale, Rajupalem, Valluru and Koppaka) in 2013, with the GVMC formed in 2005 the area could go up to 620 sq km. Moreover, Visakhapatnam had around 793 slums according to the 2011 census that housed 44 per cent (195000) of the city's households population making it the highest in India (Water Aid, 2016). Yet another source points out that out of 741 slums housing, 8.21 lakh people in the GVMC area, three lakh are living on the hill slopes always facing a perennial threat of landslips. Around 641 slums came up in the government land, six colonies in Railway lands, two colonies in Port

Trust lands, 20 slums in Endowment lands, eight slums on Wakf property, four slums in private-government lands mix and one slum in defence property. Of the 741 slums, the GVMC is yet to notify 415 slums depriving them of all the benefits under the 1956 Slums Act. (01/09/2017 Half of Smart City population lives in slums (Hans, 2017)

Given that the residents of these slums not only shoulder the burden of production both in the formal and informal sector as well as provide essential services like waste management, it remains a dilemma whether they should be

allowed to settle in the fragile ecosystems like the hills or to resettle them elsewhere. However, often the slum dwellers are victims of a lopsided development process that puts urbanisation above farming. Many these people have been displaced from elsewhere but provide essential services to the city (Mitra and Singh, 2011).

It is important to note that urban development processes cannot be very realistic or efficient if there are no reliable and up to date data bases.

Sometimes as in the case of Gorakhpur the land classification in the official records remains unchanged for decades to circumvent legislations, reflecting the lack of enforcement of plans. Often the ‘irregularities’ are regularised over time, with or without a compounding fee, but the government

records at any point in time does not show these changes.

A city grows with the provisions of its master plan. A comparative review of the Gorakhpur’s previous (1971-2001) and current master plan (2001-2021) indicates that the morphology of the city since 1990 has undergone marked change. The Gorakhpur master plan 2021 explicitly states that the achievement of targets set in the plan (2001-2001) has been as high as 91.98 per cent for residential use, but dismally low at 25.33 per cent for commercial and 30.82 per cent for recreational use; and somewhat higher for industrial (61.89 per cent); government (26.60 per cent); public/ semi-public (68.75 per cent); and Transport and Communication (49.77 per cent) uses (cf Table 2). During 1971-2001, 18.37 per cent of land has been developed contrary to what was planned.

Table 2: Planned and unplanned development in previous Master plan (1971-2001) and current land use in 2001 in Gorakhpur

| Land use category | Proposed in 1971-2001 master plan (ha) | Target Achieved as per the master plan | | Development contrary to the master plan* | | Land use pattern in 2001** (ha) |
|------------------------------------|--|--|---------------|--|---------------|---------------------------------|
| | | Absolute (ha) | % of proposed | Absolute (ha) | % of proposed | |
| Residential | 3023.34 | 2781 | 91.98 | 134.0 | 4.43 | 4103.30 |
| Commercial | 248.70 | 63 | 25.33 | 163.0 | 65.54 | 173.20 |
| Industrial | 698.78 | 432 | 61.89 | 192.0 | 27.47 | 445.00 |
| Governmental and undefined land | 488.62 | 130 | 26.60 | 173.0 | 35.41 | 161.00 |
| Public and semipublic land | 494.52 | 340 | 68.75 | 141.60 | 28.63 | 398.32 |
| Recreational (park and open space) | 943.92 | 291 | 30.82 | 291.0 | 30.82 | 291.20 |
| Transport | 230.13 | 115 | 49.77 | 30 | 13.04 | 117.0 |
| Total | 6128.01 | 4152 | 67.75 | 1125.90 | 18.37 | 5689.12 |

Source : Gorakhpur Master Plan 2021; * denotes lands which were developed under a particular category that was not envisaged in the 1971-2001 master plan, that is this reflects unauthorised land use changes/conversions in that period. ** Denotes the land use pattern, based on surveys, as of 2001 when the current master plan (2001-2021) was developed

The following inferences relating to Gorakhpur city can be drawn from the above data and Table 2:

1. Due to lack of proper enforcement of plan, the proposed land use during the previous plan was not achieved
2. Parks and green belts were not developed properly and in fact were converted to residential areas.
3. Development of commercial areas was not achieved as per the plan
4. Encroachment on government lands for residential purposes seems to have occurred. Only 26.60 per cent government land was developed as per the plan while 35.41 per cent developed in contradiction of the proposed plan
5. Overall, only some 67.75 per cent of the land development took place according to the plan while 18.37 per cent was unauthorized.

Clearly there is a serious time lag in the land use patterns as seen in Table 2. The land use patterns are depicted at the start of the plan period but do not capture the changes in the course of the plan. Moreover, the durations are extremely long: 30 years and 20 years respectively, to yield a meaningful assessment of peri-urbanisation. As such, the master plan data does not seem to be updated regularly during the course of the plan.

4. USING GIS TO MEASURE PERI-URBANISATION

One way out of the impasse of defining, demarcating and measuring peri-urbanisation is to use GIS technology. This method is increasingly being used in peri-urban studies where available satellite data is used to classify and measure urban extension/conversion of rural areas. Such

techniques have been used for instance in Leipzig (Banzhaf et al, 2009); Australia (Sutton et al, 2010). The Chinese reportedly use an integrated GIS based analysis system (IGAS) to scientifically manage urban lakes in the periphery (Sarkar and Bandyopadhyay, 2013). In India in Hubli Dharwad GIS techniques were used to produce thematic maps of changes in village populations and the landless in 25 villages (Gregory, 2005). Typically, these studies are based on the assumption that cities spread outwards from the core into the countryside. However, especially in the Indian context, including in Visakhapatnam, while the city spreads from the core into the rural areas, many peri-urban pockets remain inside the city boundaries. Caution has to be exercised in not assuming a homogenous form of the spread of a city.

However, such techniques can potentially enable us to analyse changes in land use patterns in a particular locale alongside social, demographic and economic changes; extension of the built up area, interaction between the different land uses and the effects of changing land uses on the natural landscape over time (Sarkar and Bandyopadhyay, 2013).

A preliminary attempt was made to analyse the growth and peri-urbanisation of Gorakhpur and Visakhapatnam and identify the hotspots in terms of major land use changes. While we present the methodology of identifying the hotspots for both the cities here, the subsequent analysis relates to Gorakhpur due to constraints of space.

4.1 Methodology of identifying the major hotspots of Gorakhpur through GIS

This was based on visual observation of current and past land use of the cities on Google Earth

images in lab environment. The current Google Earth images of the two cities were first captured through manifold GIS tools located in two different agro climatic zones. While importing the images of the cities, care was taken in the software to maintain the resolution of the images for better image interpretation. Further, for micro analyses of land use change, a grid of 1 km X 1 km (1 sq km) was drawn on the current (2016) and past images (2006) of the cities to understand land use changes that taken place during last ten years (2006-2016) and identify three major hot spots (marked changes in land use) within the municipal boundary and three in peri urban areas of the cities. The number of grids, marked land use change areas, their directions and randomly selected sites for community interviews in each city is given in the table:

The main focus of this exercise was the land use changes of each city. To interpret the present and past images, each grid was assessed intensively and databases generated on the built up area, water bodies and open/ agriculture land of two different points of time (2006 and 2016) on visual observation on a percentage basis. These separate databases were latter analysed on excel programme and major land use changed grids were filtered. Among the major changed grids, those that experienced marked change in land use over the three decades, within the city's boundary and in the peri urban areas were randomly selected for spot interviews and field observations.

The example of Gorakhpur, where satellite images were used to understand the changes in the land use patterns is presented here to illustrate the efficacy of using GIS tools.

Table 3: Peri-urban Hotspots in Visakhapatnam and Gorakhpur

| City | Total No of Grids (1X1km) generated | Marked land use change grids | Location of marked land use change grids | Randomly selected Hot spots for community interaction | |
|---------------|-------------------------------------|------------------------------|--|---|---|
| | | | | Within city's boundary | Peri urban villages |
| Visakhapatnam | 2367 | 109 | NE, NW, SW, SE | Peda Jalaripeta Marikavalasa BPV Kallalu Eguvapeta (Bheemunipatnam) | Lankelapalem Chipurupalli Parawada Mutyalammapalem Endada Yarada |
| Gorakhpur | 547 | 68 | NE, SE, NW, SW | Mahewa, Mugalaha Karimnagar Ram Awadhnagar Madhopur | Semradevi Prasad Moharipur Sanjhahi Jharwa Khirwania |

Figure 1: Gorakhpur City 2005-06

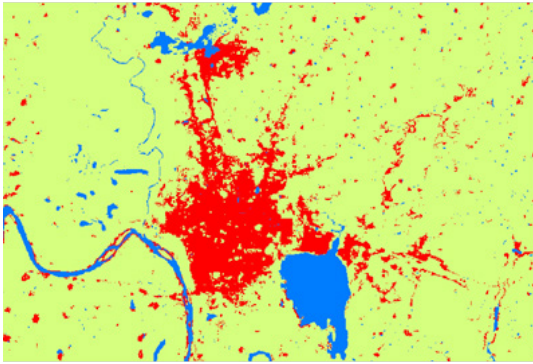


Figure 2 : Gorakhpur City 2010-11

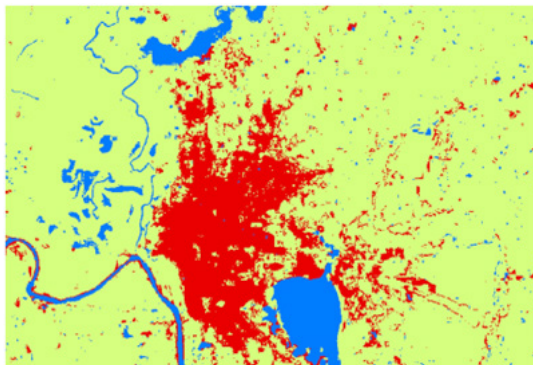
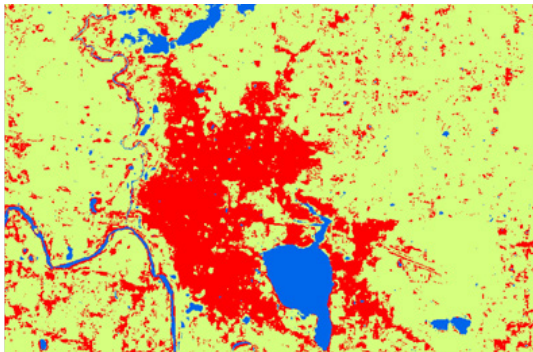


Figure 3: Gorakhpur City 2015-16



Note: In all the three maps, red denotes the built-up area, green the agricultural lands/open spaces and blue the water bodies.

Figures 1 to 3 depict the expansion of the city over 10 years and the directions in which the city

has grown. It also shows the reduction of the water bodies especially in the northwest part of the city and the construction in the flood plains.

To analyse the micro land use changes during last 10 years in different parts of the city and its peri urban areas, visual observation of Google images of two different periods i.e. year 2006 and year 2016, were taken and changes in the pattern of agriculture/open spaces and built up areas has been assessed to understand the morphology of the city. The analysis of images of different time periods is given in the table 4.

Table 4 quantifies figures 1-3. The values in the table show the average changes in land use in each categories in 10 years. For example, in the north east direction, area under agriculture/ open space use in last 10 years was reduced by 12.54 percent due to development of built-up area.

However, in north west part, chronically flood prone, the average area under agriculture / open space increased by 8.29 per cent in the given period. The reason for such increase could be due to increase in vegetable cultivation in the lands made fertile by the silt load of the flood and bringing small water bodies under cultivation. In the south west too the percentage of land under agriculture use has increased, may be because of vegetable growers. However, area marked as civic forest in the south west decreased because the area under guava orchards have reduced drastically over the last ten years due to development of settlement.

The above analyses of land use changes in the periphery of Gorakhpur shows that during last 10 years the built area has increased in all the directions but more prominently in the north east

Table 4. Land use change in peri-urban areas of Gorakhpur

| Direction | Change in land Use pattern (2006-2016) in Peri urban areas of Gorakhpur (%) | | | |
|------------|---|--------------|-------------|---------------|
| | Agriculture land | Civic forest | Waterbodies | Built up area |
| North east | -12.54 | -1.12 | -1.14 | 65.86 |
| North west | 8.29 | -1.12 | -2.50 | 38.54 |
| South East | -0.14 | -4.93 | 1 | 66.99 |
| South west | 10.20 | -30.98 | -19.45 | 46.57 |

Source : Based on Google image analysis and field validation, 2017

(NE) and the south east (SE) directions. It is 66.99 per cent in the SE, 65.86 per cent in the NE, 46.57 per cent in the south west (SW) and 38.54 per cent in the SE direction respectively. In all the segments the area under civil forests and water bodies has decreased significantly. The proportion of area under water bodies in the SE has decreased prominently by 19.45 per cent.

In the last 10 years, the ratio of agriculture land has decreased by 12.54 per cent in the NE, with the coming up of many residential colonies. In this direction, residential areas are developing very fast along Gorakhpur-Nautanwa up to Chilualta, along Maharajganj Road up to medical college, on Pipraich road up to Padri Bazar. In the SE also agriculture lands have been converted into residential areas. In this direction, big residential colonies were developed by the GDA, Avas Vikas Parishad (Housing Development Board) and private colonizers between the Deoria road and Deoria bypass.

5. UNDERSTANDING THE PERI-URBAN CRISES

No matter how measured or identified, the two city case studies as well as experiences of most other cities and towns show, peri-urban crises continue to accentuate primarily due to lack of political will

of the officials in implementing the various rules and regulations. Problems galore. These areas for instance are used to dump the city waste, sullage and sewerage, waste water or locate landfills, impacting adversely the lives and livelihoods of the residents. Children's health is severely affected in the process (Mitra, Wajih and Singh, 2015). Lack of health facilities, civic infrastructure, transport, educational facilities mark the peri-urban areas almost in every Indian city, including Gorakhpur and Visakhapatnam.

As such municipalities in India are severely cash strapped. Spending on core areas of cities itself is problematic, leave alone the peri-urban areas. Mohanty (2014:273) comments on the 'precarious' state of municipal finances, "This is puzzling as users pay, beneficiaries pay, polluters pay, exacerbates pay, congesters pay and growth pays principles offer significant opportunities for resource mobilisation in cities. Spatial planning, infrastructure investments and agglomeration externalities capitalise into tax bases." Indeed, master planning in India "seeks to address the financing of urban development outside the model of planning," (Ibid). Gorakhpur and Visakhapatnam are no exception to this. However, a budget analysis was not undertaken as it is an exercise in itself.

Linked to finances are governance issues. Corporators, often belonging to major political parties, who are usually associated with municipalities in the common mind, rarely take seriously the development of peri-urban areas or urban villages if these are included in their constituency post inclusion in the master plans. Lack of finances is cited as a reason. This in spite of the fact that as early as 1980 the Supreme Court had ruled that: "A responsible municipal council constituted for the precise purpose of preserving public health and providing better finances cannot run away from its principal duty by pleading financial inability. Decency and dignity are non-negotiable facets of human rights and are a first charge on local self-governing bodies. Similarly, providing drainage systems not pompous and attractive, but in working condition and sufficient to meet the needs of the people cannot be evaded if the municipality is to justify its existence," (AIR 1980: 1622). In Visakhapatnam, municipal elections have not been held for the last five years.

6. AN ECOSYSTEMS APPROACH

Lack of planning, finances, governance and corruption apart our studies show that a deeper malaise lies in not adopting an ecosystems approach to peri-urbanisation, leading to both ecological as well as human problems. We feel that this is due to equating construction/building activities and indeed urbanisation as progress/development a process that is unsustainable in the medium to long run. It has to be kept in mind that India's rapid urbanisation process, accompanied by significant structural changes in the economy and an agrarian crisis typified by falling agricultural growth rates and share of agriculture in the GDP, as well as a de-peasantisation and increasing feminisation of agriculture, has enhanced urban expansion in the latest decade.

Not adhering to certain basic principles of an ecosystem approach to development, including in the understanding of the 'urban, the peri-



Diminishing Green cover at the cost of development in peri-urban areas of Gorakhpur

urban and the rural' can be detrimental for both populations and the eco-system itself. This includes an understanding of the very notion of an eco-system and how urban transformations, unless carefully planned and implemented, can impact such ecosystems adversely. For instance, the process of urban sprawl in the core and at the peri-urban interface, conserved areas such as greenbelts, open spaces and floodplains are threatened and rendered fragile, all the more so in a situation of climate change. Conversely then, it is critical to maintain these spaces and in general the ecosystem as such, to build human resilience to climate change. Overall, such urbanisation processes transforms, sometimes unalterably, agrarian eco-systems, threatening the very existence of the urban space by lowering its resilience to natural and human made disasters. Understanding the role of ecosystem services, the hierarchy of ecosystems and how they relate to the lives and livelihoods of small-marginal-landless and women farmers is crucial to such analyses. Critically, such services help small and women farmers build resilience to climate change and their decline accentuates not only the people's vulnerability but also of the city itself.

Indeed, the problem begins with the prevalent conceptualisations of human habitats into dichotomous categories of rural and urban that do not recognise the 'peri-urban' beyond its spatial connotations, leave alone considering them as eco-systems.

Land-tenures in peri-urban areas are uncertain (cf Box 4 below). The infrastructure is poor, incomes low and there is no formal recognition of these areas (Prakash, 2012). Typified by mixed agricultural and non-agricultural land uses and flows of goods, services and resources between villages and urban centres and a perpetually

changing heterogeneous social population that lead to specific environmental and natural resource problems beyond the scope of urban or rural governments individually, peri-urban areas need innovative approaches (Prakash, 2012, Narain, 2010; Allen, 2003). The people and the landscape interact dynamically with the associated land uses and livelihoods based on flows of agricultural goods and ecological services both within peri-urban zones and between them and urban core areas (Prakash, 2012; Lerner and Eakin, 2011).

Thus the peri-urban forms a rapidly changing, semi-natural ecosystem which provides natural resources for growing cities while depending on the urban markets for sales and employment. This two-way interaction changes even the lifestyles and mentalities of peri-urban inhabitants. The 'extractive' nature of urbanisation places a low premium on preserving the ecosystem, affecting not only the livelihoods of those directly dependent on it but also the city itself. Peri-urbanisation leads to usurpation of ecologically sensitive lands for housing and other construction activities. These change the face of agriculture, reduce open spaces and enhance pressure on natural resources like water. These areas are marked by a lack of hygiene and sanitation infrastructure, industrial effluence, air pollution and inadequate provision of basic services. Often, the solid waste of a city is dumped in peri-urban areas (Marshall et al, 2009:7).

Changing peri-urban boundaries due to rapid urban growth leads to multiple transformations – physical, morphological, socio-demographic, cultural, economic and functional in the city periphery (Dupont, 2004; Brook and Davila, 2000). The high spatial uncertainty necessitates the protection of land-use patterns and



Urban expansion paving market and employment opportunities to peri-urban people

reclamation of common property resources for other purposes (Narain, 2009; Narain and Nischal, 2007). These transformations sometimes irreversibly change ecosystems and the services they provide.

Evidently, environmental management of peri-urban areas is critical to the sustainability of urban and rural development as the ecological, economic and social functions performed by and in them impact on both the city and the countryside (Dutta, 2012:4; Narain, 2009; Allen, 2003). Contemporary land acquisition policies in developing cities disregard social equity and environmental integrity, undermining a city's capacity to adapt to climate change and rendering the peri-urban areas and poorer populations very vulnerable. Environmental degradation, natural resource conflicts, health

concerns and social injustice are particularly acute in the peri-urban areas that are excluded in formal planning processes (Prakash, 2012; Marshall et al, 2009). The lack of basic knowledge and timely information of the urbanisation process and its long-term ecological impacts constrains development planning authorities in analysing, managing and restoring peri-urban ecosystems (Dutta, 2012; Narain, 2007). Left unaddressed, the process leads to rural-urban synergies breaking down, environmental degradation and rising urban inequities and poverty (Prakash, 2012) which could be worsened by the impact of climate change (Mitra and Singh, 2011). In the next section we describe the ecosystems approach to resilient urbanisation.

Box 2: Declining Water Bodies

Historically, Gorakhpur was famous for its water bodies. The gazetteer of Gorakhpur, 1907, mentioned numerous lakes and ponds that existed in the city and its surroundings. A study on Ramgarh lake in 2010 under the aegis of the Asian Cities Climate Change Resilience Network (ACCCRN) in Gorakhpur highlighted that in northern, western and southern Gorakhpur, water bodies such as lakes, ponds and other depressions locally called tals were an integral part of the inland drainage system of the area (Mitra, 2010). These collected excess water, acted as detention basins for flood waters during the monsoon and also provided a source of livelihood for the fisherfolk. The depletion of these water bodies has affected the livelihoods of fisherfolk (Nisad community) and very few (only 40 per cent) now depend on the lakes for their livelihoods, while the rest have been forced to leave their traditional occupation and work as casual wage labours (ibid). These fisherfolk not only reared and sold fish (an important source of food) but also maintained the health of the water bodies by regularly cleaning and removing aquatic plants. With the decline of ecosystems due to urbanisation, many such livelihoods have been lost forever, contributing to rapid distress migration (Mitra and Singh, 2011). Gorakhpur's private builders as well as state agencies continue to encroach on these water bodies and also dump wastes in them.

Water bodies all over the country are treated as wastelands, to be occupied and colonised with impunity. Even water bodies 'protected' by the Ramsar Convention (1971) are not safe. A typical example comes from Bhopal in Madhya Pradesh. The city developed around a huge lake, Bada Tal or Bhoj Tal constructed by the Paramara ruler Bhoja who ruled from 1010 to 1055 AD by building a dam between two hills that encloses the headwaters of the Betwa river. 365 streams, including the Kaliasot river drain into it. At the time of construction, the lake covered about 650 sq km, probably the largest artificial lake in then in the Indian peninsula – one unbroken sheet of water with islands adding to its beauty. It was in places more than 30 m deep and surrounded by high hills on all sides," (CSE, 1997: 17-18). The excess waters of the Bada Tal were stored in the Chota Tal. Together these two have been the lifeline of the city over the centuries. Even now the upper lake is the principal source of drinking water (40 per cent) for the city of Bhopal; the lower lake meets out the requirement of raw water and enhances the beauty of the city. These lakes are ideal spots for water-sports like kayaking, canoeing, parasailing, and water skiing and attract tourists in hordes. The upper lake is a source of livelihood – both direct and indirect – for many communities including fishermen, boat owners, and local vendors. The upper lake in Bhopal is an important wetland which is home to more than 700 species of diverse flora like zooplankton and phytoplankton. The wetland is also an important site of avian fauna with more than 150 species of both migratory and resident birds, leading to its being included in the list of water bodies under the Ramsar Convention in 2002.

This rich biodiversity of the wetland has, however, been affected adversely in the last few years due to various anthropogenic pressures and natural calamities, irregular rainfall during the last decade being one of them. Over a span of some sixty years the upper lake got reduced to 8 sq km from 30 sq km. The lower lake was reduced to 2 sq km from 8 sq km as of 2009 (http://www.rainwaterharvesting.org/bhoj_lake/bhoj_lake.htm).

The major reason for this is the rapid encroachment and urbanisation of the lakes catchment areas. The urbanisation, industrialisation and also the peri-urbanisation of the rural areas and high chemical input based vegetable cultivation has led to massive pollution of the lake's waters. In 2012 it was reported that out of the 193 million litres per day (MLD) of sewage officially generated in Bhopal, only 39 MLD of sewage gets treated. The remaining sewage goes into water sources like the upper lake which is also a source of drinking water for 40 percent of the Bhopal's population (CSE, 2012). The lower lake does not have any freshwater source; it receives seepage water from the upper lake and drainage from 28 sewage-filled nullahs. The domestic sewage of newly colonised areas along the upper and lower lakes, like Nehru Park, Gandhi Nagar, CTO, Noor Mahal, Malipura enter the upper lake directly.

Needless to say it is the sheer mismanagement of land uses and unregulated conversion of lands in the peri-urban areas of that has led to the crisis. "Around 80 percent of the catchment is peri-urban though 'officially' rural and dominated by agriculture. Intensive chemical agriculture is practised in the catchment and chemical fertilisers and pesticides are used in the cultivation. The agriculture runoff from the rural catchment enters directly via streams into the lake, predominantly on the southwest side and flows from the west to the east. It affects the quality of water in the wetlands and is a long-term threat to the health of the lake. Finally, the bulk of the silt inflow takes place from the rural side of the catchment (Purohit, 2017)."

7. THE ECOSYSTEMS APPROACH TO RESILIENT URBANISATION

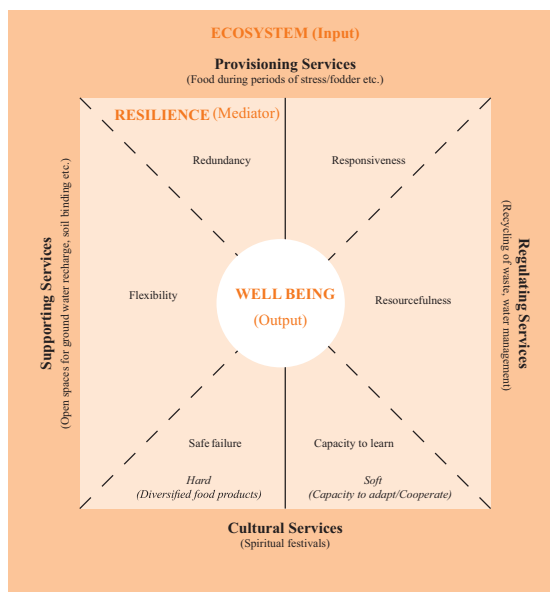
Maintaining the health of the eco-system is crucial to developing the resilience of urban spaces, a process that not only would contribute to the 'smartness' of the city, but also because of the criticality of the ecosystem services that further build resilience. These ecosystem services include:

- **Supporting services:** ecosystem services 'that are necessary for the production of all other ecosystem services' (MEA, 2005: 40) such as nutrient dispersal and cycling, seed dispersal, primary production.
- **Provisioning services:** products obtained from the ecosystems such as food, fuel and water, fodder, fibres, genetic resources, medicines, energy or ornamental products.
- **Regulating services:** 'benefits obtained from the regulation of ecosystem processes' (ibid) such as carbon sequestration and climate regulation, waste decomposition and detoxification, water and air purification, natural hazard mitigation, pest and disease control or erosion control.
- **Cultural services:** 'non-material benefits people obtain from ecosystems through spiritual enrichment, cognitive development, reflection, recreation, and aesthetic experiences' (ibid).

Overall, the different ecosystem services enhance the redundancy and flexibility of urban systems, and can help ensure that any failures are 'safe failures' so as to minimise damages (Figure 4).

7.1 The Role of Ecosystem Services

Ecosystem services ensure the well-being of the people and also play a role in regulating migration



Ecosystem for Resilience

(Source: Mitra, Wajih and Singh, 2015)

of people to urban areas as 'footloose' labour (Breman, 1996). This is because ecosystem services can play a role in influencing the various components of human well-being which include providing the basic materials for a good life, health, good social relations, security and freedom of choice and actions (MEA, 2005: v). People are integral parts of ecosystems. A dynamic interaction exists between humans and ecosystems, with the changing human condition driving, both directly and indirectly, changes in ecosystems and thereby causing changes in human wellbeing (MEA, 2005: vii.) At the same time, social, economic and cultural factors unrelated to ecosystems alter the human condition, and many natural forces influence ecosystems (ibid).

In the present overall Indian urbanisation scenario what is needed is an ecosystem-based approach to urban climate change adaptation and resilience, emphasising the role of that ecosystem services in peri-urban areas in core urban areas. Ecosystem-

based adaptation has the potential to overcome maladaptation and the inadequate consideration of biodiversity while giving the social components of adaptation more consideration, helping to avoid social inequality and disempowerment (Mitra, Wajih and Singh, 2015). The role of ecosystem services is critical to ecosystem-based adaptation strategies.

It is only when people are rooted in their original habitat, but with total access to their development rights as well as basic needs, that they are able to preserve the ecosystem, so vital to the health and also the resilience of the city. Visakhapatnam, with its four sub-ecosystems, typifies this. In the context of Gorakhpur, the driver of change has been changing land-use patterns. As the city expands, a speculative land market has emerged and agricultural land is being lost to housing. The shrinkage in agricultural production impacts the redundancy of food production that plays a critical role in augmenting Gorakhpur's food supplies. Water bodies are being increasingly encroached on or polluted, impacting on the lives and livelihoods of many. Provisioning services are critically affected as the poor become more dependent on non-cultivated foods obtained from the commons and domestic animal stocks are declining. Water pollution and soil contamination are increasing as Gorakhpur's solid wastes and sewage are dumped in the peri-urban areas while infrastructure measures to reduce urban flooding are creating waterlogging. Taken together, all these factors impact on the well-being of the people. Major efforts by policy makers, administrators and residents are required to tackle the crisis. This requires an explicit recognition that an ecosystems approach and realising the importance of ecosystem services is needed if both urban and peri-urban areas are to be developed sustainably and inclusively. Current

practices pose a tremendous threat to both the ecosystem and vulnerable populations and are exacerbated by climate change (Mitra, Wajih and Singh, 2015).

7.2 Peri-Urban Agriculture

Central to a systems approach is the protection of urban and peri-urban agriculture defined as, "Agricultural (including livestock) production, processing, and distribution activities within and around cities and towns, whose main motivation is personal consumption and/or income generation, and which compete for scarce urban resources of land, water, energy, and labour that are in demand for other urban activities," (Gundel, 2006).

Peri-urban areas are not 'waiting rooms' for entry to urban areas. A fundamental change in mind-sets is needed, to prevent further land-use change and unregulated construction activities. While international agencies like FAO and CGIAR articulate the need to for supporting policies and practices for urban and peri-urban agriculture (Marshall et al, 2009; FAO, 2007), they do not seem to consider agriculture as part of an integrated system within ecological settings which contributes to the overall resilience of the city.

Good urban and peri-urban agricultural practices, from across the world, highlight the need to identify the potential human and environmental health risks, city by city and to develop and implement evidence based policies with multiple stakeholders to eliminate /minimise these risks. But this will necessitate a major shift in the way we think about development.

Urban and peri-urban agriculture has been promoted and adopted across the world to adapt with changing climate (Mitra, Wajih and Singh,

2015). The climate risks ranging from floods, heat waves, sea level rise and scarcity of water are some of the issues cities are facing globally. Maintaining the land use pattern beyond the city edge or protection of open space in city's periphery has been tested in adapting to flooding by a range of enterprises from productive greening strategies involving fruit trees, herbal shrubs, high-value vegetables, and on hill slopes and in valleys to increase water infiltration and reduce the time lag for flood occurrence.

Increased urban and peri-urban agriculture also has adaptation potential with respect to heat waves by moderating microclimates. During the hot seasons, temperatures tend to be high, but when neighbourhood and city level productive greening involving trees is practiced, this has a potential for reducing high temperatures and effects of the urban heat island. Although provisioning potential is not as high as regulatory, urban/peri-urban can also help households of the urban poor supplement food supplies, thereby adapting to changes that might affect distant hinterlands that are the supply regions for food into the city. Thus in Gorakhpur's peri-urban villages GEAG's initiatives of combining LEISA agriculture with animal husbandry, poultry and horticulture is keeping hundreds of farmers, many of them women, from selling their lands to builders. The essential lesson from such experiences is that a conducive environment needs to be created to enable farmers to enhance their incomes, but given a choice they will not part with their lands.

Also a conducive policy framework is essential for this process. Today urban or peri-urban farmers are not recognised as such and do not get essential support from the state in the form of credit or subsidised inputs especially seeds (Mitra, Wajih and Singh, 2015). Given that a majority of

peri-urban farmers are women they too need to be recognised as farmers. Moreover, mechanisms of direct sales of their products to consumers instead of going through agents and middlemen are essential. This has to be accompanied by the development of good roads and transport facilities.

Multidisciplinary and integrated administrative land-use planning that recognises the agricultural ecosystem as a core component of the urban and peri-urban natural resources system is essential for this initiative (Marshall et al, 2009; Pothukuchi and Kaufman, 1999). Critical to this process is the adherence to the rules and regulations: if a lake covered by the Ramsar Convention like the Bhoj Tal (discussed above) be encroached on or used as a waste dump, what is happening to the thousands of water bodies all over the country? Can this happen without the connivance of petty officials and politicians?

Mismanagement, especially of solid wastes and waste water poses many risks for peri-urban agriculture. It has to be remembered that in the peri-urban areas the farmers, many of them women, switch from cultivating cereals to vegetables and greens. This is observed in Gorakhpur also. Often farmers tend to use the composted solid waste as fertilizers instead of buying expensive substitutes from the markets. Using waste water for irrigation is considered cheaper than borehole irrigation. But using urban wastes in peri-urban agriculture can be risky to the health of both producers and the consumers. The waste generated is often partially decomposed and the risks of pathogenic contamination are high. Composting organic waste is successful only if done at high temperatures or the waste is left to decompose for more than one year. The risks of entrance of high concentrations of heavy metals in the food chain also exist (Birley and Lock, 1998).

8. DIMINISHING ECOSYSTEMS SERVICES: A TALE OF TWO CITIES

Urbanisation in Gorakhpur and Visakhapatnam has led to major land use changes. Construction of buildings and roads have destroyed green belts, lakes, ponds and other water bodies as well as open spaces, forests, vegetation, fields and flood plains and coastal areas at the peri-urban interface, each of which form an ecosystem of their own. As rural areas are transformed to urban, not only are the ecosystems threatened but also the livelihoods of people who draw on these ecosystem services are adversely affected. In this section we discuss briefly some of these ecosystem losses in both the cities and their impacts especially on the weaker sections.

8.1 Conversion of agricultural land and destruction of natural resources

Gorakhpur's landscape has changed drastically. Agricultural land is being converted to housing colonies : between 2008-2012 in eight peri-urban villages alone 27.3 per cent agricultural land had been sold to real estate agents. Even fragile flood prone lands located between the Rapti river and embankment (Chakradoam, Khirwanian villages) are also being sold for housing, paving the way for future disasters (GEAG, 2016). The lure of quick cash along with the low and uncertain returns from agriculture and sometimes social needs like weddings spur small and marginal farmers to leave agriculture and sell their land in a booming land market. But the conversion of agricultural land into residential areas and decreasing common property resources of peri-urban areas enhances the vulnerability of the rural people and also of the city. Risks of flooding and prolonged water logging rise. The food production systems, including

uncultivated eco-system foods, of small-scale and marginal farmers, as well as livestock rearing, horticulture and aquaculture are being affected. Unregulated construction on the flood plains is impacting soil formation and also the region's food productivity.

The situation in Visakhapatnam is similar. Peri-urban agriculture in Visakhapatnam is vanishing rapidly due to land diversions for industrial and commercial purposes. A tahsildar of the revenue department said, "Private builders have purchased many acres of lands from small holder farmers in the vicinity of industries like the NTPC and the Steel Plant. They have developed empty plots for housing on these farms. Consequently the supply of fresh vegetables, fruits, flowers, milk, meat and eggs from nearby peri-urban areas is reducing. The dependence of Visakhapatnam city for these products, especially for fruits and vegetables, on faraway places is increasing, leading to higher prices due to transportation costs." Officials confirm the role of real estate developers in converting agricultural lands for housing and commercial establishments. In fact, the entire Sagar Nagar colony and Singapore Society in the northern part of Visakhapatnam have been developed by acquiring agricultural lands. According to EUB Reddi, a professor at the Andhra University, common property resources like grazing lands have also decreased in the peri-urban areas, leading to fodder shortages. As a result of this farmers are either selling their lands or giving them on lease and migrating to urban areas for better paying non-farm jobs in industrial zones and urban areas. The cropping pattern is also changing from labour intensive crops to plantation crops like cashew, casuarina and eucalyptus which are less labour intensive and rain fed.

8.2 Decreasing ground water table and quality

Ground water is the only source of drinking water in Gorakhpur and its peri-urban areas (Wajih et al, 2009). Presently drinking water availability is not critical. However, with increasing dry spells during monsoons and excessive extraction of ground water for construction in peri-urban areas may soon lead to dry hand pumps. Drinking water quality concerns has led to a burgeoning bottled water industry in the peri-urban areas. This too contributes to the declining the ground water table in the city and the peri-urban villages. In 2017 according to villagers of Sanjhai, Bangayi, and Jungle Bahadur Ali the water is available at around 130 feet while 20-25 years ago it was available 25 to 30 feet below the ground. The quality of drinking water in the city and also in peri-urban villages is a serious issue (Chaudhary, Shukla and Kumar, 2015). As per the Gorakhpur Jal Nigam records, the first two layers of the ground water of Gorakhpur are totally contaminated. Rampant construction activities prevent the recharge of the groundwater and the flushing of effluents. Moreover, water supply pipelines constructed five decades ago have been totally ruined (Wajih et al, 2009). This grave situation has severely affected the poor and vulnerable people.

Visakhapatnam's water situation is gradually getting critical. With the municipal water supply unable to keep up with the rapid expansion of the city boundaries, many areas face shortages in



Prolonged water logging deteriorating ground water quality in peri-urban areas of Gorakhpur

summer. A recent study covering 936 km² (GVMC area and the catchment of the springs draining into it) found that between 1976 and 2010, there was a 2.48 per cent loss of water bodies : the loss in fresh water bodies being 0.64 per cent and loss in marshes and back waters is 1.84 per cent. In 1975, the total water bodies were 6.69 per cent out of which 3.75 per cent were fresh water bodies and 2.94 per cent were marshy and back waters. In 2010, total water bodies were

BOX3: The Mehadrigedda Reservoir

The Mehadrigedda watershed in the VMR region covering an area of 364 sq. Km is a significant drainage basin whose central portion forms a reservoir downwards. The reservoir is a major source of water supply for the city and the watershed is also drained for a variety of agricultural and industrial purposes. A study conducted in 2005 to evaluate the urban sprawl of VMR region into the watershed using remote sensing techniques and examination of land use land cover changes in the watershed area reveals a dominant change in the watershed. The built up sprawl has increased from 11.09 per cent in 1975 to 33.58 per cent in 2005. This built up category includes industrial, layouts and transportation networks. Agricultural lands decreased by 8610 ha during 1975 to 2005 in the watershed areas. (Master Plan Document, 2021, VUDA, 2007).

4.21 per cent of which 3.11 per cent were fresh water bodies and 1.10 per cent marshes and back waters (Rajamani, 2014). The Mehadrigedda (cf Box 3) and Kanithi reservoirs were constructed during this period to provide fresh water supply to the city and the steel plant respectively. A decreasing trend of surface area of fresh water bodies were observed at many places as fresh water lakes or small ponds were converted into land and built-up area (Rajamani, 2014).

GEAG's discussions with local NGOs revealed that the establishment of a thermal power plant has led to environmental pollution in the Parawada region. The villages like Mutyalammalem which are near to the NTPC plant and the sea shore have been experiencing heavy water pollution (tanks, bore wells and pipelines), decreased productivity and crop output of paddy, bajra, red gram, green gram and vegetables because of fly ash production from the plant. Several health issues because of drinking polluted water have been reported.

8.3 Diminishing sanitation conditions

Increasing volume of solid waste in Gorakhpur and shrinking disposal choices are creating serious environmental issues in the peri urban villages. In 2016, there were violent clashes between peri urban communities (Mahewa) and the municipal authorities over mindless dumping of garbage.

According to the GMC records, the city generates 601 metric tons of municipal waste daily. The GMC claims that they collect 90 to 92 per cent of city's solid waste. But garbage management practices violate the Municipal Solid Waste (Management and Handling) Rules, (Municipal Solid Waste) 2000. Gorakhpur's solid waste is either being used as land fill materials (peri-urban villages like Chakra doam, Mahewa, Baharampur) or is dumped in some of the demarcated locations especially in the low lying areas in the outskirts (Mahewa, Nausad and Maheshara).



Solid waste is being used as landfilling materials in low lying areas of Gorakhpur

The peri urban areas also suffer from the city's liquid wastes. GMC records show that daily the city discharges 66.395 MLD of sewage directly into the peri urban villages, lakes (Chiluatal) and in the Rapti. Currently, the city has only 22 per cent of area under the coverage of sewer lines (55 km) but this too has gone decrepit (Wajih et al, 2009). The rest of the city is covered by 229 open drains, which not only carries the storm water, but also the sewage from homes. The topography of the city constrains building an effective drainage system. Untreated waste water is being discharged into the Rapti and Chiluatal pumping stations.

Solid waste management is a serious issue in Visakhapatnam too. The GVMC is responsible for waste management. The municipal dumping yard is located at Kapuluppada, a peri-urban locality about 25 km from the city, in Zone 1 of GVMC. Around 920 tonnes of solid waste is generated within the GVMC limits per day. In most wards of the city door to door waste collection happens but the waste is not segregated at source. Recyclables like newspapers, plastics and metals are collected by rag-pickers. A small composting plant in ward number 10 is making compost from 5-6 tonnes of recyclables and bio-degradable received per day. The waste is transported from the secondary open collection points on streets and dumper bins to transfer stations and windrows compost with the help of dumper placers, tippers and tractors. Finally, the waste from the transfer stations is transported to Kapuluppada dumping yard with the help of 10 big trippers. This dumping site of 80 acres has been operational for the last seven years and about 700 tonnes reach it daily. There are no treatment plants and often the wastes are openly burnt. Toxins leach into the soil and pollute the ground water. Scientific waste processing as per Management of Solid Waste Rules 2000 rules is absent (SWM, DPR, Visakhapatnam, 2016).

Landfill gas, mainly consisting methane is getting generated by anaerobic decomposition of organic content of the waste. The land of dumping site is located down hills of three hillocks forming a boundary from north, east and southeast side of the plot.

“The trees and shrubs in and around the valley land are getting destroyed due to this dumping and the ground water is getting polluted. This waste dumping site is affecting the health of around 10000 people” says A. Appalreddy, a 28 year old auto driver of Marikavalasa colony which is a re-settlement colony for the families who have been displaced by slum up-gradation plan/programmes within the city.

A 2011 study over an area of 1143 sq.km in the environs of GVMC reveals found high levels of metals like aluminium, manganese, copper, zinc, selenium, rubidium, cadmium, lead and cobalt in the groundwater in the areas like Akkiredypalem, Balacheruvu and Lankelapalem. These areas are in the vicinity of industries like Hindustan Zinc Limited and Visakha Steel Plant. (Babu et al, 2013).

Visakhapatnam and its peri-urban areas do not have adequate sanitation facilities. Only 48 per cent of the city has closed drains (HRVA, Visakhapatnam, 2014). The parts not covered by the sewage network depend on individual toilets and septic tanks. There is a shortage of sewage treatment plants. The sewerage collected from individual properties is pumped through the pumping stations to 70 MLD Sewage Treatment Plants (STPS) present in the city. The treated sewerage is discharged into the sea and nullahs within GVMC limit. However, out of the 149 MLD sewerage generated within the city, GVMC treats only 30 MLD at secondary stage (Rapid Baseline Assessment of Visakhapatnam City,

2013). Majority of the slums on the outskirts/ peri-urban areas have open drains for domestic sewerage (HRVA, Visakhapatnam, 2014). GEAG's researchers found while visiting the Peda Jalaripeta slum and the Eguvapeta fishing village in Bheemunipatnam grey waters from open channel drains being directly discharged into the sea. Unhygienic conditions arise near the coast because of this open sewerage drains, degrading the aesthetics as well as causing mosquito breeding near there settlements which may cause disease outbreak in rainy season when these drains overflow. Some elderly people and children were also spotted defecating in open near these drains.

8.4 Health epidemics

Gorakhpur and its surroundings have now become the epicenter of health epidemics. Official health records and interaction with community in most of the peri-urban villages have revealed that about 60-70 per cent population (in which children are more susceptible) is suffering from the abdominal diseases due to intake of polluted and contaminated water. Japanese Encephalitis (JE), Acute Encephalitis Syndrome (AES), jaundice, cholera, colitis, diarrhea, worms, dysentery, and skin diseases have become rampant. Every day, the cases of child fatality are being reported in the media due to various diseases. Data from the health department shows 62 out of 1,000 children born in Gorakhpur die before turning one. Against this, 48 out of 1,000 die in Uttar Pradesh and 40 out of 1,000 in India (Times of India, 13 August, 2017).

The peri-urban areas of Gorakhpur are notorious for water and vector borne diseases. In Harijan Basti of Chakra Doyam, home to about 50 poor Dalit households, residents complain that the city's

waste water, sewage and silage is syphoned right into their dwellings (Mitra, Wajih and Singh, 2015). Due to this waste water, skin disease, diarrhea, jaundice, colitis and cholera are very common in children of the village. The embankment constructed in the pre-Independence period to keep floodwater out of the urban wards causes waterlogging for three to four months annually. Sometime small children drown in these waters leading to clashes between villagers and urban ward residents.

Heaps of garbage near human dwellings, paddy cultivation and prolonged water logging due to faulty alignment of embankments in the peri-urban villages create a conducive environment for mosquitoes to breed and animal to human transmission of viruses and bacteria through insect vectors. Bacteria (bush typhus for instance), too, thrives in unhygienic surroundings which attack the ill-nourished bodies of poor children. Malaria and dengue are common. JE and AES has now become rampant and made this whole region (entire eastern Uttar Pradesh and adjoining parts of Bihar) notorious all over the world for this health epidemic. It is a disease carried through mosquitoes, which breeds in unclean environments and prolonged waterlogged areas (Singh, 2010). As per official records of Baba Raghav Das (BRD) medical college, one of the major government public health centres in the region for encephalitis treatment, 20 child fatalities occur daily due to JE and AES (Singh, 2017). Though the state government has initiated vaccination for JE the situation is not under the control.

Fortunately, no epidemic has occurred in Visakhapatnam so far. But the city is sitting on a powder keg. Contaminated/polluted water, lack of sanitation and heavy atmospheric pollution



Water logging leading conducive environment for mosquito breeding ground in peri-urban areas of Gorakhpur city

(the city is one of the most polluted ones in the country) due to industrialization is affecting silently thousands of its residents. According to the Assistant Emergency Medical Officer, C. H. Sridhar, diseases like swine flu, chikungunya, dengue, malaria and anthrax have emerged as new diseases in the last 30 years in the city and peri-urban areas due to climate change, deterioration in sanitation conditions, dumping yard and industrial pollution. The human resources of the medical department are not proportional to the increasing population which results in lack of services in many areas. With this rapid pace of urbanisation and changing lifestyle of people diseases like HIV and hepatitis are expected to increase.

“Our colony is a resettlement colony under Rajiv Awas Yojana, where the slum and low income population from different parts of the city reside. Every year people suffer from cholera, diarrhoea, lung diseases due to air pollution coming from the nearby dumping yard in Kapulupadda. In winters our situation becomes worse when the smog is too dense that we can even catch it by our hands. The

people who can afford to go to other places are giving their houses on rent but we do not have any other option than to bear with this pollution and unhygienic conditions says, V.Lalitha Kumari, 48, Marikvalasa colony”.

Women seem to be worse off. A study on the health of the fisherwomen living in Vasavanipalem, Peda Jalaripeta, Sivaganesh Nagar, Kotha Jalaripeta found women suffering from fever and headache, diarrhea, gynaecological problems, anaemia, joint pains, skin diseases, blood pressure, diabetes, T.B, jaundice and HIV. This morbidity pattern could be attributed to poor access to primary health care facilities, lower socio-economic status where they cannot spend much on healthcare, poor access to clean water and sanitation and lack of knowledge about hygiene and also gender discrimination within the household (Teerividhi, n.d.).

8.5 Social and Economic Marginalization

In Gorakhpur, increasing urbanisation, in-migration of people from adjoining districts and states and

growth of a speculative land market has changed the social and economic fabric of peri-urban areas. The decline of agriculture as well as of ecosystem services has been accompanied by social and economic marginalization. Due to proximity to the city few peri-urban residents remain unemployed. However, caste and gender considerations impact their remuneration and working conditions. Caste (and religious) discrimination leads many young men to seek work in Chennai or Delhi. Pravesh, a Dalit of Rampur Moharipur, works in Chennai as a house painter. Akhilesh works in Delhi as a carpenter. Both said that because of their low caste status, they could not find employment in Gorakhpur and when they did, the payment was low (Mitra and Singh, 2011).

For women, urbanisation has brought many freedoms and a sense of identity and recognition. But there are also associated problems such as alcohol abuse and domestic violence by husbands. Women's education and health are accorded a low priority. For example, Kiran, aged 33, of Jangal Bahadur, lost her husband three years ago. She is from the upper-caste trader community and owns 0.3 acres of land but rather than farm it herself, she has a tenant sharecropper. She says, 'I am not a farmer so how can I manage the land?' She receives no government benefits and survives by selling petty goods, such as ribbons, from a stall in front of her house (Mitra, Wajih and Singh, 2015).

Visakhapatnam faces issues similar to Gorakhpur, including uncertain land tenures (cf Box 4).

In Visakhapatnam, the fishers in the peri-urban villages seem to be going through major social and economic crises due to pollution, reduced catch all leading to occupational displacement as casual wage labour in the informal sector. Moreover, their caste puts them at a disadvantage.

9. CONCLUSIONS: PERI-URBAN CHOICES AND THE WAY FORWARD

Recently, in Varanasi, the UP chief minister Sri Yogi Adityanath warned land sharks to return grabbed property voluntarily or face stern action (PTI, 2017). It will be a welcome move if implemented seriously. Also it has to be borne in mind that the state, as in the case of Gorakhpur and Visakhapatnam, is the biggest land grabber, with little consideration for the environment or the impacts on the poor. Private vested interests apart, this is also due to the impact of the liberalisation policies and the choices India has made, the development alternatives chosen post 1990.

Indeed, euphoria about India's gross domestic product (GDP) growth rate over taking that of China, making it the world's fastest growing economy needs to be tempered with some

Box 4: The Land Question in Yarada

Yarada is a peri-urban agricultural village where bananas and coconuts are grown predominantly. Covering an area of 600 acres out of the total 2062 acres of Yarada land, the village is situated in Zone 4 of GVMC. Despite living there for four centuries no household owns any land of any kind, homestead or agricultural. This is because of an ongoing lawsuit with some people of the city who claim descent from an erstwhile *zamindar* who was entitled to the village revenues. The community has remained economically marginalised for a long time due to the uncertain tenure. Meanwhile, land prices have escalated to Rs 25-75 lakhs due to a proposed government tourism development project. The villagers cannot sell their lands even if they wish to in times of need nor can they mortgage it for formal credit, even for agriculture. No government agricultural services are provided by the department to these villagers as they do not have the legal status of farmers and land owners. Women are involved in marketing of the produce to nearby areas. No other livelihood options could be developed in this area as connectivity to the city is not good.

reflection on the costs of that growth, its differential impacts on the people and the environment and the choices we are making. As urbanisation goes on unbridled, in the decade 2001-2011, the number of cultivators fell by 9 million while agricultural labour rose by 38 million according to the 2011 census. More importantly, the fall in the number of cultivators was higher for women, from 41.9 million in 2001 to 36.0 million while that of male cultivators fell from 85.4 million to 82.7 million, indicating, along with falling child sex ratios across the country a further skewing of unequal gender relations.

As cities and towns engulf surrounding villages, the very nature of the economy, society and environment gets transformed unalterably. 'Development' and 'progress' is equated to building roads, embankments and bridges, housing societies and 'farm houses' for the urban rich to relax during weekends. Swanky malls replace farmers' traditional bazaars. Land sharks, often with political patronage, seek to acquire land at any cost in the urban fringes but these areas also become the dumping grounds of the wastes of the core city adding to the woes of the already suffering peri-urban inhabitants. Gurugram, earlier a part of peri-urban Delhi, is a very good example of this process. 600 out of its 700 acres of prime agricultural land that played important environmental roles has been acquired for haphazard real estate development that has left its traditional as well as new citizens choking for breathe as well as thirsting for water. Another disaster is in the making in the development of Amaravati, the new capital of Andhra Pradesh where some 33000 acres of prime agricultural land has been obtained. Forty per cent of this land is wetland where more than 100 crop varieties are cultivated. Obviously the large absentee landlords will gain and the small and marginal farmers as

well as those dependent on the agrarian economy will suffer. Moreover, the area has many human made tanks (Cheruvus) that will be used to build houses and offices but a heavy downpour will certainly lead to flooding as happened in Chennai in 2015 or Mumbai in 2017. Eighty per-cent of the area is flood prone according to the disaster management plan of Vijayawada. Moreover, equitable and inclusive development has to be climate smart. Byravan (2017) blames human activities in the recent flooding of Chennai, Mumbai and Houston, "rampant increase in built-up area across natural drainage channels, diversion or damming of rivers upstream leading to sediment transport and siltation, coastal subsidence and other effects of development," but her observations hold equally for all other cities including Gorakhpur and Visakhapatnam.

"Any rain that falls on soil or vegetation is mostly absorbed into the earth's surface. Some of it slowly trickles into shallow or deep protected aquifers that make up what we call groundwater. The rest usually flows downhill along surface or sub surface stream channels. The spread of infrastructure such as roads, highways, buildings, residential complexes, tiled or asphalt covered land obstructs rainwater from percolating into the soil. Often there are further barriers that block movement of water an increase flooding. In much of India, urban growth over the past few decades has blithely ignored the hydrology of the land, (Byravan 2017)"

Indian urbanisation has thrown basic ecological principles and concretised water bodies, agricultural lands, forests, streams, hydrology and topography, biodiversity and human beings. Clearly, some very important holistic choices have to be made nationally, locally, societally and individually. The first set of these choices relate to de-linking urbanisation /industrialisation with progress and focus again on developing agriculture and think

of the 800 million people who live in rural areas. Indeed, the choice to rejuvenate agriculture holistically is important as it relates to India's food sovereignty and ecological sustainability in as much as farms are not just spaces to grow food but also serve crucial environmental purposes like mediating the micro-climate, sequestering carbon, nutritional recycling and so on.

While between 2003 and 2012, there was a clear turnaround in India's agricultural performance, the rate of growth in agriculture and allied activities fell from about 4 per cent per annum in the 11th Plan period to just 1.7 per cent in the first three years of the 12th Plan (2012-15). Over 300,000 farmers have committed suicide in the last decade, and in Maharashtra alone, over 2,000 such cases have been reported in 2015-16 (Vijayshankar, 2016)

In fact, the choice relates to the nature of employment and combatting poverty. Do we want to increase the number of urban /semi-urban poor living in utmost misery in slums/ squatter settlements, many of the migrants climate refugees and victims of climate change? (Mitra and Singh, 2011). Gorakhpur, Visakhapatnam, Bhopal, Delhi – urbanisation in Indian cities is strongly linked to slums /squatter settlements and shanties. Locating industrial units in these areas leads to disasters that become international headlines but an apathetic state does not seem to learn or care. As a nation have we really learnt from the 1984 Union Carbide tragedy of Bhopal? In Visakhapatnam rapid industrialisation is taking place along the coast with scarce regard for the environment. A fertilizer factory on the banks of the Chiluat that heavily polluted the lake and the surrounding agriculture lands in peri-urban Gorakhpur is scheduled to be reopened soon after being shut for years following a farmers' agitation.

A Holistic Strategy

While addressing the issue of peri-urbanisation requires as a starter the de-limiting of urban growth through effective land-use policies, including a national one, the rural economy too needs attention so as to prevent small and marginal farmers from selling their lands and migrating to urban areas. According to The World Bank's World Development Report 2008, agricultural growth is at least twice as effective in reducing poverty compared to growth originating in non-agricultural sectors. In India, 80 per cent of the people officially counted as poor lived in rural India in 2011-12, highlighting the need to enhance rural incomes at higher rates in poverty reduction. This means that for making a significant dent in poverty, rural incomes have to grow at a faster rate. The gap between urban and rural consumption levels has increased over the years. Recent studies have shown that despite the spurt in rural incomes between 2005 and 2012 caused by a rise in commodity prices and favourable terms of trade for agriculture, the level of non-farm incomes is at least three times that of farm incomes even today (Vijayshankar, 2016).

In those peri-urban areas that have already come into being, the situation can be better managed by promoting and maintaining multifunctional green spaces and also peri-urban agriculture, the latter requiring greater attention from agricultural scientists and concerned departments. Moreover, better solid waste management practices need to be put in place and the peri-urban areas not used as waste dumping grounds but for promoting peri-urban agriculture.

What is needed is a systems approach in the protection of urban and peri-urban agriculture.



Sustaining ecosystem services through maintaining peri urban agriculture in city's periphery of Gorakhpur

Fundamental changes in mind-sets are needed to prevent further land-use changes and unregulated construction activities. Of course, this would require mapping the peri-urban areas and land-use patterns effectively through GIS tools instead of relying on Master Plans in addition to strictly implementing the land and water use rules and regulations. It has to be recognised that in a city the peri-urban need not be homogenous but the variety contributes to the overall resilience of the city in addition to the livelihoods of hundreds of people. The Visakhapatnam study shows this very clearly.

Our case studies as well as examples from other cities including Bhopal show that fishers live and depend on various water bodies like ponds, lakes, rivers and the sea. Rapid urbanisation or peri-urbanisation displaces their livelihoods, forcing

them to join the ranks of the urban informal labour force as casual labour. Fishers, both marine and inland, too need to be recognised and their rights protected. The CRZ rules are violated with impunity by private and state agencies alike, leading not only to loss of livelihoods but also potentially increasing the adverse impacts of disasters like cyclones.

The peri-urban areas hardly have any health facilities (Mitra, Wajih and Singh, 2015). In the absence of health facilities as well as preventive health measures accentuated by adverse impacts of climate change and water logging due to conversion of peri-urban lands and water bodies fatalities like in Gorakhpur are going to increase in the coming years.

As mentioned earlier, a major issue relates to public finance that also causes poor supply of health facilities. Will India increase the allocation on health budget as proportion of the GDP from the present low levels of 1.2 per cent to 2.5 per cent? It seems unlikely in the near future.

Forms of governance and citizen's participation in the same is an area that needs attention. Presently a lot of dissatisfaction was noticed amongst citizens in peri-urban areas during the field work. Perhaps democratic people's institutions, as is being formed by GEAG in peri-urban Gorakhpur might be a better alternative (Mitra, 2017). A lot of rules and regulations, including those relating to land use changes, waste management or ground water pollution exist but are not implemented in practice. This has to change. Health and education supply needs drastic improvement qualitatively and quantitatively. Malnutrition in the peri-urban areas is a serious issue and needs addressing.

Finally, a lot of awareness needs to be generated not only amongst bureaucrats and city planners but amongst ordinary citizens as well about the need for preserving peri-urban spaces, including water bodies. The peri-urban agriculture needs to be recognised as a distinct category that is women centred and support needs to be provided in the form of extension services, marketing facilities, transport, storage and institutional credit. Ecosystem support services, such as enhancing soil nutrition and protecting water quality, are essential to this process.

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About Organizations



Gorakhpur Environmental Action Group (GEAG)

Gorakhpur Environmental Action Group (GEAG) is a voluntary organization working in the field of environment and sustainable development since 1975. Ever since its inception, GEAG has been actively engaged in implementing several development projects addressing livelihood issues of small and marginal farmers, particularly women, based on ecological principles and gender sensitive participatory approach. Besides, GEAG has accomplished several appraisals, studies, researches at the micro and macro levels as well as successfully conducted a number of capacity building programmes for various stakeholders including women farmers, civil societies groups and government officials etc.

GEAG has established its identity in North India as a leading resource institution on sustainable agriculture, participatory approaches, methodologies and gender. Acknowledging its achievements, GEAG was awarded with the Lighthouse Activity Award by UNFCCC in 2013. GEAG also holds the Observer status to Green Climate Fund. (www.geagindia.org)



The Rockefeller Foundation

The Rockefeller Foundation supports work that expands opportunity and strengthens resilience to social, economic, health and environmental challenges, affirming its pioneering philanthropic mission since 1913 to promote the well-being of humanity. In climate change, the Foundation develops services and strategies to protect those with the least means from an imperilled environment and changing global climate. The Rockefeller Foundation envisions a world with Smart Globalization – a world in which globalization's benefits are more widely shared and social, economic, health, and environmental challenges are more easily weathered.

The Rockefeller Foundation supports work that enables individuals, communities, and institutions to access new tools, practices, resources, services, and products. Additionally the Foundation supports work that enhances resilience in the face of acute crises and chronic stresses, whether manmade, ecological, or both. (www.rockefellerfoundation.org)



Asian Cities Climate Change Resilience Network (ACCCRN)

The Rockefeller Foundation launched the Asian Climate Change Resilience Network (ACCCRN) in 2008 to help cities strengthen their capacity to prepare for, withstand, and recover from the projected impacts of climate change. This effort has resulted in insights into the process and range of actions that are needed to confront these dynamic shifts affecting urban areas. ACCCRN began with a focus on 10 cities in Vietnam, India, Indonesia, and Thailand. City-led projects include establishing end-to-end early warning systems in Surat, India, and storm and flood resistant credit and housing in Da Nang, Vietnam.

Today, ACCCRN is leading regional network connecting professionals and communities across Asia to build inclusive urban climate change resilience (UCCR) that focuses on poor and vulnerable people affected by climate change. Several ACCCRN cities are now members of the 100 Resilient Cities Network, bringing these lessons and best practices to other cities around the world. (www.acccrn.net)

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