INDIA COUNTRY REPORT

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SUMMARY

India is rapidly urbanising, throwing up many challenges for cities, especially secondary cities. Rapid residential and commercial development is replacing agriculture and other undeveloped land, including common property resources and water bodies, around urban areas, severely impacting the ecosystems and the lives of the people dependent on them. Urbanisation is bringing about changes in land-use patterns by transforming urban-rural linkages, and leading to loss of open vegetation and decline in environmental quality. This in turn, is also adversely impacting the resilience of cities.

There is an urgent need for research that can provide evidence for better understanding of the threats and opportunities that urban systems face and the ways in which ecosystem services and dis-services contribute to urban resilience in the face of climate change and urbanisation. This study, which is part of the larger scoping study being carried out by a Working Group co-created by Ecosystems Services for Poverty Alleviation (ESPA) Directorate and Asian Cities Climate Change Resilience Network (ACCCRN), aims to contribute to the learning on how ecosystems, especially in the peri-urban areas are impacting the urban resilience in secondary cities of India.

Research shows the importance of peri-urban spaces, their contribution to enhancing the resilience of the urban areas in the face of climatic changes and that these areas cannot be neglected and need policy support. Following are the key recommendations for getting entry points to bridge the gap between researchers and policy makers that this study focuses on:

- **Disconnect between Researchers and Policy Makers:** There is a disconnect between researchers and policy makers in India. Researchers are rarely concerned with the policy implications of their research work and focus more on their own interests and basic understanding of the issues. Researchers are also sectorally biased and tend to consider areas as per their agenda, lacking the holistic and systemic approach to looking at the urgency of the issues. Also, researchers are often top-down in their approach. Therefore, it is pertinent for the researchers and policy makers to come to a common understanding in scoping out the research if the uptake of findings is to be included in policy formulation.

- **Disconnect with Community:** Another limiting factor that undermines effective implementation of research is the disconnect between researchers/decision makers from those who the research is about or intended for – the "community". Community-related research must have communities involved in research design and only then their problems and perceptions can be taken into cognizance for building understanding for policy formulation which can then benefit them. The appropriate focus should be on 'participatory analysis', through encouraging public understanding

and participation. There is an increasing disconnect between research agendas and real needs at community level in terms of priorities, and the practicability for operationalizing some of the research findings which later becomes obstacles in embedding the findings in the policy formulation.

- **Localized research:** For effective uptake of research results into policy making, it is important that research is action-based, according to local context, as per the needs and priorities of communities and befitting the state policy frameworks.

- **Research alignment:** Policy recommendations from researches are often not aligned with the existing plans and policies of the government. It is important that research recommendations suggest the government mechanisms and related funding streams where the research results can be embedded so that the uptake can be effected.

- **Packaging and communicating research results:** Research results and findings need to be packaged and communicated in a format that is easily understandable by policy makers. Detailed research reports are rarely consulted by policy makers. Preparing concise policy briefs outlining key findings and recommendations in a simple language generally helps them.

BACKGROUND

This scoping study, based on desk review and field visits seeks to examine the links between ecosystem services, urbanisation and resilience to climate change, using the cases of few cities in the Indo-Gangetic Plains of eastern India. This includes understanding the notion of an ecosystem and how urban transformations, unless carefully planned and implemented, can impact such ecosystems adversely. It argues that not adhering to certain basic principles of an ecosystem-based approach to development, including the understanding of urban, peri-urban and rural areas and their associated systems, can be detrimental for both populations and the ecosystem itself. For instance, in the process of urban sprawl at the peri-urban interface, areas such as greenbelts, open spaces and floodplains are threatened and rendered fragile. This affects livelihoods which draw on ecosystem services, and are possibly more at risk in a situation of uncertainty surrounding climate change. Thus, by understanding the roles and services provided by these spaces and their ecosystems more generally, one can understand their role in contributing to urban resilience to climate change.

Ecosystems Services for Poverty Alleviation (ESPA) Directorate and Asian Cities Climate Change Resilience Network (ACCCRN) have co-created a Working Group on Urban, Peri-Urban Ecosystems to provide evidence on ecosystem services and resilience in urban & urbanising contexts in Asia. This scoping study from India helps in building an understanding on the ways in which ecosystem services/dis-services contribute/impact urban resilience and how these research evidence can enable decision-makers to implement better policies which will support the resilience building process in cities, especially the secondary cities in India, which are most impacted by climate change.

This scoping study is based on secondary sources as well as some primary data collected through fieldwork in the peri-urban areas of few secondary cities in eastern India, namely, Gorakhpur (Uttar Pradesh), Saharsa (Bihar), Jorhat (Assam) and Bashirhat (West Bengal).

Gorakhpur Environmental Action Group (GEAG), a local NGO, has been implementing projects in the peri-urban areas of these secondary cities and lot of the information was derived from project documents and experiences. This study relies on the data/information collected from GEAG's projects and on the reports from other agencies in India.

Key Informant Interviews with city stakeholders and residents from peri-urban areas in these cities were also conducted to gain understanding of the key governance gaps that exist which impedes the conservation of peri-urban spaces.

URBANIZATION TRENDS

By 2050, almost three-quarters of the world population will live in cities and towns, with most of this increase occurring in developing countries in the global south [1]. Asian cities are expected to see more than 60% of this increase and 46% of all urban population growth will occur in cities with fewer than 500,000 inhabitants.

The 2011 provisional census of India reported an annual growth rate of urban population of 2.76%, close to the 2.73% reported in 2001. The urban population of India in 2011 was 377 million, or 31.16% of the total population. The decadal urban population growth rate during 2001–2011 was 31.8%, which was 1.8 times that of combined urban and rural growth, and 2.6 times the rural population growth. Thus, for the first time since independence in 1947, the absolute increase in population was higher in urban areas than in rural areas. The proportion of rural populations declined from 72.19 per cent in 2001 to 68.84 per cent in 2011.

The challenge of this rapid urbanisation trend in India is alarming and in urgent need for attention. Rapid urbanization combined with inadequate provision of basic need services are increasing the vulnerabilities of populations living in most Indian cities. Secondary cities are growing at an unprecedented pace. These cities are the hub of opportunities where large scale migration takes place for fulfilling aspirations and in anticipation of better livelihoods. Due to these socio-economic factors, including population pressure and poverty, urban regions have seen a large influx of population from rural areas and this has led to the rapid growth of new urban centres.

This has crucial implications for infrastructure and other civic amenities in urban areas. Rapid residential and commercial development is replacing agriculture and other undeveloped land, including common property resources and water bodies, around urban areas, severely impacting the ecosystems and the lives of the people dependent on them. Urbanisation brings about changes in land-use patterns by transforming urban-rural linkages, and leads to loss of open vegetation and decline in environmental quality. This expansion and ensuing land-use change is a direct driver of damage or destruction of ecosystems in peri-urban areas, leading to a host of problems with few short-term solutions. These impacts are exacerbated by archaic policies that do not go beyond considering the differences between urban and rural areas as a question of numbers of people and geographical spaces. Once the consequences of altering peri-urban ecosystems and the potential loss of resilience-building opportunities become apparent, it may be too late to bring about a reversal. This study focuses on some of these factors in the case of few secondary cities in eastern India.

URBAN HAZARD PROFILE

The resilience of most of the secondary cities in India is threatened with the decline of ecosystem services. With rapid land-use changes and an economic shift from agriculture to urban development, small-scale and marginal farmers in peri-urban areas, whose practices provide redundancy to urban food production, are on the brink of collapse. The diversity of peri-urban agriculture, including its ability to provide food in periods of floods and waterlogging, is an example of how the provisioning services of ecosystems help in developing the flexibility of hard systems.

Generally, peri-urban areas have resulted from the extension of urban activities beyond existing administrative boundaries in urban regions. Peri-urbanisation can be defined as "a process in which rural areas located on the outskirts of established cities become more urban in character, in physical, economic, and social terms, often in piecemeal fashion" [2]. It has been characterised by changing local economic and employment structures from agriculture to manufacturing, rapid population growth and migration, rising land values and mixed land use. Peri-urban has been conceptualised as the transitional zone between a sprawling city and its rural surroundings [3], 'neither rural nor urban in its outlook and characteristics' [4].

The peri-urban is a fast-changing, semi-natural ecosystem which provides natural resources for growing cities in terms of water bodies, open and green lands, and orchards. Peri-urbanisation leads to usurpation of ecologically sensitive lands for housing and other construction activities. These change the face of agriculture, reduce open spaces, 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 [5].

Peri-urban ecosystems are increasingly at risk of degradation and loss as natural resource consumption and waste in peri-urban areas increase due to rapid urbanization and increasing human activity. Cities do not operate in isolation but within a "sphere of dependence" on surrounding areas and their ecosystems. As such, the degradation of these ecosystems results in loss of ecosystem services that support urban and peri-urban populations:

- **Water provision:** This is often the most important service lost, as polluting above-ground rivers and lakes destroys accessible sources of surface water. Dumping of sewage and solid/liquid waste in peri-urban areas contaminates the ground water, leading to spread of many diseases. Population growth increases demand for this

diminishing water supply, and water tables drop as underground aquifers fail to recharge.

- **Flood buffers:** In many cases, this is one of the most valuable services threatened, as illegal construction on areas which are demarcated as open/green belts prevent natural drainage and exacerbate floods. Acute waterlogging and floods compounds the risk of property damage and loss of life.
- **Waste treatment:** Wetland destruction undermines the ability of the ecosystem to filter refuse from water supplies. Effluents from peri-urban industry, excessive untreated human waste, and garbage pollute the remaining waterways.
- **Food production:** As the urban fringe expands, industry and housing developments (both formal and informal) replace productive agricultural land, which often displaces poor farmers and can lead to lower volumes and higher food prices, particularly in cities that are highly dependent on nearby agricultural supply.
- **Climate and air quality regulation:** Peri-urban land supports green vegetation cover that absorbs air pollution and ambient heat, but the clearing of vegetation slows the process of filtering toxic compounds from the local atmosphere. As landscapes that used to be permeable and shady become dry and solid, a "heat island" effect can occur, leading to higher temperatures in a region.
- **Fuel wood and timber:** Deforestation removes a source of fuel wood and timber that nearby farmers depend upon.

ROLE OF PERI-URBAN AREAS AND ECOSYSTEMS IN BUILDING URBAN RESILIENCE

The Millennium Ecosystem Assessment focussed on 'ecosystem services' and their sustainable use to contribute to human well-being. Growing research on the importance of ecosystem services have shown scant regard for such concerns especially in a scenario of rapid urbanisation. Ecosystem services include provisioning services (food, water); regulating services (waste treatment, flood control); cultural services (recreational benefits); and habitat services (maintaining conditions for life).

The supporting, provisioning, regulating and cultural services provided by ecosystems have been analysed at two levels: *At the first level*, these ecosystems are very intrinsically connected with the livelihoods of the people and are vital for their sustenance. *Secondly*, the ecosystems support in enhancing the resilience against climate shocks in urban areas by acting as natural protective barriers or buffers.

Experiences show that the measures to restore or conserve ecosystems need unconventional approaches involving multiple disciplines. At the core, they must involve the local communities and people who are the actual keepers and users of the

ecosystems. Central to such approaches would be preventing haphazard land conversion for construction which has a tremendous cost for both people and the ecosystem and which affect the city's resilience. Reviving ecosystems also means attending to people's development needs, especially their heath and livelihoods.

The relationship between ecosystems and cities are interlinked and is often a two-way process. Ecosystems provide a multitude of physical and environmental services to cities and their residents which also help in enhancing city's resilience. However, the cities, which are rapidly urbanising and experiencing unplanned development is leading to a threatening decline in ecosystems. This is impacting the resilience of several cities. 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. Talking of peri—urbanisation, this is leading to usurpation of ecologically sensitive lands for housing and other construction activities. These change the face of agriculture, reduce open spaces and green zones, 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. The peri-urban areas which provides ecosystem services to urban areas, are become the dumping grounds for urban solid waste, sewerage, etc., which is leading to environmental degradation, groundwater contamination and adversely impacting the livelihoods and the health of people residing in the peri-urban areas.

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 [3, 6, 7]. 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 [4, 5].

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 [3, 6]. Left unaddressed, the process leads to rural-urban synergies breaking down, environmental degradation and rising urban inequities and poverty [4], which could be worsened by the impact of climate change [8].

Case Studies from Four Secondary Cities in the Indo-Gangetic Plains

Under the Asian Cities Climate Change Resilience Network (ACCCRN) initiative of the Rockefeller Foundation, which spans 10 cities in four countries (India, Thailand, Vietnam and Indonesia) and includes Gorakhpur city from India (as well as Indore and Surat), shows that four key components of a city – knowledge, enabling policies and plans, engaged stakeholders, access to finance – collectively determine well-being where different attributes can be used to observe or assess these four components. Gorakhpur Environmental Action Group (GEAG) worked in the peri urban areas of Gorakhpur on conserving agriculture and ecosystems for building urban resilience. GEAG, then scaled up its experiences and is working in the peri-urban areas of three other secondary cities which lie on the Indo-Gangetic Plains, i.e. Jorhat (Assam), Bashirhat (West Bengal) and Saharsa (Bihar).
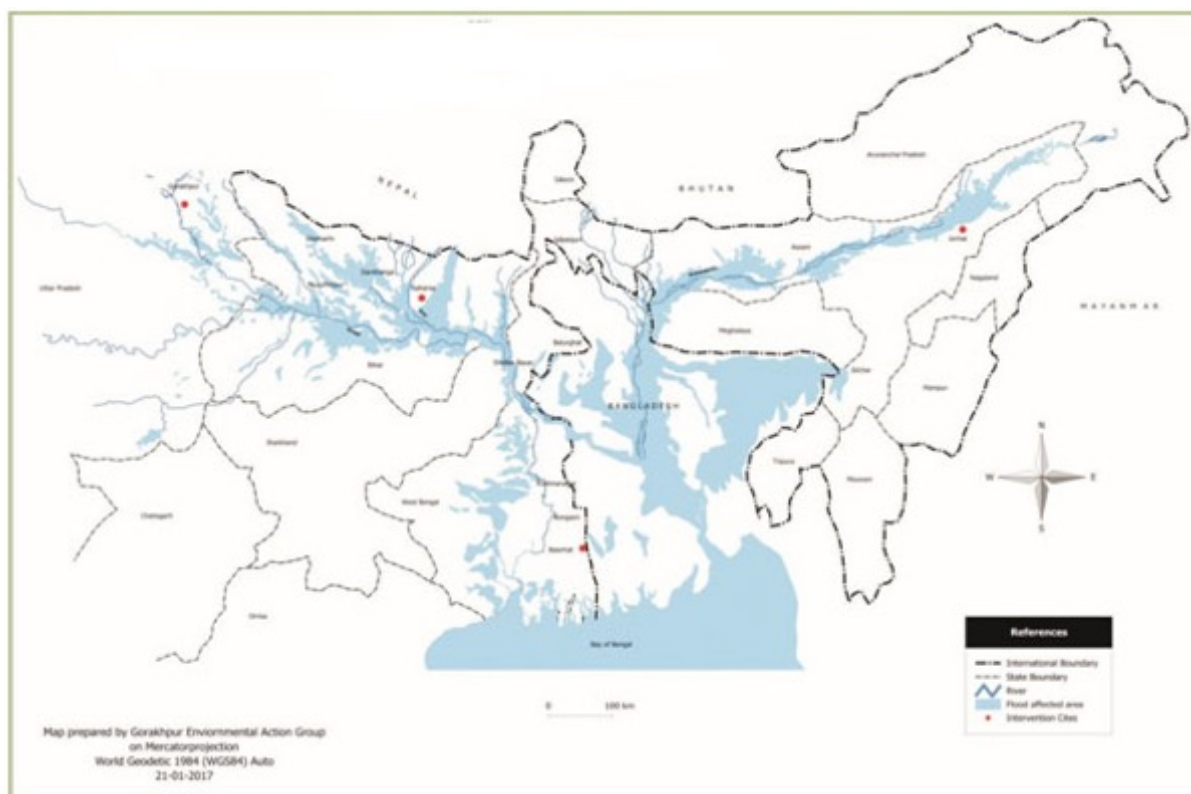
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Figure 1: Study Area (Four cities of eastern India in the Indo-Gangetic Plans

below case studies briefly outline the situation of peri-urban areas in these four cities and how the loss of ecosystems due to increasing urbanization is impacting the resilience of the cities and its people.

Case Study-1: State of Peri-urban Ecosystems in Gorakhpur, Uttar Pradesh

Gorakhpur, a secondary city, located in eastern Uttar Pradesh at the confluence of rivers Rapti and Rohin, has grown rapidly into an economic and institutional hub in the region. Its proximity to Himalayas has made the city susceptible to floods and water logging due to multiple factors, such as being located at a level lower than the river Rohin along which it is situated, discharge of excess water from Nepal and city's bowl-shaped topography. These problems are further exacerbated by climate uncertainties, impacting the livelihoods of poor and marginalized communities. Climate projections have indicated that the intensity of extreme rainfall in Gorakhpur is likely to increase in the
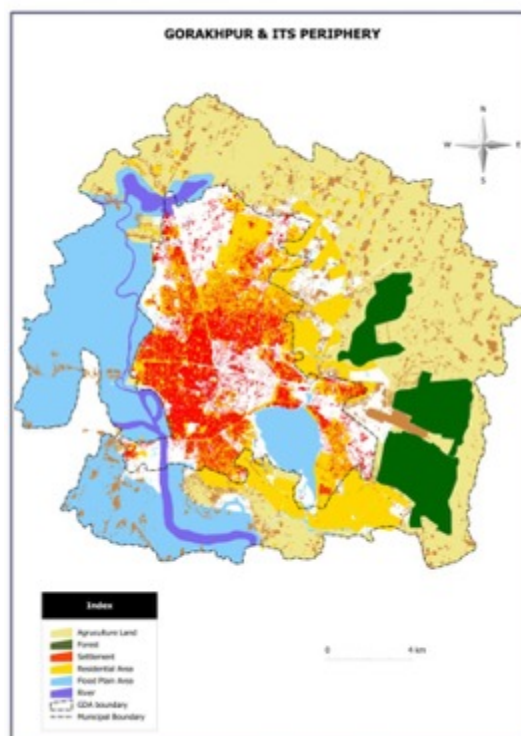
Figure 2: Gorakhpur city and its surrounds

coming years causing significant flooding in the city. Climate change is likely to increase the intensity of similar rainfall events by 10 to 20% in the future. The peri-urban areas of Gorakhpur are particularly prone to recurring floods and waterlogging for 2 to 3 months every year due to which small and marginal farmers suffer from crop losses.

In the peri-urban areas of Gorakhpur, 8089 hectares of land is prone to flood. This is in the western part of the city and gets inundated every year. In spite of flood plains and being a no construction zone, the rapid encroachment is being manifested in many parts. As per the satellite images of two-time period (2002 and 2015), 267.42 hectares (33%) of land has been converted into built-up area. The north, north-east, east and south-eastern part of the city periphery are free from water logging and flood. This segment accounts 11558.17 hectares which is marked as agriculture land/green land. The city is growing in this direction. Due to rapid urbanization, the land mafias (builders) are more active in this zone and converting the open spaces/agriculture lands into residential area.

The rapid urbanisation occurring in Gorakhpur is straining the natural resources and is absorbing the existing agricultural land on the periphery of the city leading to decreased green/open spaces, interrupted supply of food items to cities, disrupted livelihood patterns, and reduced natural drainage of excess storm water. Large scale conversion of agriculture land for non-agriculture uses is exacerbating climate change risks by increasing water logging and run-off.

About 54% of the peri-urban area represented in the Gorakhpur city Master Plan-2021 for agricultural use, has a population of 0.1 million of which a significant proportion belongs to small and marginal farmers' category. These farmers are hit by several problems of flood and waterlogging, sewage dumping, increasing cost in agriculture, changing land use patterns and governance issues which make them socially and economically vulnerable.
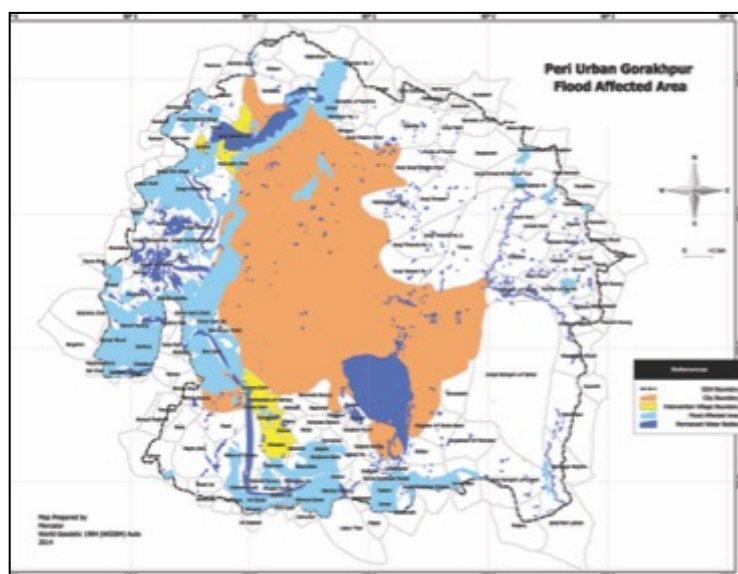

Figure 3: Peri-urban Gorakhpur - flood affected areas

The peri-urban spaces had provided vital ecosystem services such as recharging water bodies and acting as buffers. These services, and their contribution to the city's resilience, are being lost. Supporting services, including nutrient dispersal and cycling, seed dispersal, and primary production have been altered, changing the nature of all other services. The people in Gorakhpur's peri-urban villages now increasingly rely on the market for food and medicines and other goods. There is an acute fuel shortage, leading to reliance on expensive sources of energy and electricity.

Peri-Urban Agriculture – Strategy for Building Urban Resilience in Gorakhpur

Gorakhpur Environmental Action Group (GEAG), an NGO based in Gorakhpur undertook this initiative which sought to mitigate flood risks through maintenance of open spaces by strengthening peri-urban agriculture based livelihoods around the city of Gorakhpur. While the initiative aimed at enhancing incomes and increasing food security for low-income residents, it also targeted to influence citywide land use planning decisions towards the goal of developing greater flood resilience. Today, peri-urban agriculture in Gorakhpur city of India represents a practical mechanism for diversifying urban livelihoods, particularly those of poor and marginalised communities, ensuring the availability of local food supplies, particularly vegetables and fruits and maintaining open areas that can serve as flood buffers. The land use pattern and ecosystem services in these areas are maintained to promote climate resilient peri-urban agriculture with innovative methods. This has resulted in securing livelihoods of small and marginal farmers, enhancing agricultural productivity and ensuring urban food security.

Case Study-2: State of Peri-urban Ecosystems in Jorhat, Assam

Jorhat is a secondary city located in the north-eastern part of Assam. The city is located on the Bohgodi and Tarajan rivers which are tributaries of river Brahmaputra. Jorhat is one of the fastest-growing cities in Assam. The peri urban areas of Jorhat are particularly prone to recurring floods and water logging for two to three months every year, because of which small and marginal farmers suffer from crop losses. Climate change is likely to increase the intensity of similar rainfall events by 5-10 % in the future. Climate projections have indicated that the intensity of extreme rainfall in Jorhat is likely to increase in the coming years, which will cause significant flooding in the city and peri urban
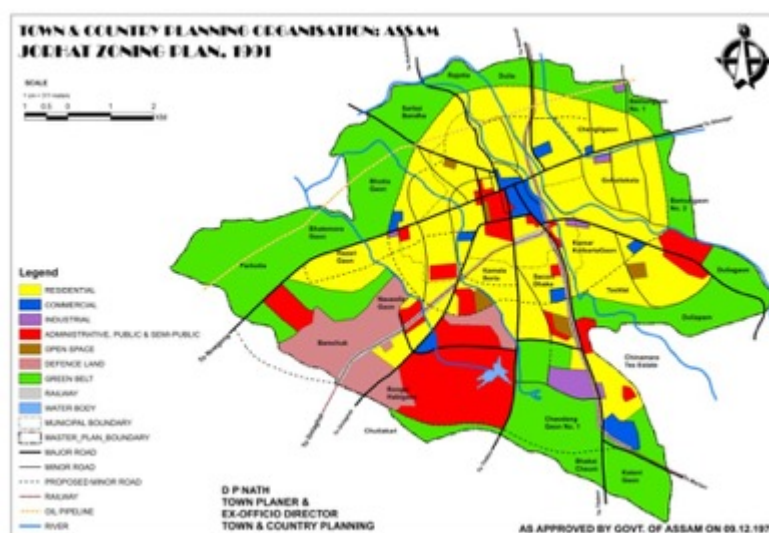

Figure 4: Jorhat city and its periphery showing green

areas. Flooding occurs in most of the village which are in low-lying areas.

Between 1962 and 2005, major land use changes have taken place both in residential and commercial areas in Jorhat Municipal Area. The vacant land decreased from 87.35 hectares to 39.88 hectares. In case of roads and railways, the land area has increased from *55.95* hectares in 1962 to 81.78 hectares in 2005. The area under parks and playgrounds has decreased from 15.39 hectares to 14.09 hectares.

Similarly, vacant land meant for open and green areas and water bodies have also decreased. All these land use changes are mainly due to urbanisation and new settlements. It is observed that covered areas have increased at a faster rate, which ultimately reduced the capacity of surface flow. As a result, surface water accumulates more and rushes to depressed areas resulting in waterlogging in the city.

The below table presents the current situation of peri-urban ecosystems in Jorhat, which is alarming:

Ecosystem	Current Situation
Water bodies	Before 10-15 years, 60-70% of the households in villages had their own waterbodies like ponds but they are only left with presently 30-32% water bodies. The main causes for decreasing of water bodies are the

	contamination of ponds, high land value, climate change (less rain fall), urbanization pressure.
Bamboo plantation	Bamboo and wood was rampantly used to construct houses a decade ago but now mainly RCC structures are being constructed. This is due to lack of bamboo availability and bamboo plantation area in the peri-urban areas has reduced by 30-35%.
Forest	The forest cover has also reduced because of constrictions taking place which has also impacted the natural habitat for animals.
Tea estate	No change in land use
Horticulture/ orchards	Old plantation cut and sold out for housing and commercial buildings.
Agriculture	Rain fed farming, only rainy season crop harvested (paddy), mainly grown for own consumption of farmers.
	No irrigation facility in the all peri urban areas; only some parts have the facility of Government deep bore wells (approx. 8-10% crops receive irrigation services and the rest 90% crops depend on rain water)
	No market oriented farming practices in the areas
	Farmers are not aware of other farming system like integration farming and other climate resilience techniques.

Peri-urban agriculture in Jorhat is also facing threats of land use change and distressed selling of land because of low income from agriculture. The ecosystems are also shrinking which used to provide much of the inputs at no cost for agriculture. GEAG is working with the peri-urban farmers in Jorhat and supporting them in learning new techniques of low external input and climate resilient agriculture, tea gardening at small scale for small land holding small and marginal farmers, integrated farming systems with combinations of crop-horticulture, horticulture-fisheries, animals-fishery-crop, growing high value crops like vegetables, citrus fruit cultivation, increasing crop diversity, and so on.

Case Study-3: State of Peri-urban Ecosystems in Bashirhat, West Bengal

The peri-urban areas of North 24 Parganas is experiencing rapid urbanization due to the neighbouring Bangladesh border. With the spread of urban sprawl, a drastic change in land use land cover and socio-economic environment has been taking place. Huge migration and rapid urbanization has resulted in the loss of critical ecosystem services. The city is also witnessing a clear impact of climate change in the form of erratic rainfall, high temperatures and humidity,

Figure 5: Bashirhat Municipality demarcating green

impacting lives and livelihoods of people. Some of the key changes witnessed in the peri-urban ecosystems of Bashirhat are that, that rapid land use change is taking place and in the last 10 years, 5-8% of agriculture land has been converted to residential buildings. There is a huge shrinkage in water bodies due to rampant encroachment and about 30% ponds are contaminated due to hybrid fish rearing. Drinking water is a major issue impacting health of the urban poor people.

The current problem in Basirhat peri-urban area is the reduction in the area for agricultural activities and continuous waterlogging, impacting the flood resilience of the city. One of the main reasons behind these two problems is that people have shifted from traditional fishing practices to rearing hybrid fish in the last decade or so. Earlier, the fish which was in demand locally was bred but now people have started rearing catfish as that is more commercially viable. Catfish is usually reared in dirty water which contaminates the environment and the groundwater.

Case Study-4: State of Peri-urban Ecosystems in Saharsa, Bihar

Saharsa is a city and a municipality in the Saharsa district in the state of Bihar in the north of the country, east of the Kosi River. It is the administrative headquarters of the Saharsa District, and is in the Kosi Division. Sahrasa is also the name of the assembly constituency, which contains the city and neighbouring parts of the district. Saharsa and its surrounding areas are a flat alluvial plain forming part of the Kosi river basin. This makes the land very

fertile. However, frequent changes during the Kosi, one of the largest tributaries of the Ganges, have led to soil erosion. Saharsa is hit by floods almost annually, causing a significant loss of life and property. In Saharsa district, the main problems of the people are poverty, unemployment, and literacy. The Kosi floods of 2008 have been a landmark event in the history of disasters in Bihar.

The land use pattern in the peri-urban area of Saharsa is mostly agriculture which is degrading at a very fast pace. As per the land use data of Saharsa, approx. 47.19% of the area is declared as open space which comprises of 37.58% agricultural land, 2.26% water bodies and 7.35% open space. In Saharsa, a lot of the poor population reside on the fringes of the city, between the embankment and the r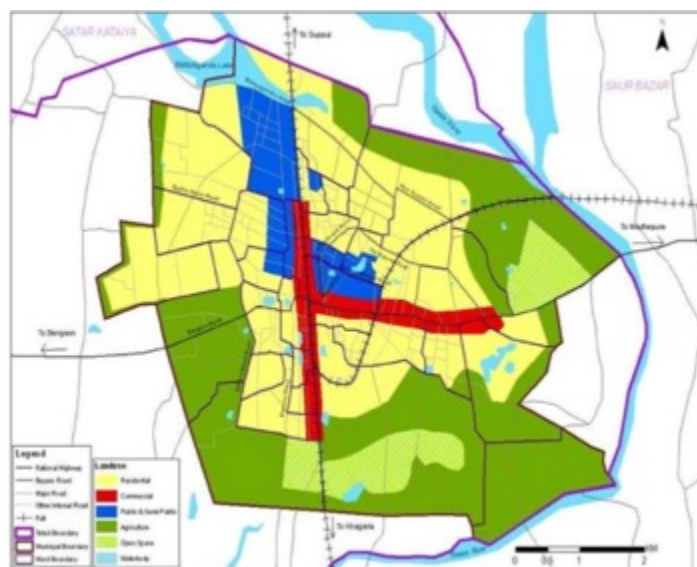iver Kosi. Most of the construction is taking place in the open lands of peri urban areas for safe houses which can protect people from floods. On one hand, where this is a

Figure 6: Saharsa Land Use

requirement of people, on the other, the encroachment on open lands and natural ecosystems is furthermore increasing the flood vulnerability of the city. Another critical factor degrading the ecosystems in the peri urban areas of Saharsa are the brick kilns. There are about 125 brick kilns in the peri urban area which are degrading the top soil, causing erosion, and encroaching over the open spaces.

Climate resilient agriculture is being promoted in the peri urban area to ensure farmers with better livelihoods and to enhance the resilience of the city by conserving open and green spaces.

DEGRADATION OF PERI-URBAN ECOSYSTEMS IN EASTERN INDIA

The above case examples show how the peri-urban ecosystems have been victims of increasing urbanisation and adversely impacting the resilience capacities of secondary cities.

Changes in Ecosystem	Gorakhpur (U.P)	Bashirhat (West Bengal)	Saharsa (Bihar)	Jorhat (Assam)
Water bodies	82 % Natural water bodies like ponds, lakes are encroached	30% ponds are contamination by restricted hybrid fish (*Clarias gariepinus*) rearing.	7 water bodies are encroached out of total 19	10.09% individual ponds and 2.3 % common water bodies lost
Agriculture	7.2% agricultural area converted into residential area	10-15% change in land use converted to fish ponds	125 brick kiln developed on the agriculture land around the city	1.05 % agricultural area converted into residential area
Horticulture / orchards	3.3 per cent area of orchards converted to housing construction	Old Mango orchards cut down and used for residential building	No orchards in peri urban area	Old plantation orchards are cut and sold for construction purposes
Forests	No change	Very little forest cover left in peri urban area	No forest cover in peri urban area	30 hectare of forest land is converted into commercial buildings
Open spaces / vacant land	15 percent area is covered by unauthorized colonies	7.23 % of open areas converted into housing and roads	841 illegal new houses were constructed	1.63% of area covered by housing and encroached
Flood plains	33 per cent flood plain area converted into residential area	54 acre of land along the bank of the Ichamati river is mostly encroached for brick kiln and housing	City have no master plan	No demarcation of flood plain in the master plan
Bamboo plantation	N/A	8-10 % of bamboo plantation area are left out and converted to buildings	N/A	Presently 30-35% of bamboo plantation area is shrinking in peri urban areas.

IMPACT ON THE VULNERABLE GROUPS

The poor are disproportionately affected by peri-urban ecosystem loss due to their propensity to live in peri-urban areas, high ecosystem dependence, and the economic impacts of land use change. The peri-urban areas tend to be occupied by low-income families and are typified by illegal settlements and slums. In addition, peri-urban areas are poorly served by urban infrastructure and experience worse hygiene and sanitation conditions.

The economic impacts of land use change are disproportionately absorbed by the poor because of their high vulnerability to service or habitat loss, and the economic cost of lost land is high due to lack of resources, influence, or alternatives for income, housing, or basic services. The peri-urban poor depend on local ecosystems for basic services because there are no alternatives, and the loss of their lone source can inflict heavy costs. Women, minorities, and children are disproportionately vulnerable to peri-urban ecosystem loss because women are directly involved in peri-urban agricultural activities. Destruction of peri-urban ecosystems therefore disproportionately impact women, as they are less likely to have alternative sources for food, nutrition or income.

The vulnerability due to loss in ecosystem services also extends to urban populations that depend on the ecosystem services provided by peri-urban areas. The benefits that urban population derive from peri-urban ecosystems in terms of air regulation, water provision, food for sale, and protection from floods and waterlogging are hampered. Loss of food production for urban markets resulting from peri-urban ecosystem degradation also contributes to rising food prices, affecting all urban inhabitants, but disproportionately impacting the poor.

KEY CHALLENGES OF PERI URBAN AREAS AND ECOSYSTEMS

Recognition: Peri-Urban areas are '*Nobody's Children* 'as there is hardly any recognition in the official disclosure on peri-urbanity. These areas are neither served by the Urban Local Bodies (Municipalities) or the rural department for basic services. Because of the lack of clear cut conception and related concrete policies from national to local, peri-urban areas have been the most threatened areas with regards to loss of biodiversity and vegetation, and land use changes (urban expansion, land price increase).

Changing land use patterns: In secondary cities where most of the peri-urban areas are agrarian in nature, the land use patterns are rapidly changing as farming has not remained remunerative enough for the farmers. This is also leading to distressed

migration. Unplanned developments and non-compliance of the city Master Plan is leading to infrastructural developments on the agricultural lands, thus resulting in shrinkage of open and green spaces (buffer zones).

Sewage dumping: Peri-urban areas are waste and sewage dumping grounds for the city. Improper management of solid waste and sewage leads to health problems, deteriorating the quality of soil and contaminating groundwater.

Encroachment: Illegal encroachments, unsafe settlements in flood plains and land grabbers' nexus are increasing problem of peri-urban spaces.

Flood and waterlogging: In low-lying peri-urban areas, severe waterlogging results in deterioration of soil fertility and increased incidence of pests and diseases in the crops. Due to increased inundation, farming becomes a problem, impacting the food security and livelihoods of small and marginal farmers.

GOVERNANCE CONSIDERATIONS

Social Governance

The problems of peri-urban spaces and the linked ecosystems is largely a governance issue. Traditionally, in India, the ecosystems were managed by communities themselves and social governance measures were taken to protect and conserve the waterbodies, orchards and other ecosystems. The social governance system was quite strong and people the communities were governed by the social norms, rules and regulations. Since, the lives and livelihoods of people was dependent on ecosystems, the ecosystems had a strong social value.

Gradually, because of the change in economy, increasing land pressures, illegal activities and other reasons, the fiscal value of ecosystems started superseding its social value. As a result, these ecosystems moved away from the control to communities and went into the hands of government, thereby, weakening the whole social governance aspects of ecosystems.

Formal Governance

In the Indian administrative context, there is a lack of clarity about the notion of the 'peri-urban.' The problem arises partly due to definitional issues. Important in this is the distinction between a 'statutory town and a census town.' Statutory' towns are towns with municipalities or corporations. Whereas, 'census' towns are agglomerations that grow in

rural and peri-urban areas, with densification of population that do not have an effective urban governance structure or requisite urban infrastructure.

In general, however, despite calling them 'rural' a peri-urban area is defined administratively according to whether the locality falls within the boundaries of the city's master plan. This leads to many administrative issues. A major challenge to better environmental governance in urban and peri-urban contexts is the lack of coordination between various line departments. Forest, land and water bodies are managed by different departments; cities are managed by municipalities and peri-urban areas by *panchayats*. In India, there is no separate department for urban or peri-urban agriculture or provisioning of extension services. There is no coordination between different departments in sharing data, nor does a common platform for discussing issues or a coordinated action plan for governance exist.

In a process of sustainable ecosystem-based urbanisation, democratic good governance that is based on the principles of equity becomes critical. The weak and the marginalised need a voice and must be heard. However, despite legislation to the contrary this rarely happens.

The 74th Constitutional Amendment which came into force in 1992, is a watershed development in urban policy initiatives in India. This is because for the first time in the history of urban governance, the municipal bodies were provided the Constitutional Status of the third tier of government. It also sanctioned the involvement of its urban citizens in planning their future and improving their present. But in real terms it meant the citizens voted in elections once every five years, and citizens' rights, development needs, priorities and goals were forgotten until the next elections. In effect, a top-down approach to development masquerades as a 'bottom-up' approach, further alienating and marginalising the excluded. Good governance and all that goes with it (accountability, transparency and process ownership) is little more than a formality in the hands of the elected elite and participation, at best, is passive. Urban planning in India is a state subject and under the 12th schedule of the 74th Amendment Act, it has been mandated to municipal corporations and municipalities, while regional planning is to be done by state governments. As per the constitutional mandate, district and metropolitan development plans must ensure coordinated spatial planning, sharing of natural and other resources, integrated provision of infrastructure and environmental conservation [4]. These areas need guidelines to synchronise bottom-up and top-down approaches [9].

The importance of good localised participatory governance and equitable people's institutions cannot be emphasised enough in building urban resilience. It is at the local level that imbalances are created that must be restored and resilience must be built up otherwise the system breaks down irreversibly.

Just to quote, the interventions led by Gorakhpur Environmental Action Group (GEAG) so far, supported by the ACCCRN initiative and other international programmes, has been to create community institutions that take their own decisions in all aspects of the dynamic linkages between ecosystem services and the components of resilience [10, 11]. Resilience at the macro level cannot be built unless the micro level is adequately addressed, reiterating the fact that local communities are the best managers of the environments that their livelihoods depend on.

RECOMMENDATIONS

Evidence-based approaches are critical in improving policy process and development. It is an approach that helps people make well informed decisions about policies, programmes and projects by putting the best available evidence from research at the heart of policy development and implementation. The evidence-based approach discourse has become popular among a range of policy communities, those within government departments, research organisations and think-tanks. It advocates a more rational, rigorous and systematic approach, and moves beyond traditional notions of research to adopt a broader understanding. However, there are a good number of researches relevant to policy conducted in India, but in most cases, findings don't inform policy-making, practice or influence policy decisions.

Research that shows the importance of peri-urban spaces, their contribution to enhancing the resilience of the urban areas in the face of climatic changes and that these areas for no reason, can be neglected and hence need policy support, should be supported so that the policy makers can be educated on these issues. Following are key recommendations for getting entry points into bridging the gap between researches and policy makers:

Disconnect between Researchers and Policy Makers: There seem to be disconnect between the researchers and policy makers in India. The researchers, most of the time, are not concerned with the policy implications of their research work and focus more on their own interests and basic understanding of the issues. The researchers are also sectorally biased and tend to consider areas as per their agenda, lacking the holistic and systemic approach to looking at the urgency of the issues. Also, researchers are mostly top-down in their nature of being conducted. Therefore, it is pertinent for the researchers and policy makers to come to a common understanding while scoping out the research if the uptake of findings must be included in the policy formulation.

Disconnect with Community: Another limiting factor that undermines effective implementation of researches is the disconnect between researchers/decision makers

from those who the research is about or intended for – the "community". The community must be at the centre of the researches and only then their problems and perceptions can be taken into cognizance for building complete understanding. The appropriate focus should be on 'participatory analysis', through encouraging public understanding and participation. There is an increasing disconnect between the research agenda and the real needs at community level in terms of priorities, and the practicability for operationalizing some of the research findings which later becomes obstacles in embedding the findings in the policy formulation.

- **Localized researches:** For effective uptake of research results into policy making, it is important that the researches are action-based, according to local context, as per the needs and priorities of communities and befitting into the state policy frameworks.
- **Research alignment:** The recommendations of the researches are many times in a way that they do not alignment with the existing plans and policies of the government. Therefore, it is important that the research recommendations suggest the exact programmes and related funding streams where the research results can be embedded so that the uptake is quick and efficient. Experiences in India have shown how an existing programme of the government can be used to build resilience of communities against climate change impacts.
- **Packaging and communicating research results:** The research results and findings need to be packaged and communicated in a format to the policy makers that it is easily understandable for them. Heavy research reports generally do not work with the policy makers and preparing concise policy briefs outlining key findings and recommendations in a simple language generally helps them.

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