



सत्यमेव जयते

Government of India

PERI-URBAN ECOSYSTEMS AND URBAN RESILIENCE

TRAINING MODULES, INSTRUCTIONS AND REFERENCE MATERIALS



Climate & Development
Knowledge Network



Local Governments
for Sustainability
SOUTH ASIA



Towards a disaster free India....



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PERI-URBAN ECOSYSTEMS AND URBAN RESILIENCE

TRAINING MODULES, INSTRUCTIONS AND
REFERENCE MATERIALS

FOREWORD



Major Gen. Manoj Kumar Bindal

Executive Director
National Institute of Disaster
Management

Asia-Pacific region is one of the most disaster-prone areas of the world. Each year, natural disasters of varied typologies like hydro-meteorological, biological, climate-induced disasters kill thousands of people and cause huge economic destruction. The recent outbreak of COVID-19, which has been declared a pandemic, has brought the world to a standstill. A healthy and robust ecosystem is one of the best defences against any natural disaster and also contributes to resilience. As urbanization continues, robust and resilient urban and peri-urban ecosystems provide the capacity to persons, communities, institutions, businesses, and systems within a city to endure, adapt and cherish no matter what kind of persistent stress and acute shocks they experience.

Today, the world is more urban with 55% population living in urban areas of different types. In addition to operating as nodes of resource consumption (and discharges) and as sites for innovation, congregations and centre of powers, cities and towns have become the living laboratories for resilience, both in theory and in practice. Sustainable urban development has been gaining global momentum and has become a centre point for discussions on Sustainable Development Goals (SDGs), Sendai Framework for Disaster Risk Reduction (SFDRR) and Paris Climate Agreement. Thus, nurturing resilience in the face of environmental, social, economic and political uncertainties and mitigating risk of disasters and extreme events have become key agenda for academics and policy decision across disciplines, sectors, and scales.

Symbiotic relationship of urban and peri-urban areas and their systems form the backdrop in understanding urban carrying capacities and in accounting for their supportive and assimilative strengths. Hence, integration and mainstreaming of development and sustainability agendas into a broader framework of urban resilience needs to recognize the role of ecosystems, particularly those in the peri-urban areas. Infrastructure and engineered systems, their redundancy, sustainability, reliability and operability, calls for greater understanding and integration of ecological infrastructure along with social resilience in peri-urban areas of a city or major township.

The Gorakhpur Environmental Action Group (GEAG), along with its collaborators across local authorities and governance, research and planning fraternities, have made great strides by implementing pilots and developing case studies on urban resilience in several cities in coastal, hilly and other parts of India, supported by the Climate and Development Knowledge Network (CDKN). National Institute of Disaster Management (NIDM) has been associated in drawing the lessons of some of the studies concerning mainstreaming of Climate Change Adaptation-Disaster Risk Reduction (CCA-DRR) into the local level developmental planning process, leading to tactical outputs such as training strategies, training modules and policy inputs.

This training module and instruction manual on 'Peri-urban Ecosystems and Urban Resilience' is an attempt to bring diverse relevant issues and knowledge under a common ambit of climate change and disaster risk reduction integration for resilient, holistic and inclusive development of cities and towns, by recognizing, promoting and utilizing the ecosystem services, along with the welfare of local inhabitants, and enduring business continuity in their multi-sectoral, multi-level and multi-faceted forms. We hope that the publication serves as a good reference document for researchers, practitioners and academic fraternities. We are thankful to professionals and practitioners for their review inputs in improving the document.

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LIST OF ABBREVIATIONS

CBDRR	Community Based Disaster Risk Reduction
CLD	Causal Loop Diagram
EbA	Ecosystem based Adaptation
EcoDRR	Ecosystem based Disaster Risk Reduction
GI	Green Infrastructure
IPCC	Intergovernmental Panel on Climate Change
MoHUA	Ministry of Housing and Urban Affairs
NIDM	National Institute of Disaster Management
NIRD	National Institute of Rural Development and Panchayati Raj
NIUA	National Institute of Urban Affairs
PUA	Peri Urban Agriculture
REDD	Reducing emissions from deforestation and forest degradation
REDD+	Reducing emissions from deforestation and forest degradation and the role of conservation, sustainable management of forests and enhancement of forest carbon stocks in developing countries
SAZ	Special Agriculture Zone
SDGs	Sustainable Development Goals
SFDRR	Sendai Framework for Disaster Risk Reduction
SIRD	State Institute of Rural Development
SPA	School of Planning and Architecture
UN	United Nations
UNDRR	United Nations Office for Disaster Risk Reduction
WALMI	Water and Land Management Institute

TRAINING DESIGN AND TRAINING PLAN

**THE PERI-URBAN
AREAS SERVE THE
CITIES THROUGH
SUPPORTING
CAPACITIES –
ECOSYSTEM
SERVICES,
RURAL-URBAN
CONNECT AND
INPUT-OUTPUT
SYSTEMS**



Introduction

The concept of urban resilience has developed in a multifaceted manner over time with pilots, experiences and lessons of past incidences. Urban resilience encompasses adaptation to risk dynamics and business continuity coupled with sustained improvement towards meeting development needs of the city, in the backdrop of climate change and related disaster risks. Cities are predominately characterized by dense habitation, infrastructure, businesses and fast-paced human activities. The peri-urban areas serve the cities through supporting capacities - ecosystem services, rural-urban connect and input-output systems- and assimilating capacities towards urban discharge and waste.

There are three key dimensions of environmental changes- climate change, land-use changes and natural resource degradation- that are also known as disaster risk drivers. Ecosystems as a critical and common component across the three dimensions and peri-urban areas as ecosystem support systems of cities have attained importance in city and regional development dynamics. Ecosystems that offer nature-based solutions (NBS) also known as green infrastructure may help reduce the risks of grey infrastructure and serve as livelihood support systems for select communities and entrepreneurs. Ecosystem services are also important in reducing social, economic and health-related vulnerabilities.

Peri-urban ecosystems provide resources, buffers and capacities that help reduce vulnerability in urban areas. It thus becomes critical to understand, appreciate and mainstream peri-urban ecosystem-based opportunities into development thinking, policies, planning and actions by the key actors, i.e., government, businesses, industry and communities. Despite the recognized need of integrating peri-urban ecosystem-based strategies to strengthen urban resilience, peri-urban ecosystems are unfortunately deteriorating in quantum and quality (Gupta et al, 2016).

Strategy

To support and facilitate capacity building of key stakeholders, a detailed toolkit containing training manual with specific modules has been worked out, with a focus on developing countries, supported by illustrations and case studies. Since the focus on peri-urban ecosystems and their relevance to the cause of resilient and sustainable development of cities or urban areas is imperative, this document provides a detailed training design and training plan to fulfil the training needs of bridging performance gaps of stakeholders and promoting a systematic approach towards peri-urban ecosystems.

This training manual is comprised of a set of five training modules, as well as training instructions and relevant case studies. The five modules include one introductory and four specialized modules. The purpose of this publication is to provide a capacity-building toolkit to enable the performance of key stakeholders associated with urban local bodies (authorities, elected members and policymakers, officials, practitioners, and community representatives) for resilient development and sustainable management of urban systems, utilize and promote ecosystem-based solutions, particularly the solutions linked with peri-urban ecosystems.



Given the above, the training toolkit has been designed to focus on two central research questions:

- 1 What are the systemic factors within the city system or city region that contribute to building resilience or exacerbating the vulnerability of infrastructure, businesses, resources and/or people to climate and disaster risks in the context of input-output relations with the peri-urban ecosystem?**

Detailed analysis in city contexts to improve the ability of stakeholders to identify policy, strategic and action points where interventions could build the capacity of specific departments/actors that might need to be involved in developing resilient cities.

- 2 What specific strategic and knowledge innovations could help to bridge the vertical gap between national policy frameworks and local contexts and the horizontal gap between sectoral actions and actions aimed at integrating concepts of peri-urban ecosystem-based urban resilience in sectoral systems and practice?**

In answering this question, we intend to focus on the science, policy, planning and stakeholders' perspectives on the challenges associated with urban and peri-urban resilience.



At the end of the training, the participants will be able to –

- i. Define the dynamics, components and requirements of urban resilience and sustainability, with reference to risks, vulnerability, and strategic management
- ii. Understand ecosystems' linkages with adaptation, climate & disaster resilience and sustainable urban development
- iii. Analyse and appreciate the benefits of peri-urban ecosystem for urban resilience
- iv. Enumerate various planning and strategic management actions aimed at enhancing peri-urban ecosystem based resilience with reference to risk and vulnerability reduction, natural infrastructure, social benefits, and field-based appreciation
- v. Delineate linkages at various levels of space and governance- sectoral, local, urban, rural, etc. for mainstreaming eco-DRR into development planning.

Target Groups/Audience

Training modules are developed looking at the performance gaps and training needs of the following target participants:

- i. Senior to mid-level officials from the state and district line departments associated with the urban local governance system such as urban local bodies (ULBs) and members of respective committees related to DRR, climate action, environment, health, special area/local development, businesses, industry, etc.
- ii. Elected representatives and executives/professionals from other government agencies/boards, programmes/schemes, including public sector undertakings, NGOs, community organizations engaged in activities related to assessment, planning, implementation or monitoring of any aspect of disaster management, environment and development, etc.
- iii. Faculty members/professionals from training, education and research centres and other master trainers related to environment/ecology, disaster management, rural development, urban planning, health, forestry, land and water, agriculture, housing, etc., and
- iv. Private sector professionals involved in water supply, environmental health, waste management, power, communication, risk management, industries, businesses, corporate social responsibility, etc.

Content and Structure of the Module

The training module(s) on resilient urban development considering ecosystem service-based benefits from peri-urban and associated urban/rural interface offers course guidelines, contents and case studies, for promoting an integrated approach for capacity development, strategic management and practices.

This will enable participants to holistically address challenges posed by climate change, extreme events and related disaster risks through the sustainable peri-urban development process. Perfected through extensive literature review, the modules provide a good mix of theoretical learning and practical exercises.

The training manual consists of five modules:



Learning Units

The details of learning units under different training modules are the following:

Module A: **Urban and Peri-urban Resilience: Challenges and Imperatives**

LU-A.1: Urban sprawl – Challenges and needs for resilience

LU-A.2: Contexts of adaptive and resilient urban development

LU-A.3: Urban and peri-urban water, temperature, winds, and health risks

LU-A.4: Strategic management of risks through green growth

Module B: **Importance of Ecosystems in Urban Disaster and Climate Resilience**

LU-B.1: Green infrastructure and resources for adaptive and resilient development

LU-B.2: Water-food-energy nexus and the role of ecosystem services

LU-B.3: Peri-urban agriculture – The land-use: Role in urban and peri-urban sustainability

LU-B.4: eco-DRR for gender justice, child care, geriatric & psycho-social health

Module C: **Understanding and Appreciating Peri-urban Ecosystems (Field visit)**

LU-C.1: Understanding peri-urban settings and ecosystems

LU-C.2: Peri-urban vulnerability and needs assessment

LU-C.3: Choices in adaptation and resilience

LU-C.4: Benefits of peri-urban ecosystem for resilience & sustainability

Module D: **Strategies for Peri-urban Ecosystem and Urban Resilience**

LU-D.1: Policy, laws and programmes

LU-D.2: Valuation of peri-urban ecosystem services and disaster impact assessment tools

LU-D.3: Green infrastructure, green spaces and resource efficiency

LU-D.4: Recognizing input-output and rural-urban nexus through participatory or- community based planning

Module E: **Mainstreaming Eco-DRR into Development Planning**

LU-E.1: Approaches, pathways, tools and entry points, for mainstreaming peri-urban eco-DRR for urban resilience

LU-E.2: Integration to sectoral/departmental, urban, regional, industrial, infrastructure, business continuity resilience, village/ULB's plans and major projects

LU-E.3: Land-use, master planning and participatory strategies

Tips to use the Module for Training

Development of this training manual followed the principles of adult learning (andragogy) where most participants/trainees are adults, in terms of age and experience in their respective fields, organizations or sectors. Each learning unit has been developed to build capacities (knowledge and skills) through discussions, presentations and engagement of the trainee in knowledge sharing and learning. Following methods can be applied to make the learning easy and interesting for the participants:



- i. **Question-answer/quiz sessions:** These sessions will help evaluate the general understanding of concepts of urbanization, peri-urbanization, climate risks, disasters, dimensions and requirements of resilience, adaptation, sustainability, ecosystem services, pathways and strategic tools, etc.
- ii. **Group discussions/work:** Group activity is an essential component of each learning unit to facilitate knowledge on developing skills related to analysis, planning and formulating strategies.
- iii. After each group work, a **presentation session** has to be included, to motivate the participants in knowledge grasping, participation and sharing.
- iv. **Table-top/classroom exercises** to enhance the ability of focused discussion in the group.
- v. **Field visit** to be organized, to facilitate understanding of data collection, group reality and situation analysis.
- vi. **Case studies** to provide live examples from the field so that knowledge could be connected with ground reality.

Selection of Trainees: The criteria for selecting the trainees is as follows:

Target level of Trainees

Senior to middle-level officials/professionals, policymakers, community or stakeholders' representatives

Nature of the Group

Heterogeneous (from elected representatives, various departments, agencies and academic institutions, independent professionals), with the representation of women participants.

Qualification

At least graduation and preferably post-graduation, having written and spoken proficiency in English/Hindi. Familiarity with computer applications is desirable.

Medium of Instructions

Mainly English with a blend of Hindi/local or vernacular language. However, looking to the needs of region/state or local levels, deliberations and discussions can be facilitated in Hindi or other suitable languages as well.

Prerequisite for the Trainer/Course Faculty

A team consisting of a minimum of three faculty members (trainers/facilitators and professional resource persons) may be required to instruct and implement the training modules of this manual. One of the team members shall be from the region where training is being planned. Other criteria for course faculty/trainer is as follows:

Eligibility	Expert on urban development issues, related ecosystem-based adaptation and resilience approaches as well as disaster management with good comprehension of environment, climate change/natural resource management, sustainability, developmental sectors and strategic management issues
Training approach	Friendly and informal approach with an ability to involve heterogeneous group at a single platform
Challenges to be addressed by the trainer	Motivating the trainees to bring them at a similar level of knowledge and experience sharing with other participants
Strategies to overcome the challenges	<ul style="list-style-type: none"> • Provide reading materials during registration (or preferably mailed in advance) • Involve the participants through group exercise, video clippings and quiz sessions, etc.

Expected Benefits

- Capacity of the policymakers, officials/disaster management professionals/environmental scientists and managers/planners and other stakeholders developed in understanding issues of urban resilience and peri-urban ecosystems, CCA and DRR mainstreaming into developmental planning.
- The overall capacity of administration, implementing agencies, academic institutions and non-governmental organizations (NGOs) improved in strategy making and implementation of interventions of urban and regional, including businesses, industrial, infrastructure and community's resilience against climatic-disaster risks.
- Overall sensitization of authorities and departments on peri-urban issues and their role in addressing urban and regional sustainability issues with enhanced abilities.
- Improved competencies, in general of all related actors/stakeholders associated with ULBs and related functionaries in state government, to collaborate with the each other both horizontally and vertically for achieving resilient - sustainable development at the urban-system level.

Instructions for the Use of Training Modules

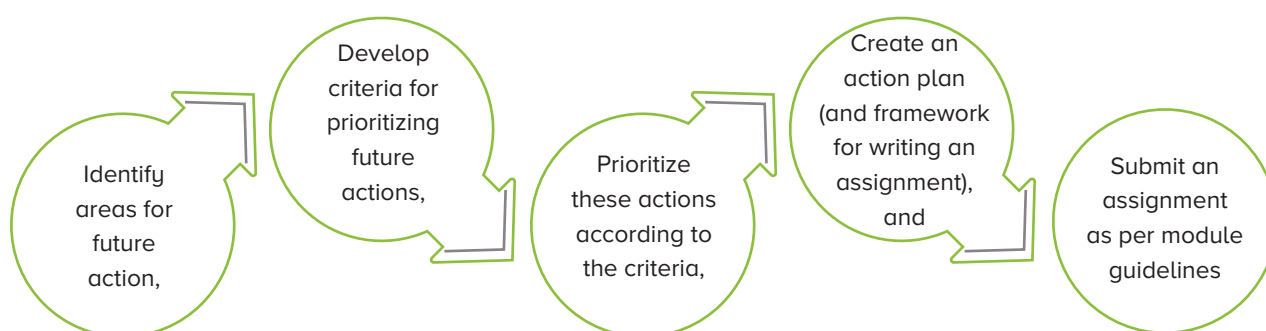
- A module from the training manual can be implemented at local, project, municipality, state level or departmental level (national or state/union territory level with suitable modification utilizing its flexibility). For example, city administrators can take lead in organizing training programs for such a heterogeneous group through coordinating with the line departments, academic institutes and other agencies. At the national level, courses may be organized by the ministries or concerned institutes like National Institute of Disaster Management (NIDM), National Institute of Urban Affairs (NIUA), National Institute of Rural Development and Panchayati Raj (NIRD), universities, School of Planning and Architecture (SPA) and other institutes or NGOs, whereas at the state level the course may be organized by State Administrative Institute, State Institute of Rural

Development (SIRD), Water and Land Management Institute (WALMI), Forest Institute, Ecology Commission, Town & Country Planning Organization, Environment Directorate, Council for Science & Technology or Disaster Management Institute/Centre.

- ii. Learning shall be facilitated by a faculty or facilitator with the relevant subject background and training proficiency would be an added requirement for running a Training of Trainers (ToT) course on the module. Appropriate resource persons shall be identified and invited as speakers or facilitators or trainers for taking up the specific lecture sessions, case studies and field survey based technical sessions. It is advisable to conduct ToT courses in every state to build their capacities in conducting training programs at the sub-national level.
- iii. A learning unit includes case studies, group work, etc. The course facilitator shall ensure that the module has been taught in light of the target group's background, time allocated and as per the resources available.
- iv. Entire manual with five modules is designed in a way to complete it within the given duration of about 5 days (flexible), depending upon time allocated for the field visit exercise. It can be administered in 3 days for senior or mid-level participants or when delivered in a seminar mode (large number participants). It can be delivered over a period of 10 days when a specific batch or a limited number of participants enrol from field level functionaries.
- v. At the end of the training, a feedback session shall be conducted by the facilitators to understand the avenues and opportunities for further improving the modules. This feedback shall be complied and appropriately included for the design and delivery of subsequent training programs.

Action Plan/Post-Training Assignment

It is well understood that the training has more impact on the ground when a mechanism for follow-up is in place. While engaging in the activities of this module, participants will review the gaps identified throughout the training to identify the improvements they might be able to make in their own and their departmental/organizations' work. Working as a group, participants will:



Modules present an opportunity for capturing the motivation that participants have at the end of training and for them to return home with a tool – an action plan – to help them focus on changes they want to make while dealing with urban development and management interventions. The action plan should help them incorporate these changes into their routines and eventually those of the department/organization.

PRE-TRAINING ASSESSMENT



Context and description of the session (15-30 minutes)

The session shall consist of either a written or oral question-answer/discussion round or a perception-based assessment before entering the training course. This would be repeated at the end of the course during the concluding session to understand the impact of the course by facilitating a comparison of the entry and exit behaviour of participants. A film can also be shown to trigger the expression of participants pre-existing knowledge and/or perceptions on subjects of climate change, disaster risks and vulnerability of urban systems, in the context of peri-urban ecosystems.



Learning objectives

- To compare the entry and exit behaviour of the trainees.
- To evaluate the knowledge and skills gained from the training.
- To assess the perceived competency of participants on disaster risks and climate-resilient cities.
- To carry out a formal internal evaluation using questionnaires.



Methodology

- Question-answers
- Discussion
- Ice-breaking games
- Film show
- Assessment of entry and exit behaviour and the perceptions of participants



Guidance

- Questionnaire-based assessment of the participant's perception at the entry-level (and also at the exit level) may be carried out.
- The questions shall be identified/framed by the course director/coordination team looking into the course module's scope, participants' profile plus duties/background, and context of the film being screened.
- Course coordinator/trainers should keep pre-developed notes for their tips and hints while delivering course sessions.
- The resource person for this session is expected to have a broad knowledge of all aspects associated with urban systems management, climate change – impacts and related disaster risk in cities, components of resilience framework for cities, urban and peri-urban ecosystems, vulnerability contexts, and the national and international framework for dealing with the subject, ideally a team of two or three resource persons drawn from a background of urban development/environment studies or planning and management. Prior experience of dealing with disaster risk management, climate resilience and ecosystem services may be a desirable criterion for the eligibility.

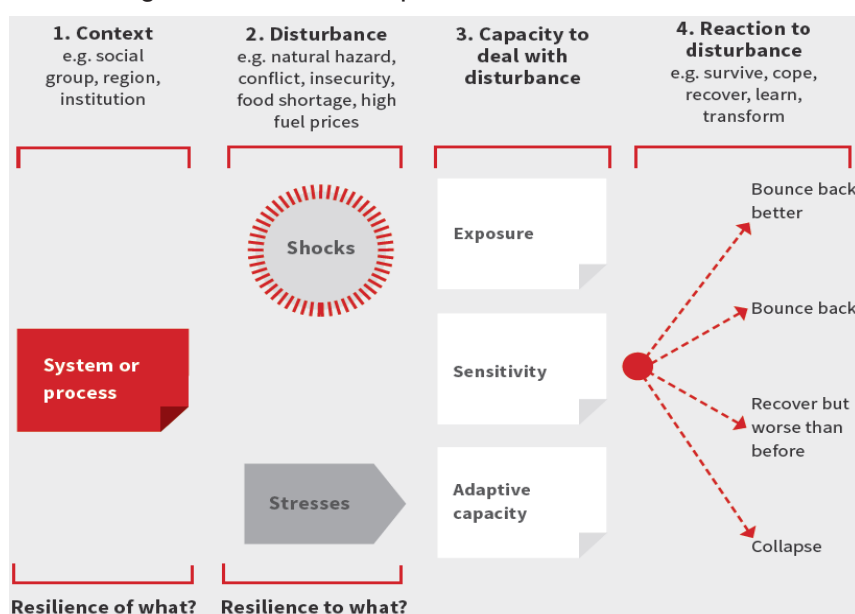
TRAINING MODULE

URBAN AND PERI- URBAN RESILIENCE: CHALLENGES AND IMPERATIVES

Background and Context

'Resilience' is understood as the ability of systems, agents and their interrelations to prevent, reduce, cope and withstand shocks or stresses and bounce back quickly to normalcy after the crisis is over, by integrating adaptation and sustainability with disaster risk management. Resilience building is critical to sustaining hard-earned gains of development over time and for ensuring ecological and socio-economic efficiency across sectors, businesses, infrastructure, geographies and communities. Urban settings as the hub of these need greater emphasis on resilience development and management, more particularly in the wake of climatic risks, social-vulnerability and city surroundings.

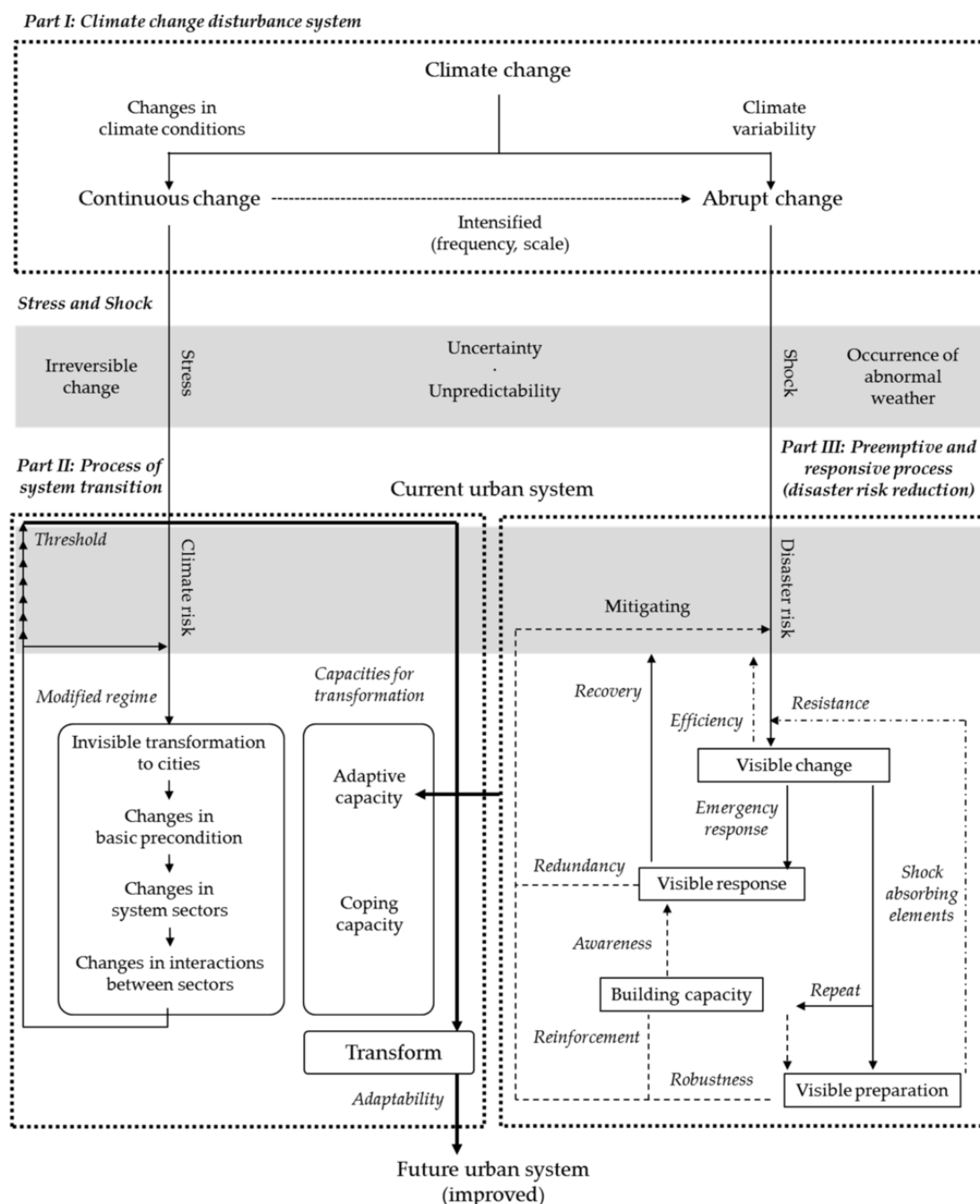
Figure A.01. Schematic showing the contexts and components of resilience.



Source: DFID, Defining Resilience: A DFID Approach Paper (London: DFID, 2011), reproduced in J. Twigg, Disaster Risk Reduction, Good Practice Review 9, Revised Edition (London: ODI, 2015), p. 19.

Globally, extreme climate events and disasters have been increasing in terms of frequency and intensity over the past few decades. By now, there has been a significant reduction in losses of human lives but economic and non-economic costs (damage and losses) due to these disasters continue to grow. Interestingly, this period also coincides with extension in technological, industrial and scientific revolution along with social and political transformations across all geographical scales. Spatial extent and people affected by disasters, their vulnerability and risks to multiple hazards have also increased over the years. It thus becomes imperative to understand complexities of the situation and draw action roadmaps with clear vision and routes of mainstreaming climate and disaster resilience via green growth in existing, upcoming and future cities of our world.

Figure A.02. Challenges and imperatives of urban climate resilience



Source: Kim, D., Lim, U. (2016). Urban Resilience in Climate Change Adaptation: A Conceptual Framework. Sustainability, 8(4), 405-22; <https://doi.org/10.3390/su8040405>

The concept of 'resilient cities' calls for a holistic and integrated approach across environmental, engineering, governance and social dimensions. Urban and peri-urban ecosystems play a crucial role in city resilience and sustainability and, thus, deserve key consideration. Cities serve as economic hubs and provide a vast array of opportunities, it is important to address the resilience of urban systems such as water, food, energy, etc. Interaction

of the populace with urban systems are defined and enabled or limited by institutions, i.e. authority, legal, regulatory, policy frameworks and processes, and hence, are of central importance.

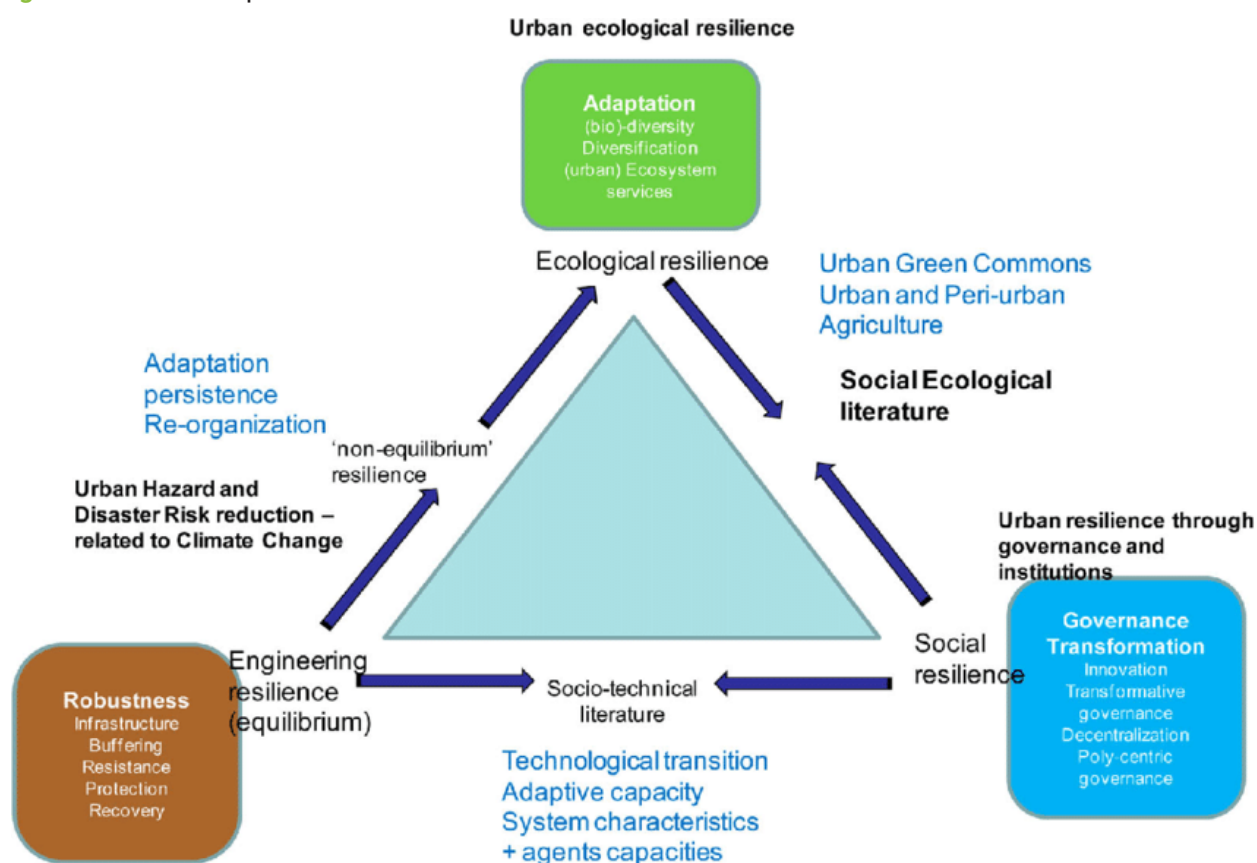
Urban and peri-urban resilience

It is estimated that nearly 55% of the global urban population was living in Asia and the Pacific by 2014. Though this has positively contributed to lifting people out of poverty, this development is neither inclusive nor sustainable because most of the Asian cities are more vulnerable to natural disasters and the projected impact of climate change. Peri-urban areas are considered as transitional zones from rural to the urban region and represent a wide range of uses, such as water catchments, forestry, recreation, productive farming, and offer a unique ambience and lifestyle. Industrial agglomerations, waste treatment plants, recycling, warehouses, agriculture-markets, labour market, goods transit, transportation yards, ecotourism, and several other businesses are common in peri-urban areas. Resilience in peri-urban areas is often less prominent and significant in economic terms, but it is crucial for a city's functioning, input-output support systems and managing urban resilience and sustainability.

The outward expansion of cities, changes in land use pattern and occupations have transformed the rural hinterland into semi-urban areas. Inhabitants in these peri-urban regions are highly vulnerable and increasingly threatened by the deteriorating quality of ecosystems leading to resource scarcity and a host of problems that very often find no solution in the short run.

Managing the environmental interface is vital in the present context as various ecosystem services provided by these transition zones have a significant impact on the sustainability of urban and rural development. Considering the importance of peri-urban interface for building and strategic management of integrated resilience, it becomes essential to understand the demographic trends, socio-economic change, ongoing process of climate change, impact on natural resources and livelihoods in this transition zones. New multi-level and collaborative governance systems are required to manage the resilience of these ecotones. The United Nations' Sustainable Development Goals (particularly the Sustainable Development Goal 11) also emphasizes on making cities inclusive, safe, resilient and sustainable by implementing integrated policies and plans for resource use efficiency and adaptation to climate change which is impossible without protecting these peri-urban regions.

Figure A.03. Static map of the resilience narratives related to urbanization



(Source: Béné et al., 2017)

India's cities and their urban-system settings are unique in terms of changing boundaries, legalization of initially irregular habitations along the mix of commercial, agriculture, industrial and other developmental or socio-economic activities, fast-changing landscape and land-uses, etc. Hence, resilience building of these urban systems has specific challenges and certain opportunities to meet the changing needs for goods, services and sustainability based strategic interventions.

Challenges associated with rapid urbanization in India are alarming and in urgent need of attention. Rapid urbanization combined with inadequate provision of basic services continues to increase the vulnerabilities of India's urban population. On top of this, secondary cities are growing at an unprecedented pace. These cities are the hub of opportunities where large scale migration takes place for fulfilling the aspirations and in anticipation of better livelihoods. Due to these socioeconomic factors, including population pressure and poverty, urban regions continue to witness a large influx of population from rural areas and this has led to the rapid growth of new urban centres.

Peri-urban ecosystems have been victims of increasing urbanization and adversely affecting the resilience of secondary cities. GEAG with the support of The Rockefeller Foundation did a scoping study on the condition of peri-urban regions of four secondary cities in India namely, Gorakhpur, Basirhat, Saharsa and Jorhat. The study indicated a significant loss of ecosystem services in these cities due to urbanization and related challenges. The findings are summarised in Table A.01.

Table A.01. Urbanization and its impact on secondary cities

Changes in Ecosystem	Gorakhpur (U.P)	Bashirhat (West Bengal)	Saharsa (Bihar)	Jorhat (Assam)
Water bodies	82% of natural water bodies like ponds, lakes are encroached	30% ponds are contaminated by restricted hybrid fish (<i>Clarias gariepinus</i>) 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 a residential area	10-15% change in land use converted to fish ponds	125 brick kilns developed on the agriculture land around the city	1.05% agricultural area converted into a residential area
Horticulture/ orchards	3.3% area of orchards converted to housing construction	Old mango orchards cut down and used for residential building	No orchards in the 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% 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 the area covered by housing and encroached
Flood plains	33% floodplain area converted into a residential area	54 acre of land along the bank of the Ichamati river is mostly encroached for brick kiln and housing	City has no master plan	No demarcation of floodplain in the master plan
Bamboo plantation	N/A	8-10% of bamboo plantation area is left out and converted to buildings	N/A	Presently 30-35% of bamboo plantation area is shrinking in peri-urban areas

Source: GEAG

Many environmental and biogeochemical challenges exist within the urban landscape that worsen within it such as stormwater runoff and flood risk, chemical and particulate pollution of urban air, soil and water, urban heat island, and summer heatwaves.

- Urban trees and urban forests can be managed to regulate the impact on urban water, heat, carbon and pollution cycles (Livesley et al., 2016). However, this form of management faces key challenges of urban catchment hydrology and stormwater runoff,
- Chemical and particulate pollution of urban air, soil and water,
- Carbon sequestration, and
- Urban heat island and enhanced summer heatwaves.

Figure. A.04. Modules under this training manual are built upon the previous studies and outcomes in terms of process frameworks and training modules on climate change, urban resilience and peri-urban ecosystem contexts. Some of the key outcomes are shown here (also listed in suggested readings).



Training Module

This is a basic training module on sustainable urban development through adaptation to climate change and disaster resilience. It integrates the common risk factors, key sectors and green growth opportunities towards the strategic management framework of urban and peri-urban resilience. The module is developed as an overview or refresher course for sensitization aimed at integration of disaster management and resilience into the urban development processes.

Four learning units are delineated under this module:

- LU-A.1:** Urban sprawl – Challenges and need for resilience
- LU-A.2:** Contexts of adaptive and resilient urban development
- LU-A.3:** Urban and peri-urban water, temperature, winds, and health risks
- LU-A.4:** Strategic management of risks with green growth and ecosystems



Training objectives

- To describe urbanization, its causes and linkages with risks and resilience
- To describe adaptive development needs, scope and opportunities in urban systems management
- To enumerate key dimensions of climate and extreme events, related disaster risks and vulnerability in an urban and peri-urban context
- To discuss strategic management framework addressing sustainable and resilient urban development – role of planning, peri-urban ecosystem and green growth strategies



Guidance

- Sharing expectations from both sides - from participants as well as from the faculty/trainers and course director/ coordination team is important, to start from and finally define the learning scope to be fulfilled by end of the module delivery.
- Other expectations regarding ground rules for participants, trainers, etc., to be communicated at the beginning of the course.
- Discussion on the role of participants/trainees in urban systems management and its relevance to resilience building would be useful to break the ice in the diverse group.
- Film on resilient cities, disasters, extremes, peri-urban systems or green growth opportunities, etc.



Methodology

- Perception check questionnaire (or Q&A)
- Lecture/PowerPoint presentation
- Case study (preferably based on film)
- Group exercises
- Experience sharing
- Discussion

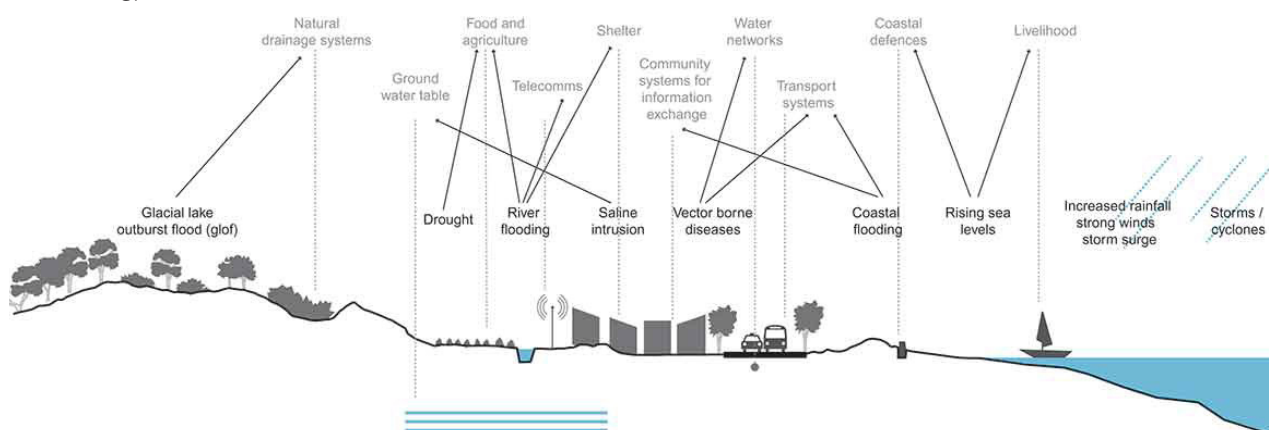
LEARNING UNIT A.1:

URBAN SPRAWL– CHALLENGES AND NEED FOR RESILIENCE

Context

In 2008, the global urban population crossed the 50% mark, i.e. more than half of the global population was living in urban areas around the globe. By 2050, the global share of the urban population is expected to cross 75%. In India, the number of urban agglomeration/towns and cities has grown from 1,827 in 1901 to 7,935 in 2011 and population in these urban areas has increased from 25.8 million in 1901 to 377 million in 2011. In this process of urbanization, cities have emerged as hubs of economic opportunities for people inhabiting surrounding rural areas. There is a significant exchange of goods and services across borders between urban and rural areas. Hence, a disruption in urban areas has the potential to impact rural population and vice-versa. Urban-rural linkages and peri-urban concerns, therefore, are important while envisioning urban disaster and climate resilience. There is a global consensus on impacts of climate change increasing the frequency of droughts, floods, severe weather events and associated environmental and health-episodes. Slow-onset climate change impacts can also undermine development gains and livelihood options (UNICEF, 2015).

Figure A.11: Climate change impacts could affect several key urban functions via direct (shocks, sudden impacts such as storms, cyclones and heatwaves, and stresses, impacts that build gradually over time such as sea level rise, general temperature increase and changes in rainfall patterns) and indirect effects (coping capacity, city functioning)



Source: da Silva, et al., 2012

In India, climate change is increasingly linked to urban concerns as it exacerbates more risks in the infrastructure or resource deficit urban environments across the country. Rapidly developing second- and third-tier cities are more vulnerable to climate change impacts due to their limited infrastructural and institutional capacities, constrained finances and rising populations. A resilient and inclusive city approach is thus required for Indian cities where infrastructure, businesses and other urban systems can withstand the shocks of extreme weather events, and cope with stresses.

Learning objectives	Session(s) & methodology
<ul style="list-style-type: none"> To learn basic concepts of urbanization- its causes, trends, impacts on urban and peri-urban systems To develop an understanding of hazard-risks and vulnerabilities in context of urban resilience 	<ul style="list-style-type: none"> One session Lecture and PowerPoint presentation Question-answer sessions Discussion
Enabling unit(s)	
<ul style="list-style-type: none"> Urbanization – trends, causes, effects, and requirements of urban climatic resilience 	
Guidance	Recommended readings
<ul style="list-style-type: none"> This session is intended to give conceptual clarity about urban climate risks and the definition of vulnerability to climate change. The three components of vulnerability i.e. exposure, sensitivity & adaptive capacity, should be briefly discussed in the context of urban risks. The session as the first learning unit of this module should be taken up in discussion mode so that trainees can express their ideas and experiences based on the session's description of climate risks in urban areas and vulnerability of infrastructure to these risks. Lecture and presentation should use pictorials and easy examples to set the context for the next Learning Units in this module. 	<ul style="list-style-type: none"> TERI, 2014. Planning Climate Resilient Coastal Cities: Learnings from Panaji and Visakhapatnam, India. Asian Development Bank.2013. Guidebook: Increasing climate change resilience of urban water infrastructure-Based on a case study from Wuhan City, People's Republic of China. Gupta, A.K., Singh, S., Katyal, S., Chopde, S., Wajih, S.A., Kumar, A., (2016). <i>Training Manual on Climate Resilient and Disaster Safe Development - Process Framework</i>, NIDM New Delhi (India), GEAG Gorakhpur (UP, India) and ISET, Colorado (USA), supported by CDKN, UK. September 2016. Gupta, A. K., S S Singh, S A Wajih, N. Mani and A.K. Singh, 2017. Urban Resilience and Sustainability through Peri-urban Ecosystems. GEAG, ACCRN & Rockefeller Foundation. Gupta, A.K., Mani, N., Sarkar, B.B., Singh, S., Katyal, S. (2019). Developing Disaster Risk Resilient Cities. Gorakhpur Environmental Action Group (GEAG), Gorakhpur (UP), National Institute of Disaster Management, New Delhi, India and United Nations Children's Fund (UNICEF), India. September 2019. Pages 72.

LEARNING UNIT A.2:

CONTEXT OF ADAPTIVE AND RESILIENT URBAN DEVELOPMENT

Context

Historically, the term ‘adaptation’ has been used to describe individual actions required to respond to climate change. The Intergovernmental Panel on Climate Change (IPCC) defines adaptation as the process of adjustment to actual or anticipated climate and its effects. In human systems, adaptation seeks to moderate harm and/or exploit beneficial opportunities. In natural systems, human intervention may facilitate adjustment to expected climate and its effects. Resilience, on the other hand, refers to the capacity of a system, organization, community or individual to create, alter and implement multiple adaptive actions over time.

Box A.21

Adaptation and resilience

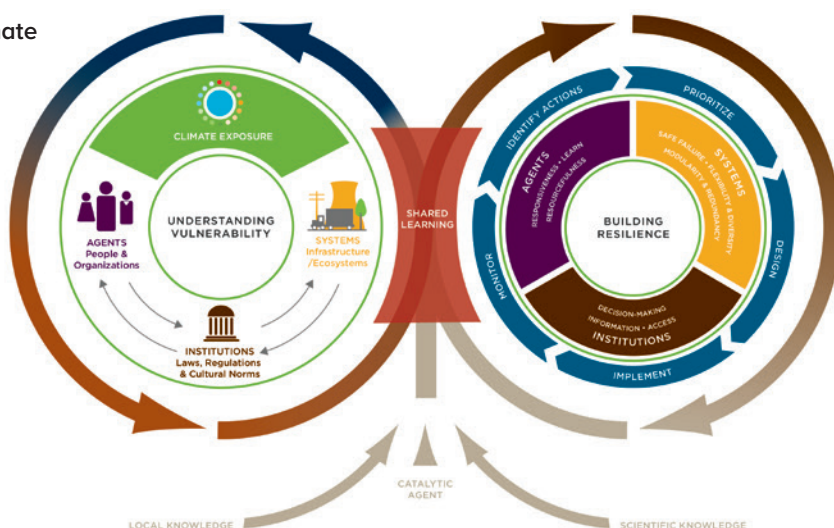
Resilience and adaptation are interlinked. Resilient systems are stable, yet flexible foundations that people require to shift strategies and adapt as conditions change. The Climate Resilience Framework uses the concept of resilience over adaptation because:

Adaptation often implies discrete actions such as building flood-protection systems or mangrove restoration that aim to address specific vulnerabilities or problems.

Resilience is a continuous process. It recognizes that vulnerability and climate risk are continually evolving, similar to the evolution and interaction of our cities and communities and the systems, agents and institutions within them.

Source: MacClune and Reed (2012)

Figure A.21. Catalyzing Urban Climate Resilience (Moench et al., 2011).



With rapid urbanization and increasing impacts of climate change on urban areas, many flagship programmes have been undertaken by different organizations globally to build urban climate change resilience. These flagship programmes have evolved different Urban Climate Change Resilience Frameworks in different contexts. These include:

- i. **International policies**— SDGs, Climate Agreement, Sendai Framework for Disaster Risk Reduction or SFDRR, etc. and related national policies and guidelines/regulations.
- ii. **Geographical, environmental and sectoral frameworks**— differ for different sized cities, coastal area, mountains, industry, businesses, etc.
- iii. **Vulnerability and inclusiveness**— focus on children, women, elderly, disabled, urban poor, etc.
- iv. Systems, agents and institutions

Learning objectives	Session(s) & methodology
<ul style="list-style-type: none"> To discuss the concepts of adaptation, resilience and Urban Climate Change Resilience Framework (UCCRF) To state the need and contexts of key urban systems, agents and stakeholders 	<ul style="list-style-type: none"> One session Lecture and PowerPoint presentations Short film show/poster exhibition Question-answer session Discussion
Enabling unit(s)	
<ul style="list-style-type: none"> Adaptation to climate change and key contexts of urban resilience building 	
Guidance	Recommended readings
<ul style="list-style-type: none"> This learning unit includes knowledge sharing sessions on various international frameworks related to urban resilience. The facilitators shall have adequate knowledge of various frameworks, SFDRR, SDGs and Paris climate agreement etc. Preparation with short film or poster(s) followed by a discussion on dimensions and contexts of urban climate resilience would be useful. Case examples of different size/ categories of cities, geographies, sectoral or vulnerability contexts, in the discussion would enrich the session. 	<ul style="list-style-type: none"> “City Resilience Framework” ARUP, December 2015, Available at https://assets.rockefellerfoundation.org/app/uploads/20140410162455/City-Resilience-Framework-2015.pdf [Accessed on April 23, 2020] da Silva, J., S. Kernaghan, and A. Luque. (2012). A Systems Approach to Meeting the Challenges of Urban Climate Change. <i>International Journal of Urban Sustainable Development</i>. 4 (2). pp. 125–145. Gupta, A.K., S.S. Nair, S. Chopde, S.A. Wajih, A. Kumar. 2014. Mainstreaming DRR and CCA Integration into District Level Developmental Plans. GEAG & NIDM. Gupta, A.K., Mani, N., Sarkar, B.B., Singh, S., Katyal, S. (2019). Developing Disaster Risk Resilient Cities. Gorakhpur Environmental Action Group (GEAG), Gorakhpur (UP), National Institute of Disaster Management, New Delhi, India and United Nations Children’s Fund (UNICEF), India. September 2019. Pages 72.

LEARNING UNIT A.3:

URBAN AND PERI-URBAN WATER, TEMPERATURE, WINDS, AND HEALTH RISKS

Context

Climate change presents a significant challenge for urban systems worldwide. Climate change impacts such as increased rainfall intensity, storm surges, flooding and urban heat island effects are likely to affect many urban systems worldwide. These will impact severely on urban systems and the populations and services they support. Adaptation will almost certainly be required to cope with these effects (Shalaby, H. and Abolnaga, S., 2017).

India has the second largest urban system in the world. Urban footprints are considerably higher than rural counterparts, as large quantities of food, water and fuel continually flow into cities and fairly large volumes of waste and sewage flows out.

Box. A.31.

Urban and peri-urban resilience in the face of pandemic

The global pandemic of COVID-19 brought the world to a halt and cities became the hotspots of contagion spread and control. It also served as a reminder for urban planners and decision makers to rethink and reimagine cities and their resilience in the context of peri-urban areas. Urban practitioners around the world started looking at the dependence on urban and peri-urban areas and the disruption the health risk has on the dynamics, resilience and sustainability of city systems.

Moreover, COVID-19 exposed faults in the urban practice and governance, faults which one should not cover up in post pandemic times. The pandemic makes it all the more important for professionals in the urban domain to start thinking about:

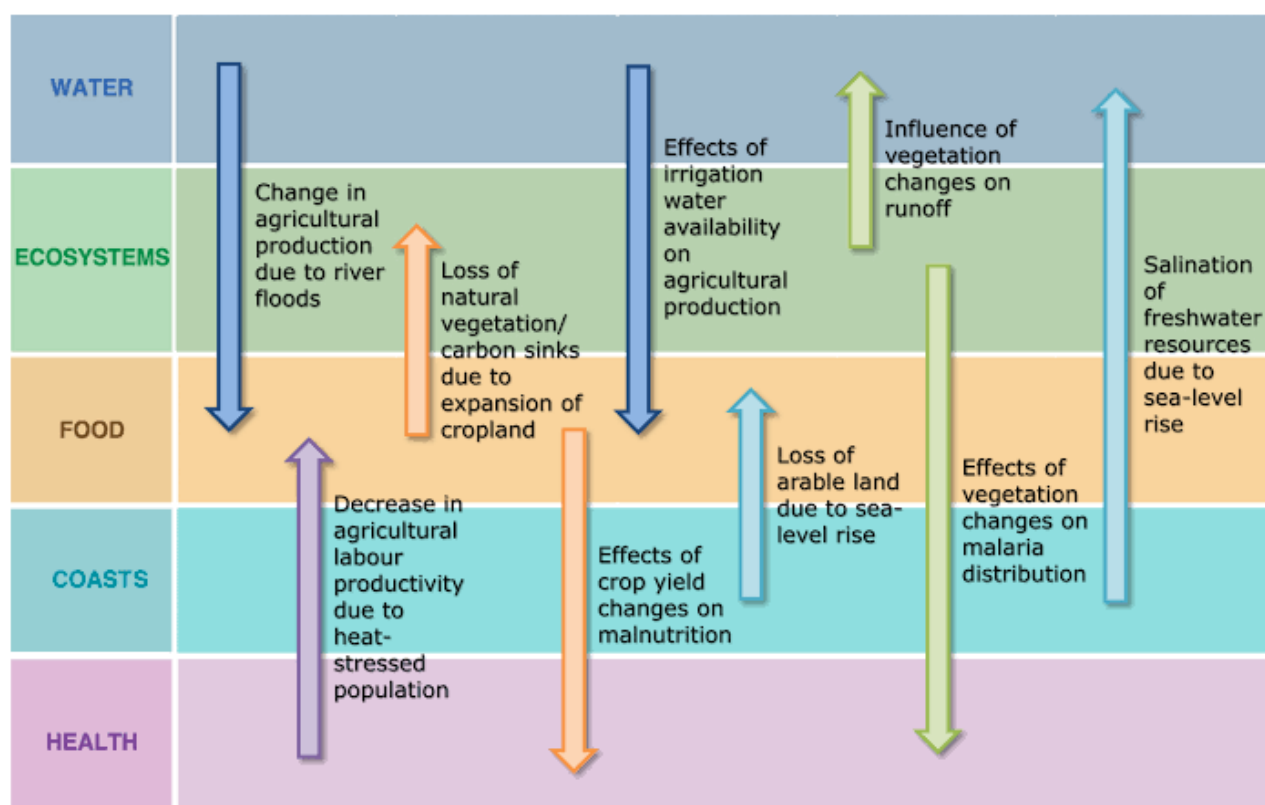
- i. Efficient and effective **health systems** which can tackle health risks.
- ii. Efficient and effective **hygiene systems** which can prevent the spread of the virus.
- iii. Bringing back **health into territorial planning**. Health districts and **health risk zonation** can be the game-changers.
- iv. Establishing and making an effective use of **robust digital infrastructure** at the district level to monitor and combat health risks.

Even though there are health risks like COVID-19 which are unforeseeable, planning and management in context of peri-urban ecosystems can certainly reduce the extent of damage due to any health risk. For a country like India where majority continues to live in rural areas, significant portion of city dwellers live in informal, unplanned spaces and implementation of social distancing is tough, urban and peri-urban systems need to champion for change from reaction to resilience.

Changes in climate regimes and weather patterns-including temperature, wind, rainfall, glacial melting and sea-level rise- are primary effects of climate change. Water is critical to human existence, sustainability and is also a leading cause of natural disasters of floods and drought. Urban flooding has become common to most cities and towns whereas drought or water scarcity is also emerging as another eminent challenge. Heatwave is known as a killer phenomenon known for significant deaths and multifaceted health risks. Cold wave is also emerging as a notable risk for urban and peri-urban populations. Cyclone lead devastations in coastal and adjoining areas pose a major challenge to infrastructure and resources. In the recent past, dust storms and sandstorms have attained significant attention of climate and disaster risk management systems. Changes in climate regimes and patterns are also known to alter disease patterns and aggravate health risks in cities and surroundings.

People living in peri-urban areas are generally poor and marginalized and largely depend on wage-earning opportunities in urban areas and primary production-based livelihood (agriculture, aquaculture, orchards, horticulture, etc.) which are sensitive to climate change impacts.

Figure A.31. Climate-risk cascades across sectors



Source: Huber et al 2014.

Damage and losses to infrastructure systems lead to economic and production losses, besides disruption to businesses, livelihoods and social systems. Effects of climate disasters and extremes variably harm urban and peri-urban systems. This involves short- and long-term damage to ecosystems and natural resources which in turn pose greater and new risks to infrastructure as well as socio-economic support systems in cities and surroundings. In essence, peri-urban systems have a critical influence on city sustainability and resilience.

Learning objectives	Session(s) & methodology
<ul style="list-style-type: none"> To identify different contexts- sectoral, hazard & impact specific- of risks, vulnerability and resilience To deliberate on urban and peri-urban resilience concerning water, temperature, wind, and health risks To enable the understanding of cause-effect relationship through causal-loop study 	<ul style="list-style-type: none"> Two sessions Lecture and PowerPoint presentations Activity and group exercise Question-answer session Discussion
Enabling unit(s)	
<ul style="list-style-type: none"> Sectoral, hazard-specific and impact specific contexts of risk, vulnerability and resilience in urban and peri-urban systems 	
Guidance	Recommended readings
<ul style="list-style-type: none"> Presentation may be developed based on case examples of past events and studies from cities or towns (preferably from the country) This training module may include a group exercise and engage the participants in developing possible causal-loop scenarios for climate and disaster risks and resilience in urban and peri-urban settings regarding hazards, sectors and specific impacts 	<ul style="list-style-type: none"> “City Resilience Framework” ARUP, December 2015, Available at https://assets.rockefellerfoundation.org/app/uploads/20140410162455/City-Resilience-Framework-2015.pdf da Silva, J., S. Kernaghan, and A. Luque. (2012). A Systems Approach to Meeting the Challenges of Urban Climate Change. <i>International Journal of Urban Sustainable Development</i>. 4 (2). pp. 125–145. Gupta, A. K., S S Singh, S A Wajih, N. Mani and A.K. Singh, 2017. Urban Resilience and Sustainability Through Peri-urban Ecosystems. GEAG, ACCRN & Rockefeller Foundation. Gupta, A.K., S.A. Wajih, N.Mani, S. Katyal. 2017. Vulnerabilities of Urban Poor Children and Urban/Peri-urban Ecosystem Based Resilience (Policy Paper). GEAG Gorakhpur, UP and UNICEF India. Shalaby, H. and Abolnaga, S., 2017; Climate Change Impacts on Urban Planning in the Cities. 1st International Conference on Towards a Better Quality of Life, 2017. https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3162375

ACTIVITY AND GROUP EXERCISE



Activity: Causal analysis

Time: 1 Hour including discussion

Material: Flip charts, different colour sketch pens, board, board pins

Objectives:

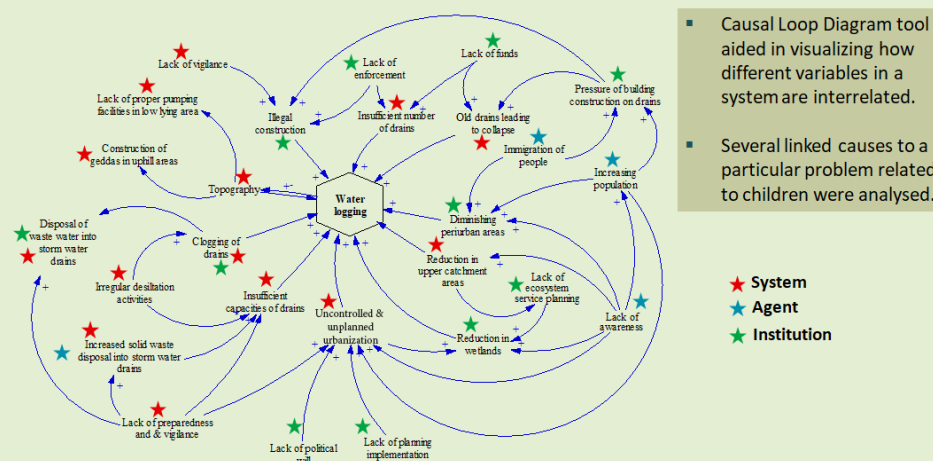
1. To identify the underlying causes of vulnerability of systems, agents and institutions across key sectors, specific hazards and impacts
2. To develop an understanding of building sector-specific resilience actions based on identified vulnerabilities and their causes

Background:

Causal Loop Diagram (CLD) tool is an important tool used in the process of identifying causes of vulnerability which ultimately leads to the identification of resilience actions. The tool aids in visualizing how different variables in a system are inter-related. The diagram consists of a set of nodes and edges. Nodes represent the variables and edges are the links that represent a connection or a relation between the two variables. A link marked positive indicates a positive relationship and a link marked negative indicates a negative relationship. A positive causal link means that the two nodes change in the same direction, i.e., if the node in which the link starts decreases, the other node also decreases. Similarly, if the node in which the link starts increases, the other node increases as well. A negative causal link means the two nodes change in opposite directions, i.e., if the node in which the link starts increases, the other node decreases and vice versa.

Figure A.32. An example of CLD for waterlogging in Visakhapatnam city, developed under the GEAG-UNICEF Project on Building Climate Change and Disaster Resilience for Urban Children.

Causal Analysis



Instructions

1. Facilitate the participants in understanding the concept of CLD using a PowerPoint slide. Emphasize on understanding the systems, agents and institutional vulnerabilities by taking the example of urban basic service.
2. Now, divide the participants into three to four groups and assign each group the responsibility of developing a CLD on various urban sectoral vulnerabilities, for example: waterlogging, sanitation, drinking water, sewerage etc.
3. Each group should be facilitated by an instructor. Give time for discussion and development of causal loops of vulnerability.
4. Collect the flip charts and post them on a wall or board.
5. Invite an active member to explain the CLD to different groups.
6. Facilitate the identification of resilience actions required for identified vulnerabilities by each group. The participants should note down the vulnerabilities, their causes and potential resilience actions on a separate sheet as it will help to build understanding in subsequent activities and modules.

LEARNING UNIT A.4:

STRATEGIC MANAGEMENT OF RISKS WITH GREEN GROWTH AND ECOSYSTEMS

Context

Rapidly emerging and expanding urban centres of India are often perceived as engines of economic growth. At the same time, these engines and their basic services- water supply, sewerage, drainage, solid waste management- are subjected to immense pressures of rising population and limited funding. Unplanned developments in cities and peri-urban areas are replacing agriculture and other undeveloped lands- common property resources and water bodies- with negative implications on people and ecosystems.

Moreover, climate-related disasters and extreme weather events are likely to pose a greater risk to city infrastructure, businesses, resources and communities. Less obvious is the fact that business-as-usual development practices may also generate complex environmental changes and accentuate risks unless these changes and risks are foreseen followed by remedial actions.

It thus becomes inevitable to develop and implement policies and strategic interventions to address urban and peri-urban climate & disaster risks and move towards safe, equitable, resilient and sustainable urban development. This is highly relevant to achieve India's commitment to SDGs and more specifically SDG 11 which calls upon governments to make cities and settlements inclusive, safe, resilient and sustainable.

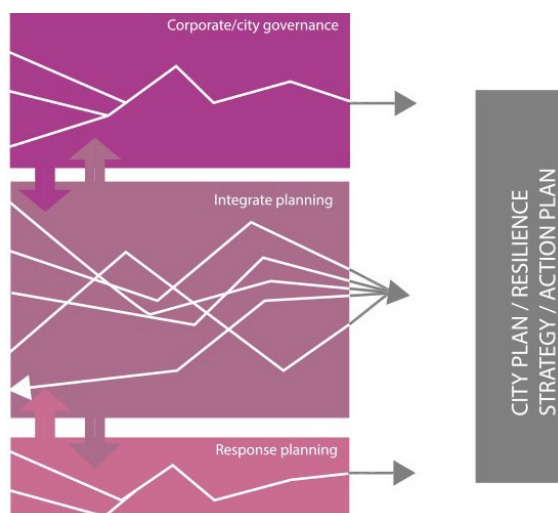
Box. A.41.

Transformative resilience

The concept of “*Transformative Resilience*” is now becoming popular among the development research peers who argue that rather than looking at resilience from a single perspective of shock and stresses, with the goal of bouncing back to original state, transformative resilience (instead of mainstreaming resilience) should be incorporated into planning frameworks.

Figure A.41. Ten essentials for making cities resilient

- 1  Organise for disaster resilience
- 2  Identify, understand and use current and future risk scenarios
- 3  Strengthen financial capacity for resilience
- 4  Pursue resilient urban development and design
- 5  Safeguard natural buffer to enhance the protective functions offered by natural ecosystems
- 6  Strengthen institutional capacity for resilience
- 7  Understand and strengthen societal capacity for resilience
- 8  Increase infrastructure resilience
- 9  Ensure effective disaster response
- 10  Expedite recovery and build better



Source: UNDRR, 2017

The concept of resilient cities entails considering cities as dynamic systems. The “systems thinking” approach aids in working across silos and simultaneously engaging with multiple and evolving risks. The resilience of a city depends on the overall performance and capacity of its systems, and not solely on its ability to manage disaster risk, reduce greenhouse gas emissions, or adapt to climate change and impacts thereof.

Green growth today is an outcome of the policy response to the economic and environmental crisis (Dis et al., 2014; OECD, 2015). Concepts of green growth and carbon-neutrality in the context of the city direct us towards a mechanism that can overcome several challenges of technology, governance and finance (Merk et al., 2012). Urban green growth is a relatively new approach in developing countries like India that integrates social and economic objectives with environmental goals (ICLEI-South Asia., 2015).

Peri-urban regions see a growing potential for green services through various schemes and missions like Green India Mission, REDD+, social and urban forestry etc. Urban and peri-urban ecosystems besides being major contributors to sustainability are important as natural infrastructure and adaptation options, towards enabling city resilience to climatic risks and vulnerability.

Learning objectives	Session(s) & methodology
<ul style="list-style-type: none"> To understand strategic management dimensions for urban resilience To grasp the theory of resilient cities through ‘resilience campaign and ten new essentials To enlist the opportunities of green growth interventions and the role of ecosystems in urban resilience To learn India’s policy–strategy framework guided towards urban resilience 	<ul style="list-style-type: none"> One session Lecture and PowerPoint presentation Question-answer session Discussion Case study presentation Group exercises
Enabling unit(s)	
<ul style="list-style-type: none"> Strategic management of climate risks by integrating green growth and ecosystem-based opportunities 	
Guidance	Recommended readings
<ul style="list-style-type: none"> Policy-planning-practice linkages with suitable examples may be discussed during the session to encourage participants to explore examples from their sectors/departments and areas Illustrations for business continuity resilience, infrastructure functioning, industrial adaptation, social and health resilience, may be discussed in the context of climate-related hazards and vulnerabilities 	<ul style="list-style-type: none"> Cities, Towns, Regions Partner to Help Achieve Paris Goals”, Article, UNFCCCC, 10 November 2016, available at <https://unfccc.int/news/cities-towns-regions-partner-to-achieve-paris-goals> Resilient Cities – what would it mean for the cities in the Global South?” Divya Sharma, September 2018, available at <www.opml.co.uk/blog/resilient-cities-global-south> Making our cities smart and resilient”, Raina Singh, 3 March 2018, available at www.teriin.org/article/making-our-cities-smart-and-resilient Gupta, A.K., Singh, S., Katyal, S., Chopde, S., Wajih, S.A., Kumar, A., (2016). Training Manual on Climate Resilient and Disaster Safe Development - Process Framework, NIDM, New Delhi (India), GEAG, Gorakhpur (UP, India) and ISET, Colorado (USA), supported by CDKN, UK. September 2016). Guiding Documents, UNISDR, Making Cities Resilient, My City is Getting Ready at www.unisdr.org/campaign/resilientcities/home/toolkitblkitem/?id=1 Gupta, A. K., S S Singh, S A Wajih, N. Mani and A.K. Singh, 2017. Urban Resilience and Sustainability Through Peri-urban Ecosystems. GEAG, ACCRN & Rockefeller Foundation.

TRAINING MODULE

ECOSYSTEMS IN URBAN DISASTER AND CLIMATE RESILIENCE

Context

Ecosystems are dynamic complex systems of living communities and their non-living environment interacting as a functional unit. An ecosystem forms the basis of life and livelihoods, providing four categories of essential ecosystem services-provisioning, regulating, supporting and cultural services- for existence and socio-economic well-being (Gupta and Nair, 2012). Natural systems are often referred to as humanity's life-support systems, providing essential ecosystem services for existence and socio-economic well-being (The Millennium Ecosystem Assessment, 2005).

Ecosystem services are the benefits that people and communities obtain from ecosystems. These include regulatory services such as regulation of floods, drought, land degradation and disease, along with "provisioning services" such as food and water, "supporting services" such as soil formation and nutrient cycling, and "cultural services" such as recreational, spiritual, religious and other non-material benefits. A decline in ecosystem services influence the resources available to the people which lead to increased vulnerability to hazards and decrease in disaster resilience.

Box. B.01.

Ecosystem services

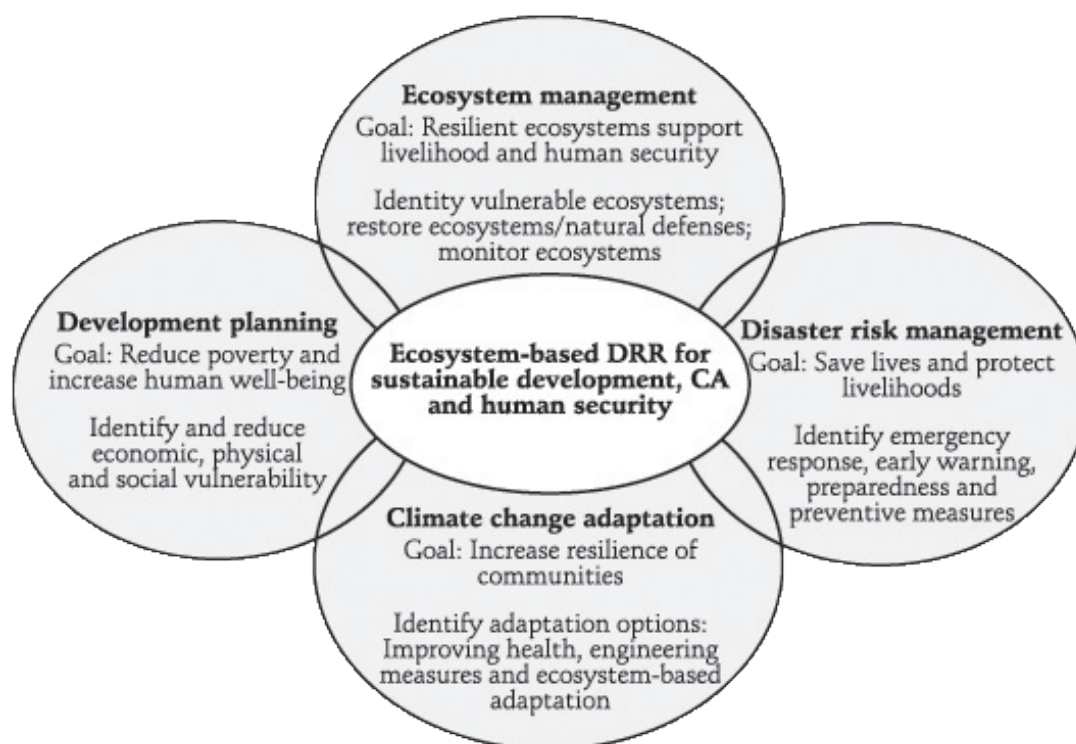
Provisioning services, the material that people extract directly from ecosystems such as food, water, forest products etc.

Regulating services, which modulate changes in climate and regulate floods, drought, disease, water quality, etc.

Cultural services, which consists of recreational such as tourism, aesthetic and spiritual benefits.

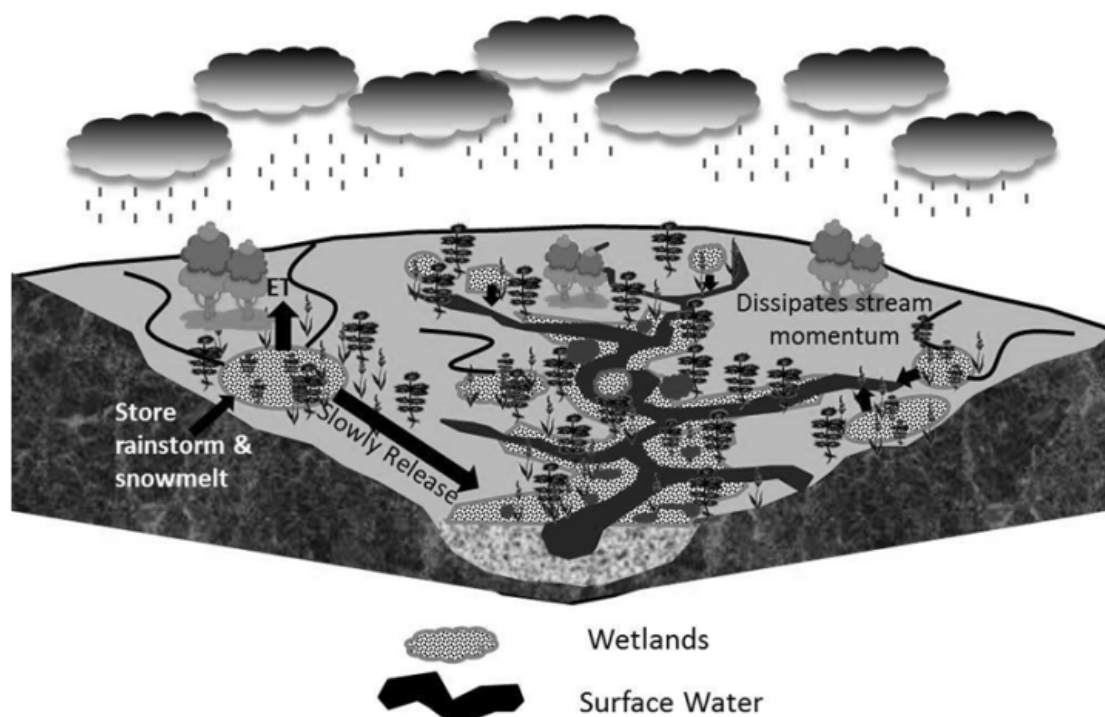
Supporting services, as soil formation, photosynthesis and nutrient recycling.

Figure B.01. Ecosystem-based disaster risk reduction, a more sustainable approach to DRR and climate change adaptation



Source: Gupta and Nair, 2012

Figure B.02. Diagram showing wetlands' flood control function through the processes of floodwater storage, dissipating the momentum of runoff and maintaining the stability of floodplain



Source: Gala, T. S., Young, D. (2015) Geographically Isolated Depressional Wetlands – Hydrodynamics, Ecosystem Functions and Conditions. Applied Ecology and Environmental Sciences, 3(4):108-116 doi:10.12691/aees-3-4-3

The term 'Ecosystem-based disaster risk reduction (eco-DRR)' refers to the use of natural environment or systems to buffer the worst impact of changing climate, extreme weather events and related hydro-meteorological disasters. The basic objective of the approach is to maintain the resilience of natural ecosystems and their services and help communities survive and cope up with extreme events.

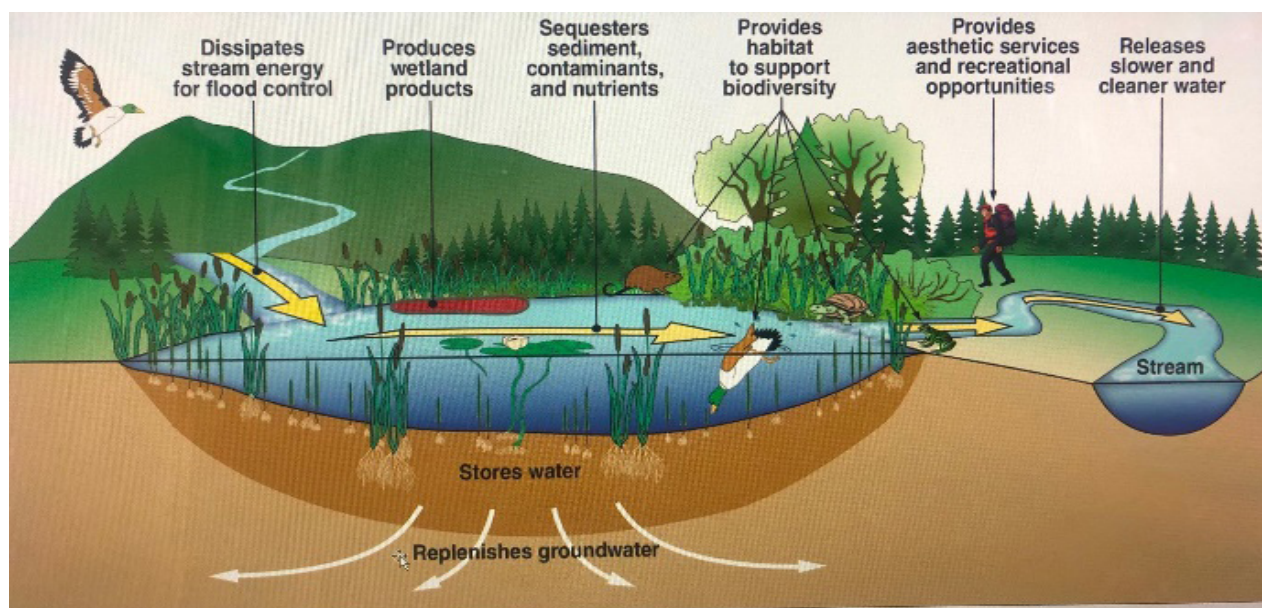
Ecosystem-based urban disaster risk reduction (eco-U-DRR)

The relationship between ecosystems and cities is complex and often a two-way process. Ecosystems provide several physical and environmental services to cities, city dwellers and also help enhance a city's resilience. Cities, however, are rapidly urbanizing and experiencing unplanned development which leads to a significant decline in ecosystems and resilient capacities of city systems. To add to the problem, the extractive nature of urbanization sets a low premium on preserving the ecosystem, affecting the livelihoods of direct dependents in the city.

Green infrastructure, defined as vegetation systems intentionally designed to promote environmental quality, can reduce the intensity of heat islands by providing shade and evapotranspiration cooling. Wetlands, known as blue-green infrastructure, are vital for city resilience for their various benefits of protective buffer against flooding, surges, heat, drought and aridity, and reducing ecological and socio-economic vulnerability against risks. Urban and peri-urban ecosystems may include urban trees and biodiversity parks, plantations, nurseries, urban agriculture, wetlands, rivers, etc., but small-scale ecological practices like home gardens, green rooftop, etc. can also contribute significantly.

Maintaining the health of an ecosystem is thus crucial to developing the resilience of the urban and peri-urban regions. Changes in ecosystem services affect people living in urban areas both directly and indirectly. Unsustainable urban development threatens the very availability of key services like the availability of water, air and water quality, waste processing, and many other qualities of the ambient environment. Agriculture practised within urban boundaries contributes to food security, healthy land and the soil is the source of livelihood particularly to vulnerable groups, wetlands in the urban vicinity absorbs extra water and buffers flood, urban parks and open spaces provide recreational and aesthetic values to city dwellers etc., are few services that peri-urban regions provide to the well-being of the humankind.

Figure B.03: Some ecosystem services provided by wetlands



Source: Amelia Rozelle, A., 2019

Resilience to natural hazards

Asia-Pacific region is one of the world's most disaster-prone areas and had experienced more than 1600 natural disasters (ESCAP, 2015) in the last decade which is 40% of the global total. Each year natural disasters of varied typology (hydro-meteorology, biological, climate-induced disasters etc.) kill thousands of people and cause huge economic damage. According to the ESCAP 2015 report, in the total disasters reported during 2005-15, about 500,000 people lost their lives, 1.4 million were affected and economic damage of \$523 billion was reported.

A healthy and robust ecosystem is one of the best defences against any natural disasters and also contributes towards the resilience (Gupta and Nair, 2012, Singh et al., 2013). However, an unsustainable pattern of development along with anthropogenic climate change has weakened the health of these ecosystems. This reduced their capacity of protecting human populations and landscapes from the impact of natural hazards. Approximately 60% of the ecosystem services have been degraded or used unsustainably and protection from a natural hazard is one of those degraded services (Millennium Ecosystem Assessment, 2005). One of the important findings of the report states that in the past 50 years humans have changed ecosystems more rapidly and extensively than in any comparable period of human history which has led to substantial and irreversible loss in the diversity of life on earth.

Figure B.04. Role of ecosystems in climate and disaster resilience (Gupta et al., 2017).

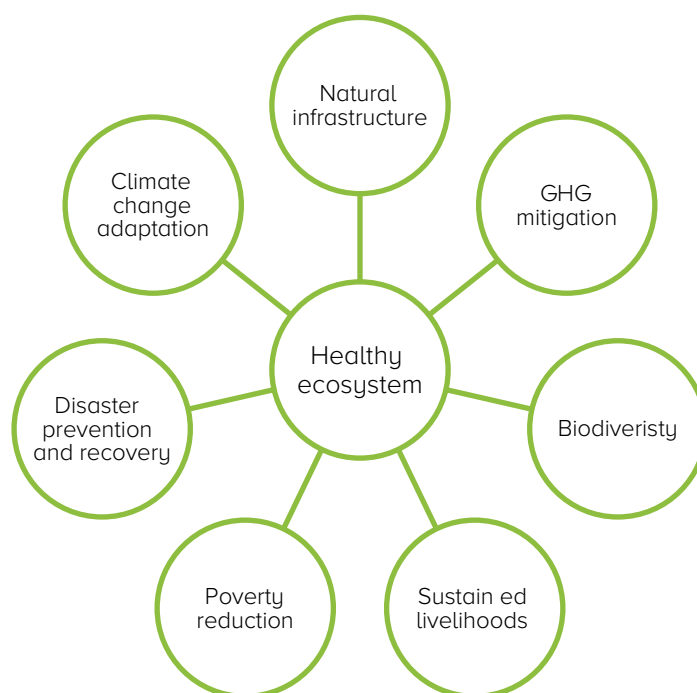


Table B.01. Mapping eco-technology for hazard mitigation

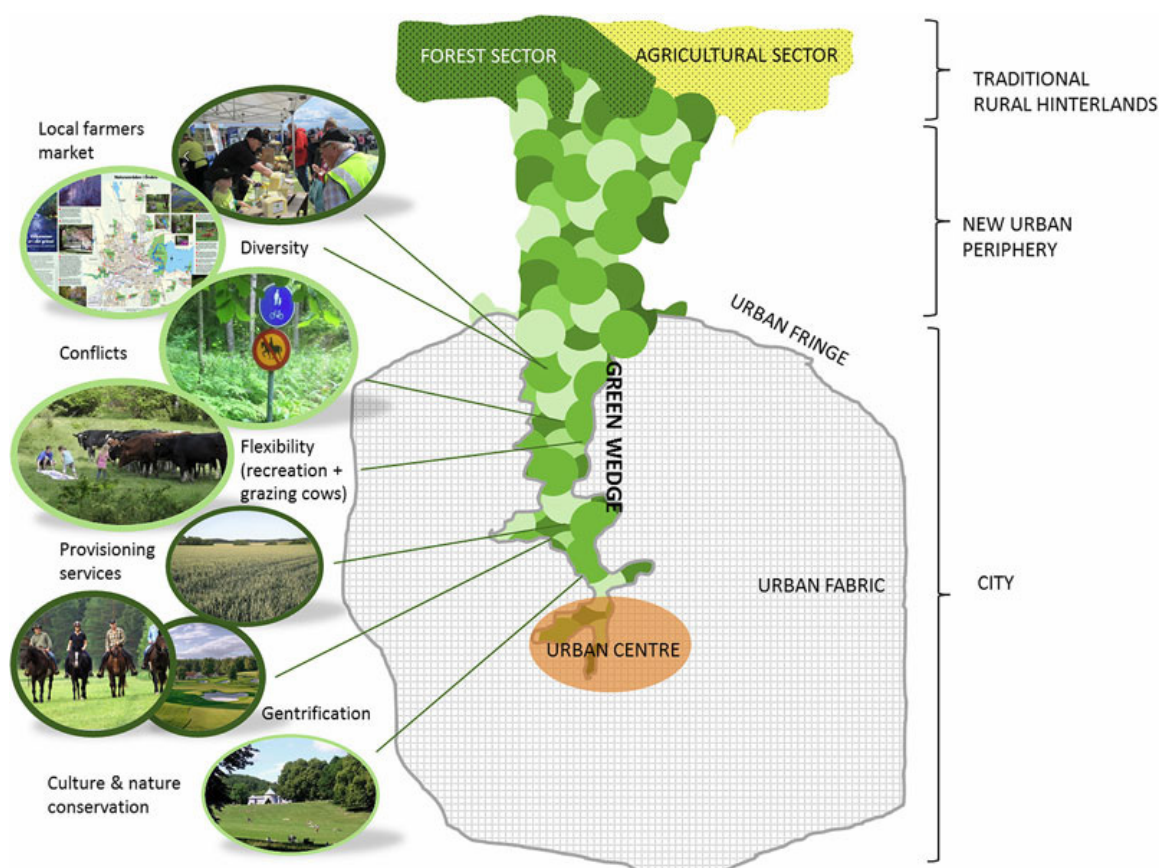
Ecosystems	DRR Function
Mountain ecosystem	Vegetation cover and root structures protect against erosion and increase slope stability by binding soil together, preventing landslides.
	Forests protect against rockfall and stabilise snow reducing the risk of avalanches.
	Catchment forests, especially primary forests, reduce risk of floods by increasing infiltration of rainfall, and delaying peak floodwater flows, except when soils are fully saturated.
	Forests on watersheds are important for water recharge and purification, drought mitigation and safeguarding drinking water supply for some of the world's major cities.

Ecosystems	DRR Function
Wetlands and floodplains	Wetlands and floodplains control floods in coastal areas, inland river basins, and mountain areas subject to glacial melt.
	Peatlands, wet grasslands and other wetlands store water and release it slowly, reducing the speed and volume of runoff after heavy rainfall or snowmelt in springtime.
	Coastal wetlands, tidal flats, deltas and estuaries reduce the height and speed of storm surges and tidal waves.
	Marshes, lakes and floodplains release wet season flows slowly during drought periods.
Coastal ecosystem	Coastal ecosystems function as a continuum of natural buffer systems protecting against hurricanes, storm surges, flooding and other coastal hazards –combined protection from coral reefs, seagrass beds, and sand dunes/coastal wetlands/coastal forests is particularly effective. Research has highlighted several cases where coastal areas protected by healthy ecosystems have suffered less from extreme weather events than more exposed communities.
	Coral reefs and coastal wetlands such as mangroves and salt marshes absorb (low-magnitude) wave energy, reduce wave heights and reduce erosion from storms and high tides.
	Coastal wetlands buffer against saltwater intrusion and adapt to (slow) sea-level rise by trapping sediment and organic matter.
	Non-porous natural barriers such as sand dunes (with associated plant communities) and barrier islands dissipate wave energy and act as barriers against waves, currents, storm surges and tsunamis.
Dryland ecosystem	Natural vegetation management and restoration in drylands contribute to ameliorate the effects of drought and control desertification, as trees, grasses and shrubs conserve soil and retain moisture.
	Shelterbelts, greenbelts and other types of living fences act as barriers against wind erosion and sand storms.
	Maintaining vegetation cover in dryland areas, and agricultural practices such as use of shadow crops, nutrient enriching plants, and vegetation litter increase resilience to drought.

Modified after Estrella et al. (2012)

Integrated management of land, water and living resources that promotes conservation and sustainable use provides the basis for maintaining ecosystem services, including those that contribute to reducing disaster risks. Sendai Framework for Action, Sustainable Development Goals as well as the Paris Climate Agreement has emphasized building resilience by protecting natural ecosystems. According to a study in the Mississippi Alluvial Valley in the US, restoring wetlands on the crop-fields result in a net increase of ecosystem services including greenhouse gas mitigation, nutrient mitigation and waterfront recreation and therefore net benefit to the society (Jenkins et al, 2010). It has been studied that some coastal ecosystems including mangroves forests, coral reefs and salt marshes, help to reduce the risks associated with coastal hazards such as storm surge and coastal flood. Such an ecosystem also provides a host of associated ecosystem services which may be lost if natural systems are replaced by built structures (McIvor et al., 2012). A study conducted by the scientists at the University of Delhi and Duke University notes that coastal villages in Odisha - with some of the largest mangrove belts - suffered fewer deaths, compared to those with smaller belts or no mangroves in the devastating cyclone of 1999 (Das et al., 2009).

Figure B.05. Conceptual illustration of the urban green wedges in Stockholm and their relation to the urban centre, urban fringe and rural hinterlands. Illustration taken from Hedblom, M. et. al. 2017. Flexible land-use and undefined governance: From threats to potentials in peri-urban landscape planning.



The State of Louisiana has adopted policy guidelines for using natural wetlands to assimilate nutrients in secondarily treated municipal effluent, thus utilizing ecosystem services of natural wetlands. In addition to water quality improvement, wetland assimilation provides additional ecosystem services, including increased vegetative productivity, surface accretion, and carbon sequestration (Young Ko et al., 2012). The floodplain wetland system provides several ecosystem services, the key being regulation of hydrological regimes, groundwater recharge, water quality improvement, support to biodiversity and life support system, effective in flood control, wastewater treatment, reducing sediment loads, low input sustainable agriculture, fisheries development, tourism and valuable for educational and scientific interest and recreational benefits. River floodplains have been reported as potential sites to mitigate extreme events in the hydrological cycle (Gosselink, 2000). Figure B.06 presents an ecological framework on significant ecosystems in peri-urban and urban systems in reducing hazard factors as well as the underlying aspects of vulnerability.

Urban and peri-urban agriculture and food security

Peri-urban agriculture is multi-functional and has several ecosystems that provide ecological, social and economic services to the city (GEAG, 2016). The European Parliamentary Research Service (EPRS) defines urban and peri-urban agriculture as the “cultivation of crops and rearing of animals for food and other uses within and surrounding the boundaries of cities, including fisheries and forestry” (EPRS, 2014). On the other hand, the Food and Agriculture Organization defines urban agriculture as “small areas within the city for growing crops and raising small livestock or milk cows for own consumption or sale in near markets”. Interestingly, agriculture in peri-urban areas reaps the benefits of crop or food production, as well as agri-tourism- on the lines of eco-tourism- which is emerging as a trend in various countries (Yang et al., 2010).

Peri-urban agriculture refers to “farm areas close to towns/cities which operate intensive, semi or fully commercial farms to grow vegetables and other horticulture, raise poultry and other livestock and produce milk and eggs” (FAO, 2001). Urban and peri-urban agriculture, particularly in the context of developing countries, play a crucial role in diversifying urban diets and providing environmental services in urban and peri-urban areas (Nambi et al., 2014).

Table B.02: Ecosystem services of peri-urban agriculture

Provisioning	Regulating	Supporting	Cultural
Dependable access to adequate and nutritious food (food security)	Minimizes the impact of urban heat island	Preservation and creation of green spaces help in augmentation and sequestration of carbon	Creates urban open space in city edges and provides an aesthetic look
Important source of income for urban poor (economic security)	Helps in absorbing extra water at the time of flood and saves urban areas from inundation		A well maintained peri-urban site provides a way for eco-tourism e.g. bird sanctuary
Less transportation infrastructure requires to bring food into the city premises, thus reducing the supply chain			

Cities-like the city of Minneapolis, Seattle, Cleveland in the United States - around the world have adapted pro urban agriculture policies (Sahasranaman, 2016) and have supported PUA that not only supplies food to cities but also helps shape urban growth (Brinkley, 2012). For example, the Urban Agricultural Policy Plan of Minneapolis city was adopted in 2011 to build strong local food system and promote healthy lifestyle along with improving community gardens and food markets which sell locally and regionally grown foods (MPLS Plan, 2011).

In a developing country like India, the Government of India launched the scheme of Vegetable Initiative for Urban Clusters (VIUC) in 2011-12. The scheme aimed to address concerns of demand and supply of vegetables, enhance productivity and encourage the establishment and efficient supply chain in urban and peri-urban clusters (Ministry of Agriculture, 2013). In another scheme of the Centre-the National Mission for Sustainable Agriculture, which is one of the eight missions of National Action Plan on Climate Change (NAPCC) - promoting sustainable agriculture via the dimensions of water use efficiency, nutrient management and livelihood diversification, is given attention (NMSA, 2010).

Training Module

This is the second training module of the manual which focuses on the role of ecosystems and ecosystem services for sustainable urban development and resilience as well as climate and disaster risks. It discusses ecosystems' functions and benefits to people and businesses in cities and in reducing risks by enhancing coping capacity, reducing social, physical and environmental facets of vulnerability. The module is developed as an orientation or sensitization course towards the integration of disaster management and resilience into the urban development processes.

Four learning units are delineated under this module:

- LU-B.1.** Green infrastructure and resources for adaptive and resilient development
- LU-B.2.** Water-food-energy nexus and role of ecosystem services
- LU-B.3.** Peri-urban agriculture – A new land-use: Role in urban and peri-urban sustainability
- LU-B.4:** eco-DRR for gender justice, child care, geriatric and psycho-social health



Training objectives

- To describe ecosystems, functions and services in reducing disaster risk and resilience building
- To describe various dimensions of ecosystems in urban and peri-urban systems concerning water, food and energy management vis-à-vis new land-use dynamics in form of urban agriculture
- To enumerate the ecosystem services supporting environmental, physical and social resilience and addressing vulnerability aspects of women, children, aged, mental health, etc.



Guidance

- Recap of previous module learning's, past experiences and examples from both sides - from participants as well as from the faculty/trainers would be useful
- Discussion on an understanding of ecosystems – their structure, functions, benefits in general and then bringing orientation towards specific functions supporting urban systems and in particular towards adaptation and resilience would be an important strategy
- Case examples in the discussions/case study analysis would be a value addition to the learning process



Methodology

- Film on ecosystem services, the protective role of wetlands and vegetation, green roof, etc. against hazards and extremes, etc.
- Lecture/PowerPoint presentations
- Case study (analysis and Q&A based on the case study)
- Group exercises
- Experience sharing
- Discussion Learning Unit B.1: Green infrastructure and resources for adaptive and resilient development

LEARNING UNIT B.1:

GREEN INFRASTRUCTURE AND RESOURCES FOR ADAPTIVE AND RESILIENT DEVELOPMENT

Context

Urbanization is almost synonymous with modern age development. Altering the natural environment and ecosystems, urbanization compromises sustainability and well-being of city systems. An ecologically-sound urban planning and design paradigm, therefore, becomes essential to harmonise development in and around urban systems, linked with ecosystem services to attain natural capital benefit.

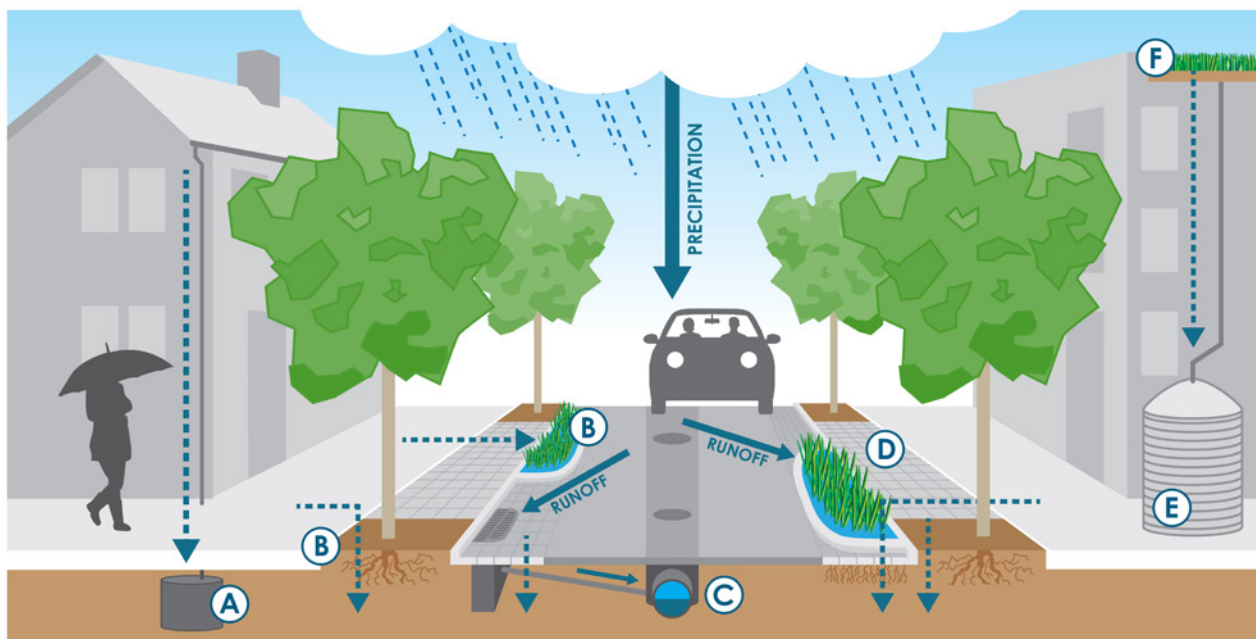
Natural capital- soil, living organisms, hydrological cycle- is the stock of natural ecosystems that yield a flow of ecosystem services from nature to human societies. Since the flow of these services is reliant on the functioning of ecosystems, the structure and biodiversity of ecosystems are critical components of natural capital. (Heymans, A., Bredsell, J., Morrison, G.M., Byrne, J.J. and Eon, C., 2019).

Box. B.11.

Some common benefits of green infrastructure

- Health and well-being: Increasing life expectancy and reducing health inequality; improving levels of physical activity and health; improving psychological health and mental well-being.
- Climate change: Heat amelioration; reducing flood risk; improving water quality; sustainable urban drainage; sustainable transport; improving air quality.
- Land regeneration: Regeneration of previously developed land; improving quality of the place; increasing environmental quality and aesthetics.
- Wildlife and habitats: Increasing habitat area; increasing populations of some protected species; increasing species movement.
- Economic growth and investments: Inward investments and job creation, land and property values; local economic regeneration.
- Stronger communities: Social interaction, inclusion, and cohesion; community engagement; education and participation; a sense of place; experiencing nature (Sturiale, L. and Scuderi, A., 2018).

Figure B.11. GI to manage stormwater flood risks



A: Dry Well B: Stormwater Planter C: Storm Drain D: Permeable Paving E: Rainwater Harvesting Cistern F: Green Roof

Source: <http://tomorrow.norwalkct.org>

A sustainable landscape is fundamental to ecosystem services continuity and, hence, the capacity of supporting to future generations is not undermined (Arnold, R.D. and Wade, J.P., 2015). Landscape connectivity, between habitat patches, wetlands, green space, natural elements, and different ecosystems is, therefore, essential for conservation and ecological flow (Parker, K., Head, L., Chisholm, L.A. and Feneley, N.A., 2015).

Figure B.12. Benefits of green infrastructures.

Benefit	Reduces Stormwater Runoff											Improves Community Livability				
	Reduces Water Treatment Needs	Improves Water Quality	Reduces Grey Infrastructure Needs	Reduces Flooding	Increases Available Water Supply	Increases Groundwater Recharge	Reduces Salt Use	Reduces Energy Use	Improves Air Quality	Reduces Atmospheric CO ₂	Reduces Urban Heat Island	Improves Aesthetics	Increases Recreational Opportunity	Reduces Noise Pollution	Improves Community Cohesion	Urban Agriculture
Practice																
Green Roofs	●	●	●	●	○	○	○	●	●	●	●	●	○	●	○	○
Tree Planting	●	●	●	●	○	○	○	●	●	●	●	●	●	●	○	○
Bioretention & Infiltration	●	●	●	●	○	○	○	●	●	●	●	●	●	●	○	○
Permeable Pavement	●	●	●	●	○	○	○	●	●	●	●	○	○	○	○	○
Water Harvesting	●	●	●	●	○	○	○	●	●	●	○	○	○	○	○	○

Yes
 Maybe
 No

Source: www.powerhousegrowers Image via CNT, American Rivers.

The green infrastructure (GI) concept emerged in 2006 and has since then expanded and integrated into urban planning and policy regime. For instance, the New York City Green Infrastructure Plan (Lindholm, G., 2017). GI has also been described as planned interconnected networks of green spaces for promoting ecosystem values and functions. The GI concept differs from the objectives of greenways for aesthetic and recreational purposes by focusing on ecology and the provision of ecosystem services in cities. GI also include rivers, wetlands and lakes and even the green roofs and green walls, etc. Multifunctionality is another key dimension of GI. However, many examples of GI referred to a single benefit, such as stormwater abatement, etc. It is important to note that poorly designed or managed GI can be a source of pollution and compromise urban biodiversity. For GI to continually provide ecosystem services, it requires the continuous intersection of knowledge, strategic support and stakeholder engagement.

In the urban areas, which represent demand areas for ecosystem services, GIs represents the goods and services provided to humankind by nature. GIs are among the best practices in local governance when combined with traditional grey infrastructure to achieve greater urban sustainability and resilience (Sturiale, L. and Scuderi, A., 2019).

Figure B.13. Schematic approach to develop GI plan involving communities



Source: Kramer, M., 2014. Enhancing sustainable communities with green infrastructure. Office of Sustainable Communities, US Environmental Protection Agency.

Learning objectives	Sessions & methodology
<ul style="list-style-type: none"> To define green infrastructure, its typology and ecosystem services To enumerate the benefits of GI in urban development To strategize GI integration into urban planning for adaptive and resilient development 	<ul style="list-style-type: none"> One session Lecture and PowerPoint presentation Question-answer sessions Discussion Case study presentation Group exercises
Enabling unit(s)	
<ul style="list-style-type: none"> Understanding and promoting green infrastructure for adaptation and resilience in urban development 	
Guidance	Recommended readings
<ul style="list-style-type: none"> Description of the concept and value of GI with their types and allied components may be discussed with real examples Short films can be shown to illustrate GI benefits May include a brief exercise on mapping stakeholders' motivation and participatory planning 	<ul style="list-style-type: none"> Gupta, A.K., Singh, S., Katyal, S., Chopde, S., Wajih, S.A., Kumar, A., (2016). Training Manual on Climate Resilient and Disaster Safe Development - Process Framework, NIDM, New Delhi (India), GEAG, Gorakhpur (UP, India) and ISET, Colorado (USA), supported by CDKN, UK. September 2016). Gupta, A.K., Singh, S., Wajih, S.A., Mani, N., Singh, A.K. (2017). Urban Resilience and Sustainability through Peri-Urban Ecosystems: Integrating Climate Change Adaptation and Disaster Risk Reduction, Gorakhpur Environmental Action Group, Gorakhpur (U.P.) India. Gupta A.K., S. Gotmore, U. D. Nair and Saurabh Kumar (2019). Green Growth Benefits for Climate and Disaster Resilience. GGGI and NIDM. P22.

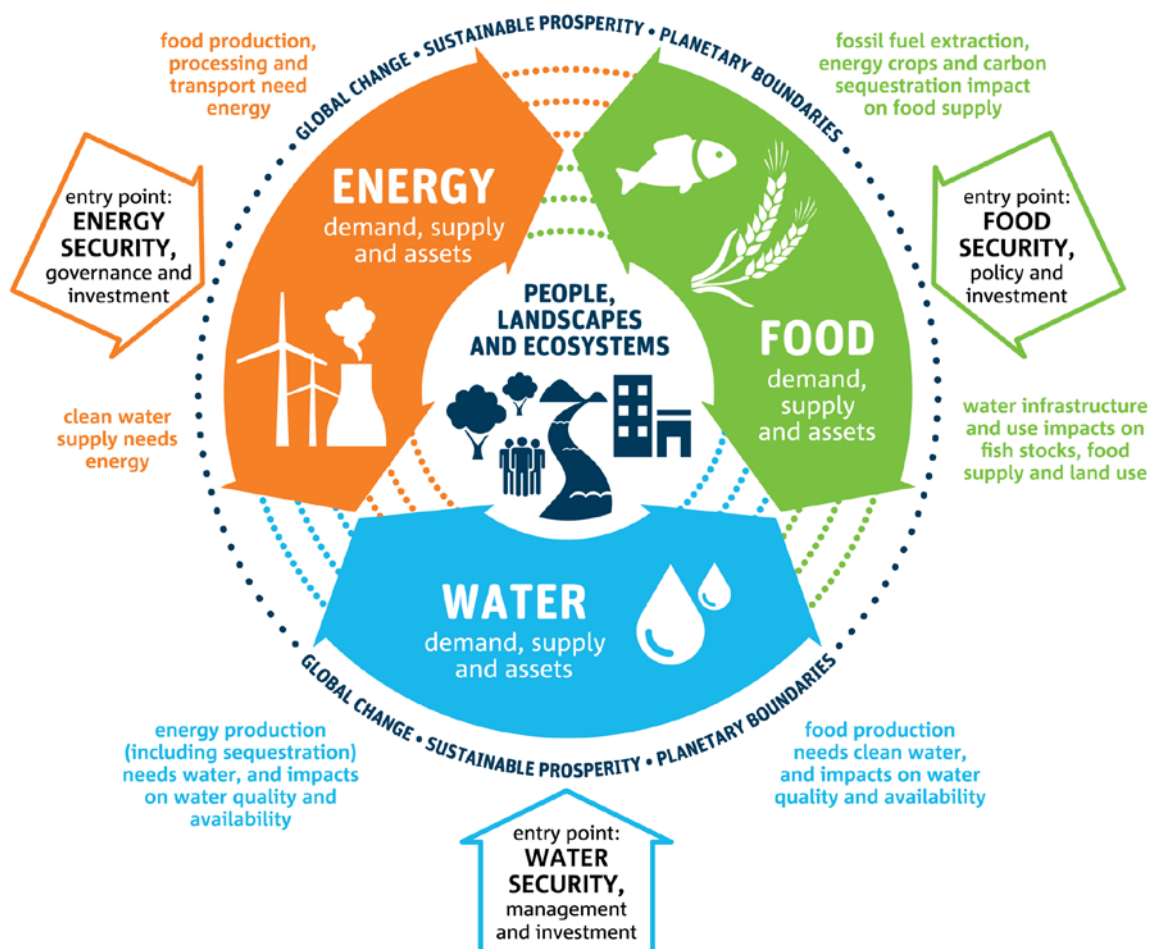
LEARNING UNIT B.2:

WATER–FOOD–ENERGY NEXUS AND THE ROLE OF ECOSYSTEM SERVICES

Context

In view of the current fast pace of urbanization and climate change, sustainable use and supply of natural resources have become important and complex (Hoff 2011; Childers et al. 2015). Cities represent dense, large conglomeration with increasing demands for services and goods (Hoff 2011) under the prevailing set of water–energy–food (WEF) nexus.

Figure B.21. Water-energy-food Nexus

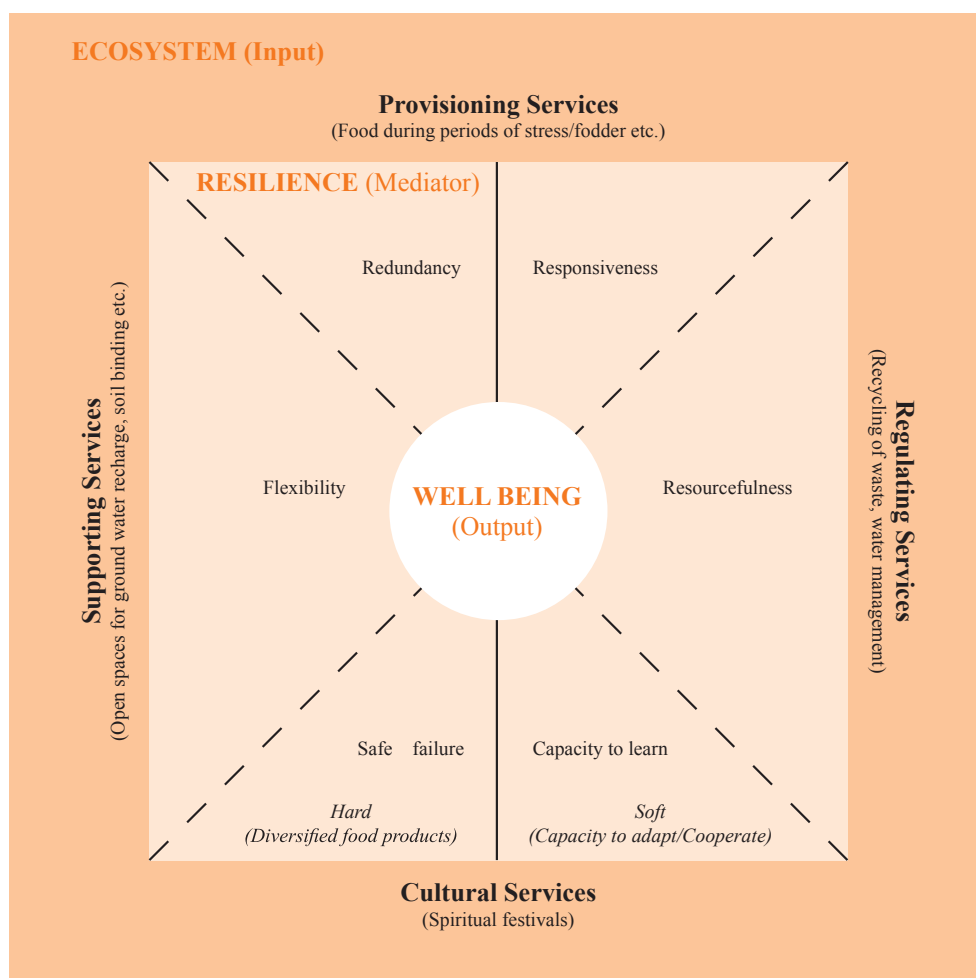


Source: <https://planning.unc.edu>

Global climate change poses critical challenges of temperature rise, melting glaciers, changing wind and precipitation for water, energy, and food as well as the ecosystem processes. Ecosystem services provide life support, goods, and natural resources from water, energy, and food, as well as the environment. However, linkages of drivers of climate change with water-energy-food nexus is a poorly researched area.

Water infrastructure is commonly important for water, energy and food security. This nexus has led to new demands for water infrastructure and technology solutions. This includes engineered structures such as dams, reservoirs, canals and irrigation systems, as well as ecosystems and watersheds that act as natural infrastructure. The latter includes mangroves that buffer against severe storms, floodplains that absorb floodwaters, and forests that stabilize soils, lakes and wetlands that clean and store water. If these natural infrastructures are healthy and well-functioning, it supports built infrastructure to protect, store, clean and deliver water to varied sectors.

Figure B.22. Depiction of ecosystem services benefits in urban system

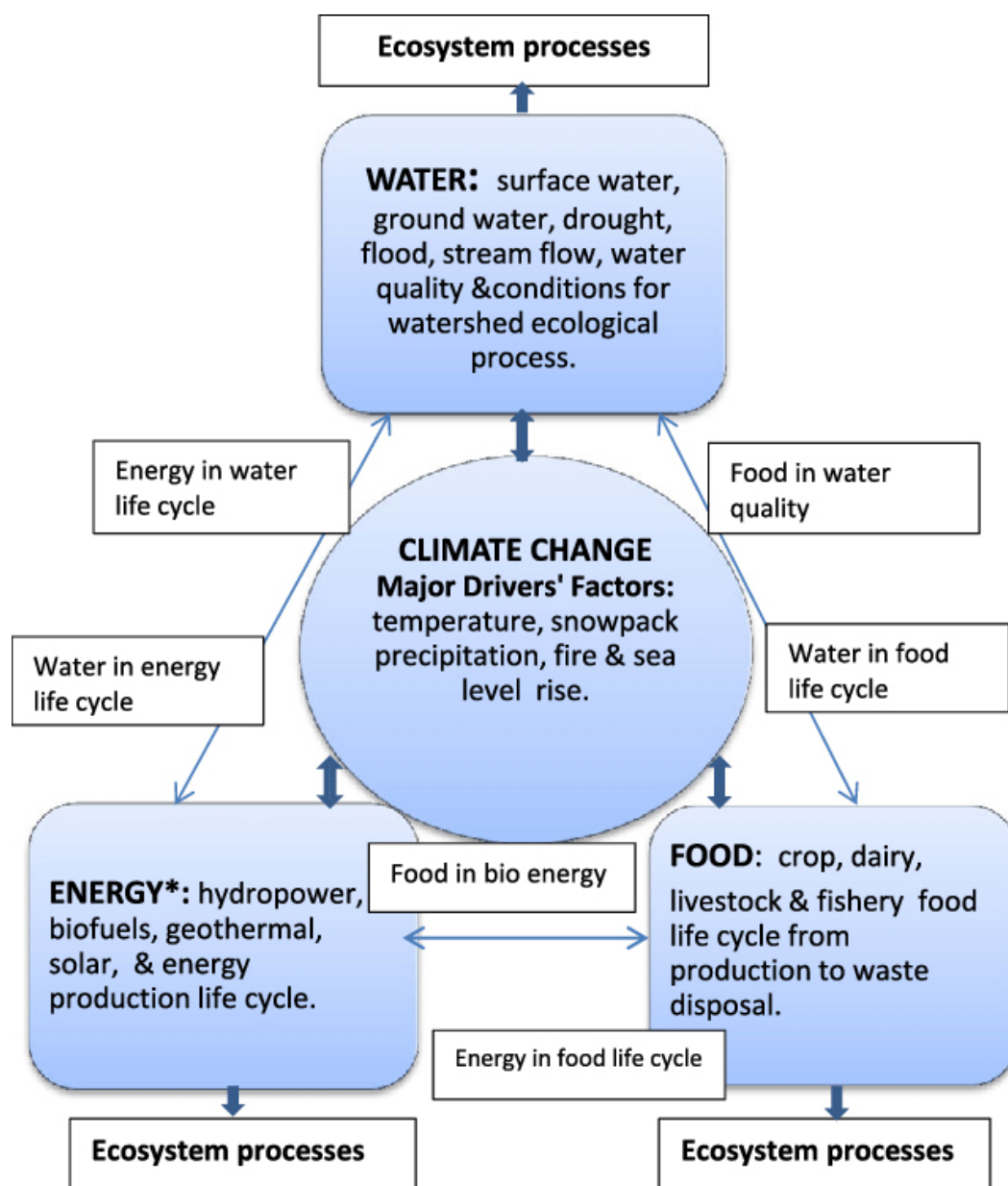


Source: Mitra, A., Wajih, S. and Singh, V. (2015). Wheezing ecosystems, livelihood services and climate change resilience in Uttar Pradesh. Working Paper No. 15. IIED, Rockefeller Foundation, GEAG, ACCRN.

Challenges in food, water and energy sectors are interwoven with watersheds. To add to it, the regional integration of upstream and downstream watershed ecosystems is critical for food, water, and energy security (Rasul 2014). Despite this, the focus remains on one sector at a time (e.g., energy) without accounting the effect of sectoral policies or interventions on other sectors (e.g., water). Water is a critical input for agricultural production and associated value chains. It is also necessary for the production of energy. This relationship is guided by distinct sectoral requirements for different forms of energy.

Ecosystems, such as forests, wetlands and grasslands, are at the heart of the global water cycle. The degradation of these ecosystems is a multidimensional issue. Climate change plays an important role, together with natural hazards, conflicts and the unsustainable management of natural resources. Disruptions to ecosystems, for example through the unsustainable harvesting of wood fuel resources, will consequently impact the local availability of water.

Figure B.23. Interdependence of urban water, food and energy dynamics on ecosystem processes and services.



In essence, urban and peri-urban ecosystems offer a natural infrastructure support system for enabling water-food-energy nexus towards urban system adaptation and resilience against climate and related disaster risks. In the conventional planning process, networks of protected areas, green spaces and their importance for human wellbeing are well acknowledged. But the value of farmland preservation is largely ignored in urban management strategies.

Learning objectives		Session(s) & methodology	
<ul style="list-style-type: none"> To characterize water-food-energy nexus in an urban context To delineate urban and peri-urban ecosystems supporting the nexus, and To suggest planning measures for ecosystem-based nexus management for resilient urban development 		<ul style="list-style-type: none"> One session PowerPoint presentation. Group exercise Question and answer Discussion 	
Enabling unit(s)		<ul style="list-style-type: none"> Role of urban water-food-energy nexus and its management through ecosystem services towards resilience building 	
Guidance		Recommended readings	
<ul style="list-style-type: none"> To develop a scenario based on input-output relations of water-food-energy nexus involving the participants Case study of good planning and/or bad planning, with an example of ULBs under risk or that faced hydro-meteorological disasters in recent past, may be discussed 		<ul style="list-style-type: none"> Gupta, A.K., Singh, S., Katyal, S., Chopde, S., Wajih, S.A., Kumar, A., (2016). Training Manual on Climate Resilient and Disaster Safe Development - Process Framework, NIDM, New Delhi (India), GEAG, Gorakhpur (UP, India) and ISET, Colorado (USA), supported by CDKN, UK. September 2016, Available at <https://geagindia.org/sites/default/files/2018-07/7.-CLIMATE-RESILIENT-AND-DISASTER-SAFE-DEVELOPMENT-PROCESS-FRAMEWORK_0.pdf> [Accessed on April 23, 2020] Gupta, A.K., Singh, S., Wajih, S.A., Mani, N., Singh, A.K. (2017). Urban Resilience and Sustainability through Peri-Urban Ecosystems: Integrating Climate Change Adaptation and Disaster Risk Reduction, Gorakhpur Environmental Action Group, Gorakhpur (U.P.) India. Available at <https://geagindia.org/sites/default/files/2018-08/26.-TRAINING-HANDBOOK---URBAN-RESILIENCE-AND-SUSTAINABILITY.pdf> How to Make Cities More Resilient: A Handbook for Local Government Leaders, March 2012, UNISDR, Available at <https://www.unisdr.org/files/26462_handbookfinalonlineversion.pdf> [Accessed on April 23, 2020] 	

LEARNING UNIT B.3:

PERI-URBAN AGRICULTURE – THE LAND-USE: ROLE IN URBAN AND PERI-URBAN SUSTAINABILITY

Context

India lives in its villages, but the nation's population is moving towards urban. In 2018, nearly 40% of Indians lived in cities. More importantly, the urban population proportion is expected to rise to 60% by 2025 (Brockerhoff, 2000). Demographic and economic expansion of cities, through processes such as migration, businesses and industrialization, is accompanied by spatial expansion and encroachments by cities upon adjoining peri-urban areas. Areas that were earlier distant from a city begin to come within the city's influence area. Urban food needs are expected, explicitly or implicitly, to be fulfilled by production in rural areas and, hence, the emphasis remains on rural agriculture.

Role of urban and peri-urban agriculture- as a major source of produce, means of improving food security and enhancing the livelihoods of poor producers- is becoming increasingly important (Bakker et al., 2000). Pressures on urban, peri-urban and rural water and agricultural systems are becoming increasingly complex with multiple stresses and impacts. As a way of addressing these issues, there has been a growing consideration to build and manage resilience in these complex social-ecological systems. Use of recycled water in peri-urban agriculture has emerged as an important approach for adaptive water management.

Box. B.31.

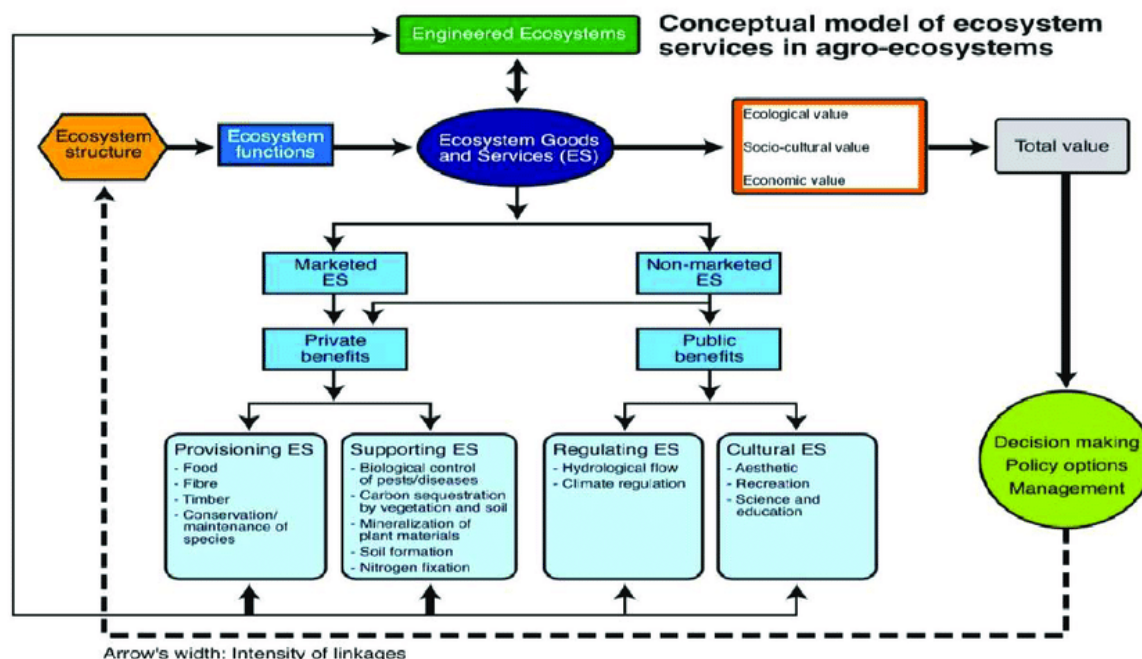
Distinctions of peri-urban agriculture

Agriculture in urban and peri-urban areas may include a wide range of activities such as fisheries, poultry and goat rearing, horticulture, floriculture, dairy farming, cattle farming and arable farming. The prominent characteristic of peri-urban area includes a concentration of poor people from inner-city, rural migrants and/or marginal local farmers. Urban fringe areas in Asia, for instance, are characterized by densely populated intensive smallholder agriculture. A forest, wildlife or bird habitat or ecotourism site can also be found in the peri-urban agro-ecosystem.

As these areas have reasonably well-developed transportation, access to city markets, cheap migrant labour force and qualified urban professionals, peri-urban areas are valuable locations for several industries and businesses. However, natural resources in these areas exhibit complex pressures from the use of land for, clay pits, quarries, sewage-disposal tanks and garbage dumps. This poses livelihood challenges for the poor inhabiting rural-urban fringes.

Urbanization and industrialization affect agriculture in the peri-urban areas as it leads to land-use changes. Cultivation practices change the agriculture land-use. Access to urban ready markets for agriculture produce and seasonal labour opens up the possibility of commercially cultivating high-value, perishable crops such as leafy vegetables, replacing storable crops such as cereals and pulses. Industries and their derivative trade and commerce activities offer new labour opportunities for cultivators and agricultural labourers, leading to a change in occupational structures. (Telintelo, D., Marshall and Bhupal, S, 2002).

Figure B.31. Ecosystem services in agricultural landscape



Source: Sandhu and Wratten, 2013.

Learning objectives	Session(s) & methodology
<ul style="list-style-type: none"> To define urban and peri-urban agriculture and its descriptions To examine the ecosystem services of peri-urban agriculture and associated interventions To understand the benefits of peri-urban agro-ecosystems for resilience and sustainability of city systems 	<ul style="list-style-type: none"> One session Short film show PowerPoint presentation Lecture and discussion Question and answer
Enabling unit(s)	
<ul style="list-style-type: none"> Peri-urban and urban agro-ecosystems and their ecosystem values for urban resilience and sustainability 	
Guidance	Recommended readings
<ul style="list-style-type: none"> Small films or videos and pictorial presentation (with glimpses from the field) would help the participants understand the characteristics of peri-urban agro-ecosystems Real-life examples of the benefits of urban and peri-urban ecosystems would be useful Discussion on integration with urban planning may be included in the session 	<ul style="list-style-type: none"> Gupta, A.K., Singh, S., Katyal, S., Chopde, S., Wajih, S.A., Kumar, A., (2016). Training Manual on Climate Resilient and Disaster Safe Development - Process Framework, NIDM, New Delhi (India), GEAG, Gorakhpur (UP, India) and ISET, Colorado (USA), supported by CDKN, UK. September 2016). Gupta, A.K., S.A. Wajih, N.Mani, S. Katyal. 2017. Vulnerabilities of Urban Poor Children and Urban/Peri-urban Ecosystem-Based Resilience (Policy Paper). GEAG Gorakhpur, UP and UNICEF India. Gupta, A.K., Mani, N., Sarkar, B.B., Singh, S., Katyal, S. (2019). Developing Disaster Risk Resilient Cities. Gorakhpur Environmental Action Group (GEAG), Gorakhpur (UP), National Institute of Disaster Management, New Delhi, India and United Nations Children's Fund (UNICEF), India. September 2019. Pages 72.

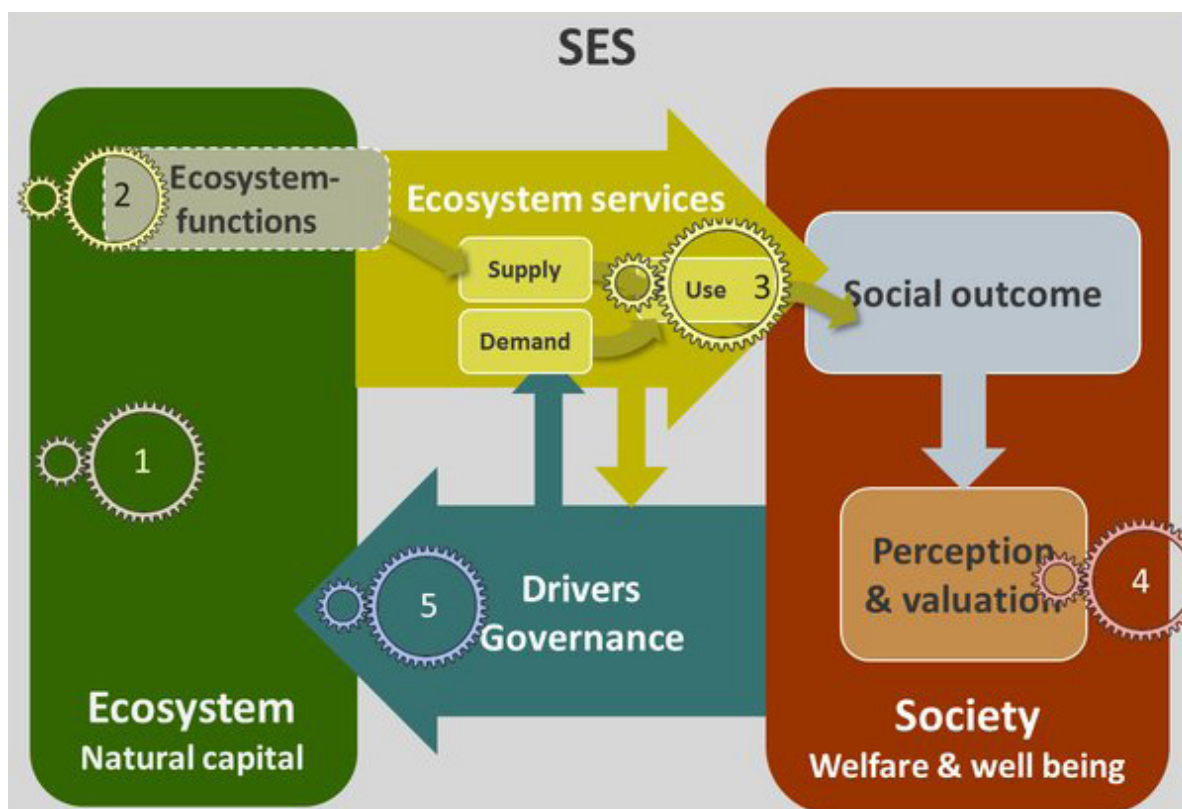
LEARNING UNIT B.4:

ECO-DRR FOR GENDER JUSTICE, CHILD CARE, GERIATRIC AND PSYCHO-SOCIAL HEALTH

Context

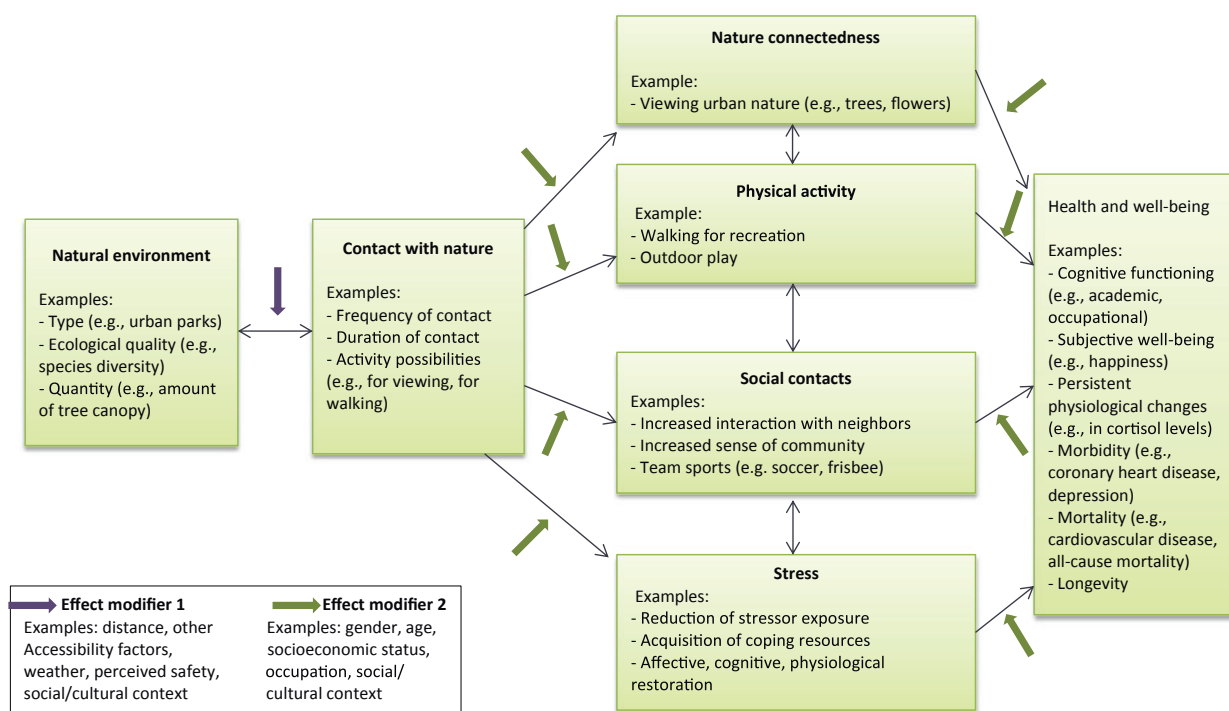
Social health and social vulnerability are important dimensions of human development. Concerns of women, children, elderly people, and psychological – mental health patients are critical to people's risk mitigation and adaptation capacity towards enabling a resilient society. These aspects are even more important to care during and in the aftermath of any disasters or crises. Stress is a common factor in urban life, affecting an individual's well-being and professional performance that, in turn, affects a community's or a system's resilience.

Figure B.41. Social-ecological-system (SES), including ecosystems and society. Both systems are connected by two flows. Ecosystem services generating benefits for society; drivers & governance changing ecosystems. Five 'biodiversity control buttons' influence the SES: (1) total stock of biodiversity generating resilient ecosystems; (2) specific functions & structures regulating ecosystem service supply; (3) biodiversity directly used or harvested; (4) biodiversity valued by society; (5) biodiversity strategy changing human impact. (Schneiders, A. and Muller, F. (2018).



Urban and peri-urban ecosystem services have a significant contribution to human wellbeing. Indeed, ecosystem services in such contexts are often associated with monetary values while their social values and underlying social benefits remain underreported (Schmidta, K., Sachsea, R. and Ariane, W., 2016). The monetary valuation of ecosystem services often referred to as economic valuation, is essentially inadequate due to methodological constraints and uncertainties. Not all services provided by ecological systems are marketable goods with a monetary value. Human well-being is enabled by access to basic materials, food and shelter which are required to sustain life and maintain personal health, healthy social relations and freedom of choice (MA, 2003).

Figure B.42. Functional relationships between (peri-)urban natural environment's cultural ecosystem services and human health (Hartig et al., 2014).



Urban lifestyle is typically associated with low physical activity and sometimes with high mental stress, both contributing to an increasing burden of diseases. Nature-based solutions that make effective use of ecosystem services, particularly of cultural ecosystem services (CES), can provide vital building blocks to address these challenges. People with special needs associated with their gender, age, health or economic conditions in urban and peri-urban areas have to face different challenges due to high pace of occupational and business activities and need to adjust with the fast life of their family members in urban settings. Ecosystem in their surroundings and areas in many forms can be of great value to heal their sufferings and thus, help reduce their vulnerability as well. This is an important area of further research to find out prudent case studies and to supersede the social benefits of ecosystems over purely monetary-valued benefits.

Figure B.43. Gender and ecosystem services (Brown, K. and Fortnam, M., 2018).

Approach	Assertions	Implications for gender and ecosystem services
• Eco-feminism	• Women have greater inherent connection to nature – it makes essentialist and (almost) universal arguments	• Women are more directly dependent on ecosystem services than men; women recognise and value ecosystem services, and are more affected by changes in flows of ecosystem services than men
• Gender and development	• Women and men have different roles and responsibilities, and this results in gendered divisions of labour	• Women's relationships with services are predicated on their roles and responsibilities in terms of provision of food, fuel, water and care for children and the elderly
• Household bargaining	• Within households, different members have different power in negotiating strategies and roles	• Decision making on the allocation of household resources, including labour, reflects men's priorities – for example, in the adoption of new technology for land and water management
• Feminist political ecology	• Gender dimensions of relations with the environment are shaped by gendered knowledge; rights and responsibilities; politics and grassroots action. Gender intersects with different axes of identity (e.g. class, caste, race, age)	• Ecosystem services are gendered because of the social and political relations of access, ownership and control. The relationship between individuals and ecosystems is shaped by their distinct identities, part of which is gender.
• Natural resources management	• Women's participation in decision making and collective action is limited; women have different interests and motives compared to men	• Women are more motivated by social than private benefits than men, emphasising security over profit and perhaps subsistence over cash benefits from ecosystem services

Learning objectives	Session(s) & methodology
<ul style="list-style-type: none"> • To state the challenges of socially vulnerable sections of society in urban and more particularly in urban settings • To enumerate the ecosystem-based disaster risk reduction benefits, concerning vulnerable people, especially women, aged, children and in terms of health and psychological benefits • To delineate a process framework for integrating the benefits of peri-urban ecosystems in reducing social vulnerability for improving resilience against climatic and disaster risk in an urban environment 	<ul style="list-style-type: none"> • One session • PowerPoint presentation • Case study examples • Lecture and discussion • Question and answer
Enabling unit(s)	
<ul style="list-style-type: none"> • Understanding ecosystem benefits in disaster risk reduction through social vulnerability reduction concerning women, children, aged and psycho-social health 	
Guidance	Recommended readings
<ul style="list-style-type: none"> • Case study-based illustrations would be important to include in the lecture and presentations • Short visit to a site showing such benefits would be of added value • Short film show may be included showing ecosystem values towards social vulnerability reduction 	<ul style="list-style-type: none"> • Guiding Documents, UNISDR, Making Cities Resilient, My City is Getting Ready at www.unisdr.org/campaign/resilientcities/home/toolkitblkitem/?id=1 • Gupta, A.K., S.A. Wajih, N.Mani, S. Katyal. 2017. Vulnerabilities of Urban Poor Children and Urban/Peri-urban Ecosystem Based Resilience (Policy Paper). GEAG Gorakhpur, UP and UNICEF India. • Gupta, A.K., S. Wajih, N. Mani, S. Singh, B. Kumar. 2018. Child Health Vulnerability in Bihar (India) with Reference to Climatic Risks (Policy Brief). GEAG Gorakhpur, UP and UNICEF India.

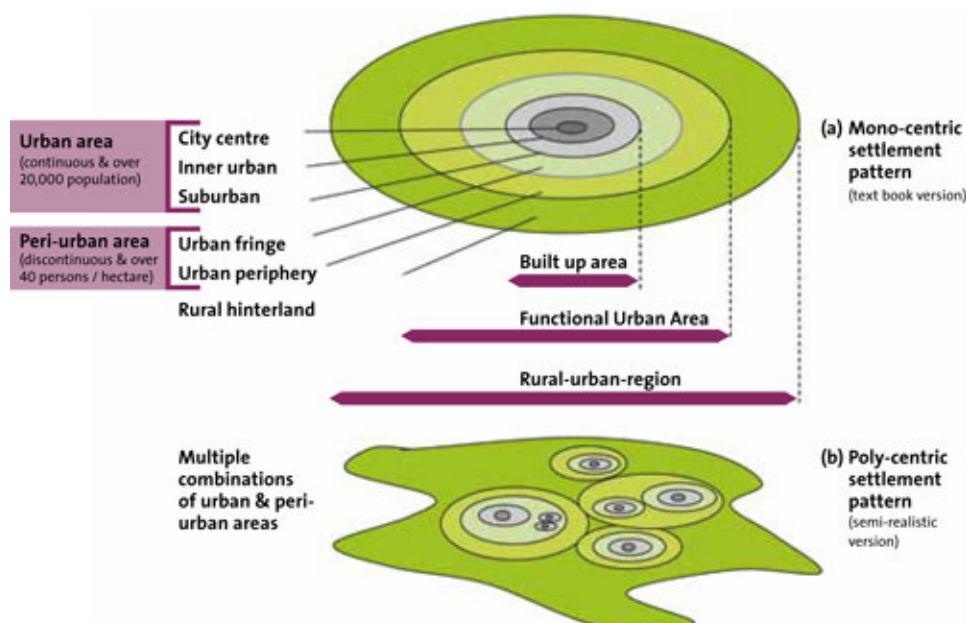
TRAINING MODULE

UNDERSTANDING AND APPRECIATING PERI-URBAN ECOSYSTEMS (FIELD VISIT)

Background

Peri-urban is neither geographically nor conceptually well defined. Generally, these are considered as transitional zones from rural to urban region (Dutta, 2011; GEAG, 2015), encompassing characteristics of both regions. Located between the outer limits of urban and regional centres, peri-urban is the fastest-growing region in the world. The outward expansion of cities, changes in land use pattern & landscapes and occupations have transformed the rural hinterland into semi-urban areas. The dynamic nature of the peri-urban ecosystem is the key feature, wherein, social forms and arrangements are created, modified and discarded (Laquinta and Drescher, 2000).

Figure C.01. An emerging trend of peri-urban sprawl in Europe



Source: Piorr et al., 2011

A new kind of space dynamism of urban-peri-urban land-use is emerging in Europe. The peri-urban contains the urban fringe and urban periphery and is located in between the urban and rural areas. In this in-between-space, major demographic, economic and land-use shifts occur, presenting the urban regions with several challenges of sprawl, air- and spatial quality and accessibility (Piorr et al., 2011). In France and Europe, peri-urban forests are subject to high social demands for recreational purposes. These demands form avenues for frequent visits of people for sports or rest. Local governments have succeeded in creating new wooded parks close to cities that are highly appreciated by the people and tourists. New approaches targeting health and peace benefits may also be observed on the part of both individuals level and at the health sector level. These new approaches indicate the existence of a wellness function in peri-urban forests.

In India, peri-urbanization is creating severe problems in terms of infrastructure delivery resulting in perpetuity of physically underdeveloped peri-urban areas. In comparison to the enormous growth and environmental stress these peri-urban areas absorb, by virtue of their spatial adjacency to city proper, their conditions are dismal. There is a lack of identity and proper planning and management across all sectors of governance, finance and infrastructure delivery that pertains to peri-urban areas, and more particularly the ecosystems. Furthermore, these peri-urban areas are often occupied largely by low-income families and are typified by several illegal settlements and slums. Also, peri-urban areas are poorly served by urban infrastructure and experience worse hygiene and sanitation conditions.

However, peri-urban areas also have huge potential as they will be the future urban areas. This situation calls for an in-depth understanding of the challenges and opportunities these peri-urban areas harbour as well as possible areas of innovation required to transform the urban fringe into self-sustainable peri-urban areas. A summary of issues, challenges and opportunities based strategic framework is suggested in Table C.01.

Table C.01. Strategic framework for planning and innovation in peri-urban sustainable development

	Challenges	Opportunities	Innovation
Infrastructure	<ul style="list-style-type: none"> • Incrementality • Maintainability • Poor connectivity of all social & physical infrastructure • Poor quality of housing 	<ul style="list-style-type: none"> • Availability of land • Availability of natural resources • Integrated planing 	<ul style="list-style-type: none"> • Growth containment strategy • Land information systems • Technology enhancement like - Solar roadways
Energy	<ul style="list-style-type: none"> • Poor quality of electricity • Increasing system of energy distribution • Poor systems of energy distribution • High generalized cost of transport 	<ul style="list-style-type: none"> • Energy efficient buildings • Energy efficient transport • Energy efficient planning • Energy management 	<ul style="list-style-type: none"> • Renewable • Distributed micro-grids • Hybrid power system • Energy from waste - biomass
Social conditions	<ul style="list-style-type: none"> • Sudden socio-economic change • Lack of sense of ownership/ participation • Lack of adequate employment opportunities 	<ul style="list-style-type: none"> • Local participation • Availability of human resources • Opportunity to provide skills training 	<ul style="list-style-type: none"> • Livelihood opportunity • Peri-urban commons • Inclusive planning/ participatory
Governance & Management	<ul style="list-style-type: none"> • Defining peri-urban areas • More political will for development • Increasing problem of security 	<ul style="list-style-type: none"> • Parameterization of peri-urban areas • Data creation: land database • Transparency of land transactions and allocation of resources • Public participation 	<ul style="list-style-type: none"> • enhancing local economy with more linkages with urban core • Technical capacity building of local body

	Challenges	Opportunities	Innovation
Environment	<ul style="list-style-type: none"> • Degradation of natural assets • Solid waste disposal and management • Ground water contamination • Ecosystem threats • Urban heat islands • Air pollution • Degrading quality of life 	<ul style="list-style-type: none"> • Less local SW generation • Rain water harvesting • Use of non-degradable material • Policies to reward and penalize citizen in order to safeguard the environment • carbon trading • Air quality improvement 	<ul style="list-style-type: none"> • Reduce/reuse SW • Creating baseline status of environment resources • Monitoring of resources • Public participation of SW management • Technologies develop renewable and green energy • Improvement of air quality

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 the loss of ecosystem services that support urban and peri-urban populations, including:



Water provision:

This is often the most important service lost, as pollution of rivers and lakes destroys accessible sources of surface water. Dumping of sewage and solid/liquid waste in peri-urban areas contaminates the groundwater, leading to the spread of many diseases. Population growth increases the 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 compound 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.



Fuelwood and timber:

Deforestation removes a source of fuelwood and timber that nearby farmers depend upon.

Managing the environment of this interface is pertinent in the present context because various ecosystem services provided by these transition zones have a significant impact on the sustainability of both urban and rural development. Thus, it becomes important to understand the demographic trends, socio-economic change, ongoing process of urbanization, expected climate change, impact on natural resources and livelihoods in these transition zones. New multi-level and collaborative governance systems are required to manage the resilience of these ecotones.

Inhabitants of these peri-urban ecosystems are vulnerable and increasingly threatened by the deteriorating quality of the ecosystem leading to resource scarcity and a host of problems that very often have no solution in the short run. Poor are disproportionately affected by the loss of peri-urban ecosystem due to their propensity to live in peri-urban areas, high ecosystem dependence and the economic impacts of land-use changes. 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 as there are no alternatives, and the loss of their only 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. Hence, destruction of peri-urban ecosystems has a disproportionate impact on women, as they are less likely to have an alternative source of food, nutrition or income.

Given the above discussion, experiencing and appreciation of peri-urban ecosystem is thus, the first step in responding to the challenges and opportunities of peri-urban ecosystems.

Training Module

This training module is planned to give a field exposure to the participants through a field visit to the peri-urban area facilitated by trainers and coordinators. It is better to schedule the field visit at the near end of the module as a touristic outing to allow participants to better connect module learnings with field experiences.

While planning the visit, the trainer needs to assess the feasibility of the visit. Objectives of the field visit need to be well-defined in advance. The field visit can be carried out at any place relevant to this module and in places where appropriate field visit sites are available. Following criteria must be followed in choosing a field visit site:

- The site selected must be relevant for the module contents and previous experience of participants.
- The focus should be on learning of new concepts and methodologies.
- The logistical feasibility like distance, accessibility, security and cost etc.

A proposed field visit with methodology and learning objectives is provided below. Likewise, other types of field visits may be carried out as per the place/ region where the course will be administered. Field visit to a peri-urban area shall be conducted to enable the participants to better understand the dynamics of peri-urban ecosystems and the ecosystem's role in urban resilience.

Field-visit methodology

- A well-planned preparation of logistics and participants is required before the field visit. The resource persons, communities and other stakeholders who will be consulted during the visit should be informed before the visit so that they can understand the purpose of visit and help to achieve the goal of this visit.
- The trainer should give an introduction of the site to be visited. The discussion should mention the objectives of the field visit followed by a question and answer session to satisfy the queries of participants.
- Participants will be divided into groups with tasks assigned on different aspects, to cover multiple dimensions of peri-urban ecosystems. For example, a group may be assigned the task to interact with the community members living along the site.
- Transect walk should be carried out across the peri-urban site to identify and explain the relationships among peri-urban area- its natural vegetation, cultivation, human activities and settlement pattern- and understand the various ecosystem services provided by the peri-urban site. It will help to understand the natural

resources, current land-use pattern, vegetation, changes in the physical features and cropping systems, social differentiation and mobility in urban and rural communities living in and around the site.

- The trainers should facilitate the participants to understand how unsustainable land use planning and changing landscapes degrade the natural infrastructure.
- A field survey will help to understand the perception of communities living in peri-urban site- their linkages to ecosystem services provided by the peri-urban site and disasters faced by them. This will also give knowledge about CBDRR where communities are involved in the sustainable management of natural resources and trying to adapt to climate change to improve livelihood resilience.
- The participants will prepare brief reports after returning from field visit and deliver a PowerPoint presentation on the next day for cross-learning purposes.

There are 4 learning units under this module:

- LU- C.1.** Understanding peri-urban settings and ecosystems
- LU- C.2.** Peri-urban vulnerability and needs assessment
- LU- C.3.** Choices in adaptation and programmes
- LU- C.4.** Benefits of peri-urban ecosystems for resilience and sustainability



Training objectives

- Connect theoretical knowledge with ground reality and experiences
- Describe peri-urban ecosystems- concept, values, needs and impact assessment frameworks
- Analyse the vulnerability of peri-urban ecosystems due to natural and anthropogenic factors
- Analyse the benefits of peri-urban ecosystems for urban resilience and sustainability
- Discuss challenges, opportunities and options in adaptation and resilience of peri-urban ecosystems



Guidance

- The participants are requested to wear comfortable sports shoes during a transect walk.
- Ground rules and roles of participants & trainers, etc. to be communicated before the field visit
- Clear communication before site-visit on expected outcomes/ expectations from participants as well as faculty/ trainers and course director/ coordination team leader
- **Resource persons:** Field visit resources may include field guides with diverse areas of expertise. For example ecologists, conservationists, social experts and ornithologists etc. who are well aware of the present field visit site. These resource persons can guide the participants to understand the socio-ecological aspects in a better way.
- **Field survey:** A small survey questionnaire can be prepared before proceeding for the field visit so that participants can interact with communities living around and the officials present there. The resource team & the participants can interact with the communities in peri-urban area.
- Discussion of experiences on-site to examine values, risks identified by participants
- **Presentations:** The trainer should encourage participants to explore beyond the objectives of field visit and take photographs and/or videos so that presentations can become more effective.
- Discussion or comparative analysis of participant's expectations before field visit and experiences post-field visit.
- **Research proposals:** The participants should be encouraged to submit research proposals after coming back from the field visit so that the issues requiring further scientific research may come to limelight. They should develop a brief 'Statement of Purpose' and a 'Research Methodology' based on their observations.
- Identify priority action areas



Methodology

- Before the site visit
 - Lecture/PowerPoint presentation
 - Case study
 - Perception check questionnaire (or Q&A)
 - Group exercise to identify perceptions of peri-urban ecosystems
 - Logistics and preparation of participants is required before the field visit. The resource persons, communities and other stakeholders who will be consulted during the visit should be informed before the visit so that they can understand the purpose of the visit and help to achieve its goal.
- On-site
 - Primary survey- visual assessment, interviews with stakeholders
 - Documentation- audio/visual documentation, notes, sketches
- Post-site visit
 - Experience sharing: The participants will prepare brief reports after returning from field visit and deliver a PowerPoint presentation on the next day so that all participants can learn about all the objectives of this visit.
 - Comparative analysis of pre- and post-site visit understanding of peri-urban ecosystems
 - Discussion

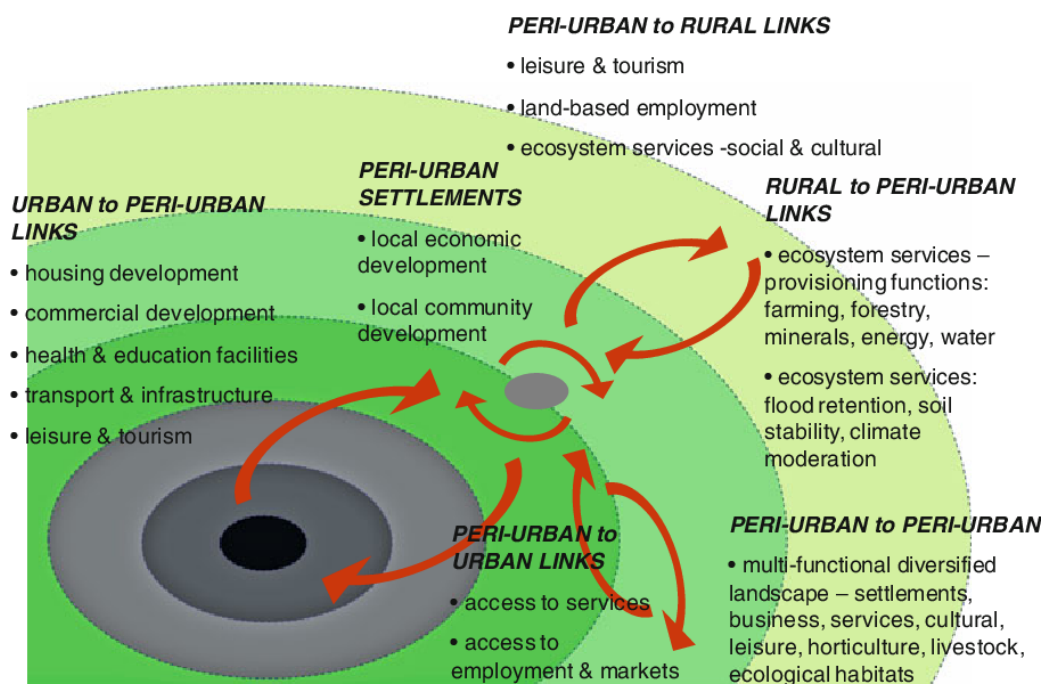
LEARNING UNIT C.1:

UNDERSTANDING PERI-URBAN SETTINGS AND ECOSYSTEMS

Context

Peri-urbanization is a dynamic process that changes the land use in the margins of growing cities and towns (large and small), often displaying a form, structure and interaction that is unique and geared to support the urban centre, across many sectors. The peri-urban area, due to its dynamic nature (Figure C.11) and setting at the urban-rural interface, has often fallen between the cracks of “rural” and “urban” development planning.

Figure C.11. Dynamics of Peri-urbanization



Source: Ravetz J., Fertner C., Nielsen T.S., 2013

Peri-urban ecosystem 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. Located between the outer limits of urban and regional centres and the rural environment; peri-urban ecosystem provides a range of services, such as water catchments, forestry, recreation, and productive farming, as well as offering a unique ambience and lifestyle (Narain et al, 2013; Mitra et al, 2015). They are considered important in the context of food security, water and energy security, economic security, market linkages and provide breathing space for recreational activities. Peri-urban agriculture also provides livelihood security and increases household income (Thornton, 2008), along with

supplying nutritious and healthy food to the city residents as well as vulnerable populations living in the area, and its role in terms of various ecosystem services are vital (Thornton, 2008; Mitra et al, 2015).

Considering water and sanitation in the peri-urban settings is critical since there are social, economic, environmental and institutional interactions between urban and rural areas captured in this interface. Many of the processes of change in urban-rural flows take place, leading both to problems and opportunities not only for peri-urban communities but also for the sustainability and resilient development in the adjacent rural and urban systems. The peri-urban interface often acts as an 'environmental sink' for liquid and solid waste from the denser urban core. Urban wastewater can be used for peri-urban irrigation as well as for peri-urban industrial cooling systems. Hence, a broad-based integrated water management intervention, which builds on these problems and opportunities, along the aspects of sanitation, waste management and appropriate linkages with the public health system is critical.

Understanding and appreciating peri-urban ecosystems are thus important for Indian cities and regions to maintain the health of the ecosystem and enhance the resilience of urban areas.

Learning objectives	Session(s) & methodology
<ul style="list-style-type: none"> Learn basic concepts of the peri-urban ecosystem, its setting, need and linkages to urban and rural systems Describe various ecosystem services of peri-urban ecosystem Discuss peri-urbanization, rural-urban ecotones and its challenges in the context of changing climate, environment and disasters Connect theoretical understanding with ground experiences 	<ul style="list-style-type: none"> One session PowerPoint presentation Case study examples Lecture and discussion Question and answer
Enabling unit(s)	
<ul style="list-style-type: none"> Dynamics of peri-urban ecosystems: Understanding the services, linkages, values and functions 	
Guidance	Recommended readings
<ul style="list-style-type: none"> Before site visit Presentation or lecture to include case study-based illustration of the concept, setting of peri-urban ecosystems as well as its value Short film show may be included to illustrate ecosystem values towards social, economic and environmental vulnerability reduction Site visit Experience and examine the benefits of the peri-urban ecosystem and threats to the ecosystem Post site visit Discussion on the setting of peri-urban ecosystems- values, linkages to surroundings as well as urban and rural, functions & services 	<ul style="list-style-type: none"> Bahadur, A., Tanner, T., & Pichon, F. (2016). <i>Enhancing Urban Climate Change Resilience: Seven Entry Points for Action</i>. Manila: Asian Development Bank. Gupta, A. K., Singh, S., Wajih, S. A., & Mani, N. (2017). <i>Urban Resilience and Sustainability through Peri-Urban Ecosystems</i>. New Delhi: GEAG, ICLEI South Asia, ACCCRN, NET, UNICEF, School of Planning and Architecture, New Delhi, Rockefeller Foundation. IUCN. (2013). <i>Eco-Disaster Risk Reduction</i>. Retrieved February 13, 2020, from IUCN: International Union for Conservation of Nature: https://www.iucn.org/commissions/commission-ecosystem-management/our-work/cems-thematic-groups/eco-disaster-risk-reduction Ravetz J., Fertner C., Nielsen T.S. (2013) The Dynamics of Peri-Urbanization. In: Nilsson K., Pauleit S., Bell S., Aalbers C., Sick Nielsen T. (eds) <i>Peri-urban futures: Scenarios and models for land-use change in Europe</i>. Springer, Berlin, Heidelberg

LEARNING UNIT C.2:

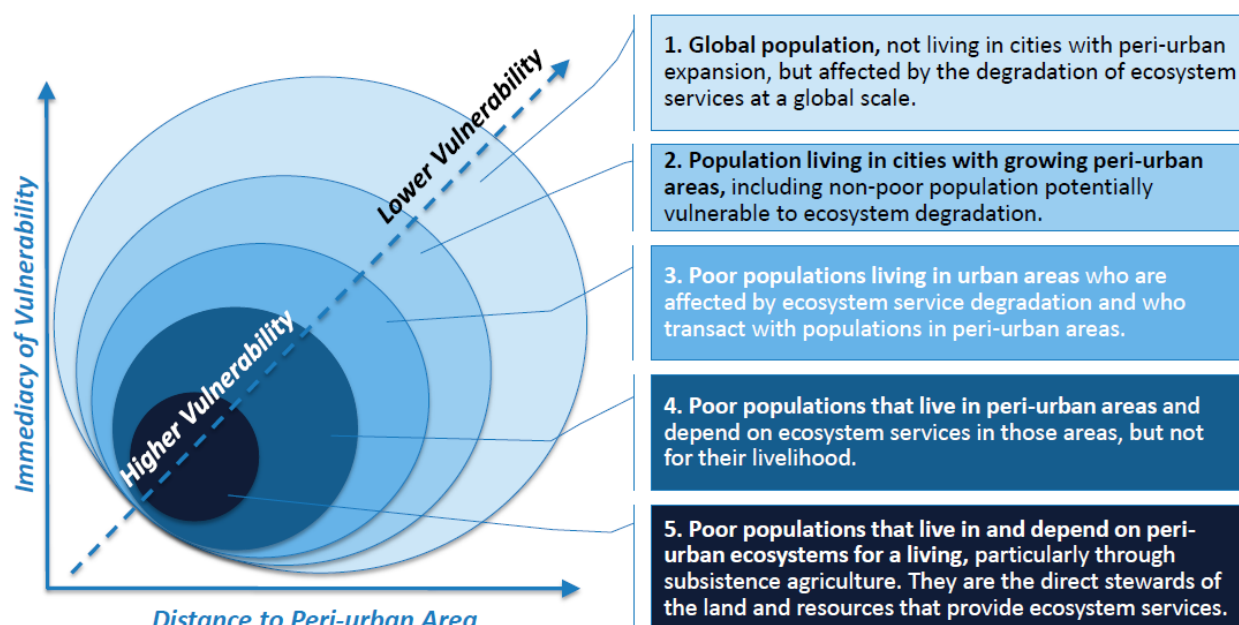
PERI-URBAN VULNERABILITY AND NEEDS ASSESSMENT

Context

Peri-urban areas are complex hybrid systems blending the essence of urban and rural communities. This peri-urban interface consists of highly heterogeneous and rapidly changing socio-economic groups. Thus, the needs and demands of local populations and producers for food, water and sanitation services are also quite diverse and change over time. The identification of these needs is more complex than in either urban or rural areas due to the particular mix of newcomers and long-established dwellers, and also because farming, residential and industrial land uses often coexist. Furthermore, an assessment of needs- livelihood activities, natural resources management and adaptation strategies- in peri-urban areas helps to highlight opportunities and challenges for enhancing marginalized people's adaptive capacity.

It is important to note that the impacts of unplanned or poorly planned urbanization coupled with extremes of climate change are not the same for all peri-urban residents (Figure C.00). The poor and marginalized sections like small farmers, labour class and women are disproportionately affected by the decline of the peri-urban ecosystem due to their propensity to live in peri-urban areas, high dependence on ecosystem services, and the economic impacts of land-use change.

Figure C.21: Relationship between immediacy of vulnerability and distance to peri-urban area



(Source: Rockefeller Foundation, 2013)

Mostly, the peri-urban areas tend to be occupied by low-income families and are typified by illegal settlements, slums and unorganized businesses. Also, peri-urban areas are poorly served by urban infrastructure, lack of municipal services and experience poor hygiene and sanitation conditions.

In India, rapid urbanization and growth of secondary cities combined with inadequate provision of basic services are increasing the vulnerabilities of populations living in peri-urban areas. 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.

To effectively reduce vulnerability of marginalized section of the society, holistic and inclusive response to changing climate, favourable institutional mechanisms, market connectivity, developing a package of practices for better agricultural activities etc. in the peri-urban region is a must to build resilient communities to withstand the range of shocks and stresses that they are exposed to.

This session can be discussed in detail by taking the case example of Vishakhapatnam city and its peri-urban crisis culminating from the coastal regulation zone (CRZ) violations or other such case studies.

Learning objectives	Session(s) & methodology
<ul style="list-style-type: none"> To identify vulnerable communities living on the city fringes To assess the needs of communities living in and/or dependent on peri-urban ecosystems To describe the impact of unplanned urbanization and changing climate on identified vulnerable communities To identify climate-resilient livelihood strategies for vulnerable communities To describe various capacity development and coping mechanisms which can support communities in their adaptation effort and/or mainstreamed into sustainable development 	<ul style="list-style-type: none"> PowerPoint presentation/lecture Discussion Case study Question-answer sessions Experience sharing
Enabling unit(s)	
<ul style="list-style-type: none"> Situational analysis of peri-urban ecosystems- needs assessment, vulnerabilities and action areas 	
Guidance	Recommended readings
<ul style="list-style-type: none"> It is important for trainers to explain and appreciate the concepts of diversification of livelihood and economy and how it can be used in climate change adaptation process and linkage with peri-urban ecosystems and urban resilience. Trainer may identify specific examples, and references from the case studies, for administration. Trainer may ask the participants to cite specific examples from participant's localities, concerning vulnerable groups in peri-urban settings and their proneness to disasters and climatic risks. 	<ul style="list-style-type: none"> Gupta, A. K., Singh, S., Wajih, S. A., & Mani, N. (2017). <i>Urban Resilience and Sustainability through Peri-Urban Ecosystems</i>. New Delhi: GEAG, ICLEI South Asia, ACCCRN. NET, UNICEF, School of Planning and Architecture, New Delhi, Rockefeller Foundation. Douglas, I. (2006). Peri-urban ecosystems and societies: transitional zones and contrasting values. In: McGregor, D., Simon, D. & Thompson, D. (eds) <i>The Periurban Interface: Approaches to Sustainable Natural and Human Resource Use</i>. Earthscan, VA, USA. Rockefeller Foundation (2013) <i>Decision Intelligence Document: Degradation and Loss of Peri-Urban Ecosystems</i>. Rockefeller Foundation, New York, United States

LEARNING UNIT C.3:

CHOICES IN ADAPTATION AND RESILIENCE

Context

Maintaining the health of the peri-urban ecosystem is crucial to developing the resilience of the urban and peri-urban regions. Changes in ecosystem services affect people living in urban areas both directly and indirectly. Unsustainable urban development threatens the very availability of key ecosystem services and hence, reduced their capacity to adapt and mitigate against natural hazards.

According to the Millennium Ecosystem Assessment Report, 2005, approximately 60% of the ecosystem services have been degraded or used unsustainably and protection from a natural hazard is one of those degraded services. One of the important findings of the report says that in the past 50 years humans have changed ecosystems more rapidly and extensively than in any comparable period of human history which has resulted into substantial and irreversible loss in the diversity of life on earth.

Building urban and peri-urban resilience and effective adaptation to natural hazards and climate extremes first and foremost requires a move away from current reactive approaches and toward the development and implementation of effective local planning and management systems to support a better quality of life.

One of the choices to adapt and improve the resilience of peri-urban ecosystems is the ecosystem-based disaster risk reduction approach. It refers to the use of natural environment or systems as a way to buffer the worst impact of changing climate, extreme weather events and related hydro-meteorological disasters. The basic objective of the approach is to maintain the resilience of natural ecosystems and their services to help communities to survive and cope up with the extreme events. In this approach, detailed analysis at a specific geographic region/rural-urban level is imperative to identify practical points where ecosystem-based interventions could build resilience as well as the capacity of the specific departments that might need to be involved in developing peri-urban regions.

The second choice emphasizes integrated management of land, water and living resources that promotes conservation and sustainable use, providing the basis for maintaining ecosystem services, including those that contribute to adaptation and resilience to climate and disaster risks. Agriculture, for example, practised within urban boundaries contributes to food security, healthy land and the soil is the source of livelihood particularly to vulnerable groups, wetlands in the urban vicinity absorbs extra water and buffers flood, urban parks and open spaces provide recreational and aesthetic values to city dwellers etc. are few services that peri-urban regions provide for the well-being of humankind.

Sendai Framework for Action (SFDRR), Sustainable Development Goals as well as Paris Climate Agreement has emphasized building resilience by protecting natural ecosystems. The framework to understand community vulnerabilities and promote resilience and adaptation in peri-urban regions has four inter-related action areas:

1. Promotion of climate-resilient livelihoods strategies in combination with income diversification and capacity building for planning and improved risk management;
2. Disaster risk reduction strategies to reduce the impact of hazards, particularly on vulnerable households and individuals;
3. Capacity development for local civil society and governmental institutions so that they can provide better support to communities, households and individuals in their adaptation efforts; and
4. Advocacy and social mobilization to address the underlying causes of vulnerability, such as poor governance, lack of control over resources, or limited access to basic services

This session can be discussed in detail with the case example of Gorakhpur city and its circular economy approach toward urban resilience, or other such case studies.

Learning objectives	Session(s) & methodology
<ul style="list-style-type: none"> • Understanding the importance of peri-urban ecosystems in adaptation and resilience to climate change and disaster risks • Learn impacts of unplanned growth, changing land uses and landscapes on peri-urban regions • Identify various ecosystem services of the peri-urban ecosystem which helps in natural mitigation, adaptation and resilience • Learn and evaluate different ecosystem-based choices and/or options to increase resilience and adaptation of peri-urban ecosystems 	<ul style="list-style-type: none"> • One session • PowerPoint presentation • Short film or poster exhibit • Case study examples • Lecture and discussion • Question and answer
Enabling unit(s)	
<ul style="list-style-type: none"> • Alternatives and innovations promoting adaptation and resilience of peri-urban ecosystems 	
Guidance	Recommended readings
<ul style="list-style-type: none"> • This session is intended to introduce to participants the critical role of peri-urban ecosystems in mitigation, adaptation and resilience • Trainers may provide hand-on examples, most of which are also included in detail in the training module • Hand-outs containing different choices of ecosystem-based adaptation and resilience 	<ul style="list-style-type: none"> • Gupta, A. K., Singh, S., Wajih, S. A., & Mani, N. (2017). <i>Urban Resilience and Sustainability through Peri-Urban Ecosystems</i>. New Delhi: GEAG, ICLEI South Asia, ACCCRN, NET, UNICEF, School of Planning and Architecture, New Delhi, Rockefeller Foundation. • Gupta, A.K., Nair, S.S., Wajih, S.A., Chopde, S., Gupta, G. and Aggrawal, G. (2014). Mainstreaming Climate Change Adaptation and Disaster Risk Reduction into District Level Development Plans. NIDM New Delhi (India), GEAG Gorakhpur (UP, India) and ISET, Colorado (US), P 114. • Rockefeller Foundation (2013) Decision Intelligence Document: Degradation and Loss of Peri-Urban Ecosystems. Rockefeller Foundation, New York, United States

LEARNING UNIT C.4:

BENEFITS OF PERI-URBAN ECOSYSTEM FOR RESILIENCE AND SUSTAINABILITY

Context

The relationship between ecosystems and cities' resilience and sustainability 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 the city's resilience. However, the cities, which are rapidly urbanizing, expanding and experiencing unplanned development is leading to a threatening decline in ecosystems. This extractive nature of urbanization places a low premium on preserving the ecosystem, affecting not only the livelihoods of those directly dependent on it but also the resilience and sustainability of cities and surrounding peri-urban ecosystems.

To improve and manage urban resilience it is pertinent to recognize various functions of peri-urban ecosystems. The services can be explored sector-wise under following heads:



Peri-urban agriculture and food security:

The ecosystem services, rendered by peri-urban regions, like agriculture plays a varied role in urban sustainability as well as resilience, ranging from food security to disaster management. Urban and peri-urban agriculture, particularly in the context of developing countries, play a crucial role in diversifying urban diets and providing environmental services in urban and peri-urban areas (Nambi et al., 2014). Conversion of agricultural spaces in the peri-urban regions impacts the city adversely and lack of policy framework for peri-urban agriculture impacts urban locales and marginalized section of the society.



Water security:

Steady population growth is exerting stress on both surface as well as groundwater and this stress will aggravate with changing climate and unplanned urbanization. Strong measures are required to conserve water resources and land conversion as concretization by real estate developers are destroying the natural recharge zone of the aquifers. In most cities, water supply is sourced from long distances and the length of pipeline determines the cost including the cost of pumping water. Due to the lack of local resource, water is conveyed from the nearest source to the city. Thus, peri-urban ecosystems play a vital role in providing cities with drinking water as they ensure flow, storage and purification of water (TEEB, 2011). Healthy vegetation and green spaces in the city vicinity influence the quantity of water availability locally.



Energy security:

Peri-urban areas can contribute significantly to meeting the energy demand of cities. Several possibilities in the use of energy resources, primarily connected to the distributed-generation network, can promote the transition to energy systems which guarantee high levels of sustainability and resilience. The location of cogeneration and waste-to-energy plants at the edge of the urban areas allows a convenient and efficient energy transmission to the consumers and at the same time does not affect densely populated areas. To seize the opportunities offered by peri-urban areas from an energy perspective, it is necessary to consider the bidirectional relationships they have with the city and the linkages between production and consumption of resources.



Health security:

Peri-urban ecosystem provide various health benefits including air purification, noise reduction, urban temperature regulation, etc. Air pollution from domestic heat, industries, transportation and solid waste burning affects environmental quality and human health in cities. Vegetation and green spaces help in removing pollutants from the atmosphere and thus improve the air quality of the region. Similarly, trees and soils help in reducing stress-causing noise pollution from heavy traffic, construction works and other human activities through absorption, deviation, reflection and refraction of sound (Bagetthan et al., 2011).



Economic security:

Urban and peri-urban agriculture provides food and nutritional security, enhances livelihoods security for urban and rural poor. For these marginalized communities, agriculture forms a key part of diverse livelihood strategies such as a source of income from selling products or as employment as farm labourers (Mitra et al., 2015).



Green growth and carbon neutrality:

Cities are responsible for a significant part of global greenhouse gas emission (UNECE, 2011) and thus play a key role in the global agenda aimed at addressing climate change (Chaoui et al. 2009). Main sources of GHG emissions attributable to cities are energy use in buildings, electricity supply, transportation and waste generation. Growing and unplanned urbanization will lead to a significant increase in energy use and carbon emissions particularly in Asia and Africa where urban energy use is based on carbon-intensive energy sources (Lamia and Robert, 2009). Green growth and carbon-neutral concept in the context of the city can help overcome numerous challenges associated with technology, governance and finance (Merk et al., 2012). Peri-urban regions are witnessing an increasing potential for green services.

This session can be discussed in detail with the case example of Shimla city where the connect of urban and peri-urban guides institutional coordination for water supply.

Learning objectives	Session(s) & methodology
<ul style="list-style-type: none"> Understand the different ecosystem services provided by peri-urban regions Learn how different services can promote sustainability, reduce and regulate disaster risks and mitigate climate change 	<ul style="list-style-type: none"> Lecture PowerPoint presentation Question-answer sessions Discussion
Enabling unit(s)	
<ul style="list-style-type: none"> Role of peri-urban ecosystems in resilience and sustainable development 	
Guidance	Recommended readings
<ul style="list-style-type: none"> The session will cover various ecosystem services of peri-urban regions which will provide trainees with different approaches for the implementation of DRR-CCA measures from various ongoing schemes to protect the landscape in transition. In this context, trainees shall understand that with ongoing population growth, overuse of natural resources, and climate change impacts costs of disasters and climate change will likely increase. Hand-outs containing brief description on ecosystem services of urban and peri-urban region may be given to the participants. 	<ul style="list-style-type: none"> Gupta, A.K., Nair, S.S., Wajih, S.A., Chopde, S., Gupta, G. and Aggrawal, G. (2014). Mainstreaming Climate Change Adaptation and Disaster Risk Reduction into District Level Development Plans. NIDM New Delhi (India), GEAG Gorakhpur (UP, India) and ISET, Colorado (US), P 114.

TRAINING MODULE

STRATEGIES FOR PERI-URBAN ECOSYSTEM AND RESILIENCE

Background

Urbanization in present times is mostly driven by the unsustainable pattern of resource use, energy extraction and change in land use pattern, with social and political aspirations in the backdrop besides lack of inadequate understanding on the techno-legal regime and wider gaps in implementation target versus ground realities. As per the UN 2016 report one in every three people will live in cities by 2030. With this growing trend, unplanned urbanization, especially in developing countries of Asia and Africa, will pose new challenges for socio-economic and environmental well-being, jeopardizing the very essence of sustainable development and inclusive growth. In this context, strategies for peri-urban ecosystems and resilience is essential. To develop, implement and monitor these strategies, developing capacities of different stakeholders for understanding peri-urban spaces and its linkages with developmental parameters is critical.

Sustainable and resilient urban and peri-urban development is only possible by identifying gaps in the existing process and systems and developing capacities of the same. The several milestones achieved post-2015 at global level emphasizes on systematic approach towards long term capacity across governance, institutions, inter- and intra-departmental levels and various stakeholders including communities to deal with various uncertainties.

Strategies for peri-urban ecosystem and resilience

There are numerous examples of adaptation and mitigation strategies that have been implemented across the world, including India, for peri-urban ecosystems and resilience. Some of these strategies are as follows:

- **Agriculture innovation:** Peri-urban areas are a catalyst for agricultural innovation and water resources management, and hence, proper management can be a win-win situation to both, i.e., urban communities as well as rural communities on the city fringes. Special Agriculture Zone (SAZ), which is a concept given by Prof. MS Swaminathan may be mapped out in master plans where priority is to be given to dairy and pulse crop, that require lesser water and overcome three kinds of deficiency in urban areas - undernutrition, protein hunger and hidden hunger. The Department of Agriculture may be roped in by city planners for providing further assistance in terms of extension services to peri-urban farmers so that their income can be increased, to result in improved economic security. The State of Uttarakhand had pioneered and became the first SAZ state in the country. The concept of home gardens, genetic gardens etc. can be applied in the planning process.

- **Watershed and integrated flood management:** While planning, watershed approach and resilient water infrastructure can be applied in the city master plans. Watersheds are the subsets of a larger ecosystem, are geo-hydrological units comprising of all land and water within the confines of a drainage divide (Manju et al, 2014). The watershed approach focuses on all water concerns and uses the concept of hydrology rather than a political boundary to define the geographic planning area.
- Strategic investment (**green money**) in peri-urban areas that help protect and promote ecosystem services than degrade or deteriorate
- **Green infrastructure, green spaces and resource efficiency:** a network of interconnected green spaces that serves as an infrastructure (similar to electricity, water infrastructure) providing ecological services of climate resilience, disaster risk reduction, wildlife conservation and resource preservation.
- **Quantification of ecosystem services** which renders negotiation power to mainstream strategies for peri-urban ecosystem and resilience into planning, policies, laws and programmes
- **People's participation** in planning and management of peri-urban ecosystems. Community engagement is also crucial for preparedness, coping strategies and resilience
- **Gender mainstreaming and transgenerational** strategies to ensure effective interventions and actions aimed towards peri-urban ecosystems and resilience

To sum it up, reimagining peri-urban areas has the potential to invigorate a more meaningful discussion on implementable, impactful strategies for urban resilience.

Training Module

This training module is planned to give exposure to various strategies that are deployed or can be deployed in Indian cities and surrounding peri-urban areas. There are 4 learning units under this module:

- LU- D.1.** Policy, laws and programmes
- LU- D.2.** Valuation of peri-urban ecosystem services and disaster impact assessment tools
- LU- D.3.** Green infrastructure, green spaces and resource efficiency
- LU- D.4.** Recognizing input-output and rural-urban nexus through participatory community involved planning

Training objectives



- Understand the importance of peri-urban ecosystems in urban resilience
- Identify the strategies for peri-urban ecosystems and resilience
- Enhance knowledge on the interaction between urban areas and the surrounding ecosystem and provide an overview of the different actors and institutions at local and sub-national levels

Guidance



- In this session, trainers will discuss with participants the strategies for urban regions and understand how urban ecosystems and the periphery are important factors which determine urban disaster risk.
- They will be sensitized on important factors for adequate urban (ecological) planning to minimize disaster risk, as well as informed about the involved groups and institutions.

Methodology



- Lecture
- PowerPoint presentation
- Case study
- Experience sharing
- Question-answer sessions
- Discussion

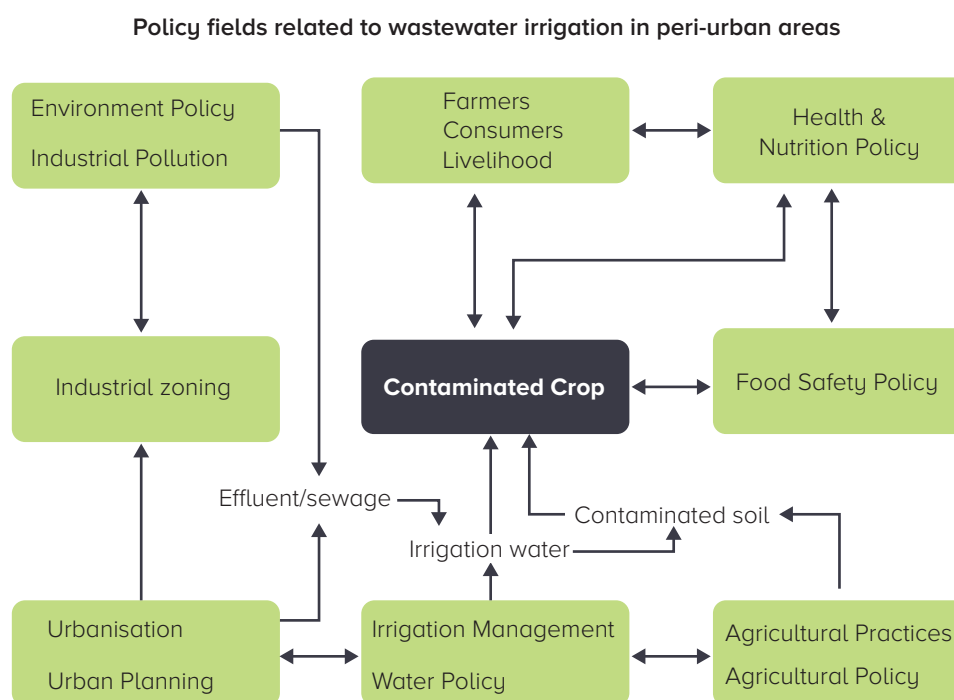
LEARNING UNIT D.1: POLICY, LAWS AND PROGRAMMES

Context

Peri-urban areas, commonly known as transition zone are characterized by geographic, social and institutional transition (Narain et al., 2013, Saxena & Sharma, 2015). Saxena and Sharma (2015) have termed these areas as “degenerated periphery” which is largely associated with basic problems of poor infrastructure, low economic activities, poor land-use planning, encroachment, waste dumping, slums’ proliferation, legal and law order problems and the absence of a political system.

However, policy frameworks for peri-urban sustainability in relation to urban resilience do not ignore rural-urban and livelihood linkages. Policies at the national, sub-national and local level are important. An example of policy fields related to wastewater application, a common phenomenon in peri-urban areas, is depicted in Figure D.11.

Figure D.11. Policy attributes and linkages for wastewater application in peri-urban agriculture.



The problem of peri-urban spaces and related ecosystem is largely a governance issue. Though the region provides with various services to the city like fresh food products, labour, water, open spaces etc. but itself lacks attention, at least in the discourse of officials and policymakers in developing countries like India (GEAG Issue Brief-1, 2016). A major challenge 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 (GEAG Issue Brief-1&2, 2016). Panchayat jurisdiction is not sufficient and effective to resolve the problems of city expansion (Saxena & Sharma, 2015).

Peri-urban areas generally lie beyond or between legal and administrative boundaries of central cities, which weakens the capacity of government authorities to regulate economic activities (Narain et al., 2013). Due to the lack of clear-cut conception and related concrete policies from national to local, they have been the most threatened areas with regards to land-use changes, biodiversity and climate change. There is an institutional and legal confusion over the management of this transitional land that does not come under the municipal jurisdiction nor village panchayat. Since they are keys to developing city's resilience and rural prosperity, there must be a strategic, participatory governance approach local as well as state and national level to environmental planning and development of the peri-urban areas. The real challenge lies in recognizing peri-urbanity and entering and influencing official discourse.

Learning objectives	Session(s) & methodology
<ul style="list-style-type: none"> Appreciate and enlist techno-legal and institutional framework for effective planning, implementation and finance for peri-urban regions. Understand issues of governance in peri-urban areas and its linkages to urban resilience. Describe the integration of disaster risk reduction planning and policies in a holistic, participatory, inclusive and sustainable manner for peri-urban region. 	<ul style="list-style-type: none"> One session PowerPoint presentation Short film Case study examples Lecture and discussion Experience sharing Question and answer
Enabling unit(s)	
<ul style="list-style-type: none"> Understanding policy and legal frameworks for peri-urban ecosystems 	
Guidance	Recommended readings
<ul style="list-style-type: none"> This module includes knowledge sharing sessions on various schemes and programmes being run in the specific states and country. The facilitators shall have in-depth knowledge of legal mechanisms, various schemes and policies. The session will cover governance issues of peri-urban regions and provide participants with conceptual understanding. In this context, trainees shall understand that with ongoing population growth, urbanization, overuse of natural resources, and climate change impacts the costs of disasters will likely increase. 	<ul style="list-style-type: none"> Gupta, A. K., Singh, S., Wajih, S. A., & Mani, N. (2017). <i>Urban Resilience and Sustainability through Peri-Urban Ecosystems</i>. New Delhi: GEAG, ICLEI South Asia, ACCCRN.NET, UNICEF, School of Planning and Architecture, New Delhi, Rockefeller Foundation. Gupta, A.K., Nair, S.S., Wajih, S.A., Chopde, S., Gupta, G. and Aggrawal, G. (2014). <i>Mainstreaming Climate Change Adaptation and Disaster Risk Reduction into District Level Development Plans</i>. NIDM New Delhi (India), GEAG Gorakhpur (UP, India) and ISET, Colorado (US), P 114.

LEARNING UNIT D.2:

VALUATION OF PERI-URBAN ECOSYSTEM SERVICES AND DISASTER IMPACT ASSESSMENT TOOLS

Context

Peri-urban ecosystems provide a wide variety of services, which may be ecological, cultural, regulatory, aesthetic or provisional services. It is also evident that peri-urban ecosystems around the world are deteriorating in quantity and quality due to development pressures and unplanned urbanization. Need for conservation and preservation of peri-urban ecosystems is thus, imperative. Valuation or assessment of peri-urban ecosystem services can be used in this context to (Neugarten, et al., 2018):



There are numerous techniques and tools for valuing ecosystem services, some of which are indicated in Table D.21.

Table D.21: Example of tools and techniques for valuation of peri-urban ecosystems

Tool/Technique name and Website	Description
Toolkit for Ecosystem Service Site-based Assessment (TESSA) v.2.0 http://tessa.tools/	<ul style="list-style-type: none"> • TESSA is a PDF manual that provides guidance and low-cost methods to evaluate the benefits people receive from nature at particular sites. • TESSA generates information that can be used to influence decision making. • It does not require computer modelling but it does require stakeholder participation and encourages primary data collection
Ecosystem Services Toolkit https://biodivcanada.chm-cbd.net/documents/ecosystem-services-toolkit	<ul style="list-style-type: none"> • The EST is a guidance document consisting of steps with practical worksheets for conducting qualitative and/or quantitative ES assessment, indicators, advice on relevant issues, and a compendium of tools, methods, and models that might be applied.
Artificial Intelligence for Ecosystem Services (ARIES) http://aries.integratedmodelling.org/	<ul style="list-style-type: none"> • ARIES is designed for integrated socio-economic-environmental modelling, which includes ecosystem services • ARIES can accommodate a range of different users and user needs, including scenarios, spatial assessment and economic valuation of ES, optimization of payments for ecosystem services programs, and spatial policy planning.
Co\$ting Nature v.3 http://www.policysupport.org/costingnature	<ul style="list-style-type: none"> • C\$N is a web-based tool for spatially analysing ecosystem services and assessing the impacts of human interventions such as land-use change scenarios. • It provides a globally or locally relative index of service provision that can be used for ecosystem services' assessment, conservation prioritization, analysis of co-benefits, pressures and threats. • Version 3 includes economic/ monetary valuation
Integrated Valuation of Ecosystem Services and Tradeoffs 3.4.2 https://naturalcapitalproject.stanford.edu/software/invest	<ul style="list-style-type: none"> • InVEST is a suite of software models for mapping and quantifying ecosystem services in biophysical or economic terms under different scenarios (e.g., policy or management options).
Multiscale Integrated Models of Ecosystem Services (MIMES) http://www.afordablefutures.com/	<ul style="list-style-type: none"> • MIMES is an analytical framework designed to integrate different ecological and economic models to understand and visualize ecosystem services' values.
Social Values for Ecosystem Services (SolVES) solves.cr.usgs.gov	<ul style="list-style-type: none"> • SolVES is an ArcGIS-dependent application that allows the user to identify, assess and map the perceived social values that people attribute to cultural ES, such as aesthetic or recreational values. • Combining spatial and points-allocation responses from surveys, it produces points-based social-values metric and raster maps of social value intensities.

Source: Neugarten, et al., 2018

There is also a need to assess disaster and development impacts on peri-urban ecosystems to better plan, manage and implement holistic actions for peri-urban ecosystems and resilience. Environmental impact assessment (EIA) should be made an integral part of the project approval procedure for local government and other authorities. EIA is one of the policy innovations, as an anticipatory mechanism, designed to contribute to the integration of economic, social and environmental concerns in the development process in a balanced way as key to the attainment of sustainable development at or above the project level (Suparb et al., 2008). If applied at the project level, it is

termed traditional reactive environmental assessment, and if applied above the project level it is known as strategic environmental assessment (SEA).

Rapid urbanization needs to be modified with advance assessment by adopting environmental impact assessments as part of an incremental system to integrate environmental considerations into the planning and approval process of development activities and use the EIA as a major policy instrument within the environmental regulatory system (Dubai Municipality, 2001). Environmental impact assessment law in China applies it on land use planning and related policy decisions and projects. Such decision tools will have a direct impact on regional land-use patterns and then affect the regional eco-environmental quality. Currently, theories and methodologies for environmental impact assessment of land use planning are gaining traction in the field of plan environmental impact assessment. Plan EIA is a process in-between the project EIA and the SEA. The plan EIA offers significant opportunities to recognize the importance and risks associated with the peri-urban ecosystems for the people and their resources in the area, comprising urban and/or peri-urban.

Another approach is the ecological suitability analysis of land use as a comprehensive application of ecology, earth science, system science, environmental science and computer science to analyse land development and utilization suitability for seeking the best pattern and planning of land use.

A more sophisticated approach to analyse the impact of cities has been developed to calculate the city's Ecological Footprint (Rees, 1992). This utilizes the ecological understanding of how a city extracts food, water, energy and land from a bioregion (and beyond) and requires ecosystem services to absorb its wastes. Besides, EIA, SEA, ecological footprint, other environmental policy tools of assessment like – Life Cycle Analysis, Natural Resource Accounting, Environmental Auditing, Risk and Vulnerability Analysis, also offer significant opportunities for improving not the land & land-use decisions but the financial – investment, public and private decisions, which will have a significant bearing on the ecosystems inside the city jurisdiction and even more on the peri-urban systems.

Learning objectives	Session(s) & methodology
<ul style="list-style-type: none"> Understand the need and techniques for assessing the value of peri-urban ecosystem services and disaster impacts Examine strategies for mainstreaming valuation methods of ecosystem services and impact assessment into plans, policies and programmes 	<ul style="list-style-type: none"> One session PowerPoint presentation Case study examples Lecture and discussion Question and answer Experience sharing
Enabling unit(s)	
<ul style="list-style-type: none"> Tools and technique to quantify peri-urban ecosystem services and assess the impact of disaster 	
Guidance	Recommended readings
<ul style="list-style-type: none"> This module includes knowledge sharing sessions on various techniques and tools for assessing the value of peri-urban ecosystem services and impacts of disasters The facilitators shall have in-depth systems knowledge 	<ul style="list-style-type: none"> Neugarten, R. A., Langhammer, P. F., Osipova, E., Bagstad, K. J., Bhagabati, N., Butchart, S. H., . . . Willcock, S. (2018). <i>Tools for measuring, modelling, and valuing ecosystem services: Guidance for Key Biodiversity Areas, natural World Heritage</i>. Gland: International Union for Conservation of Nature. Gupta, A. K., Singh, S., Wajih, S. A., & Mani, N. (2017). <i>Urban Resilience and Sustainability through Peri-Urban Ecosystems</i>. New Delhi: GEAG, ICLEI South Asia, ACCCRN. NET, UNICEF, School of Planning and Architecture, New Delhi, Rockefeller Foundation.

LEARNING UNIT D.3:

GREEN INFRASTRUCTURE, GREEN SPACES AND RESOURCE EFFICIENCY

Context

Green infrastructure, defined as vegetation systems intentionally designed to promote environmental quality, can reduce the intensity of heat islands- increasing in spatial expanse and intensity with rising urbanization and peri-urbanization- by providing shade and evapotranspiration cooling.

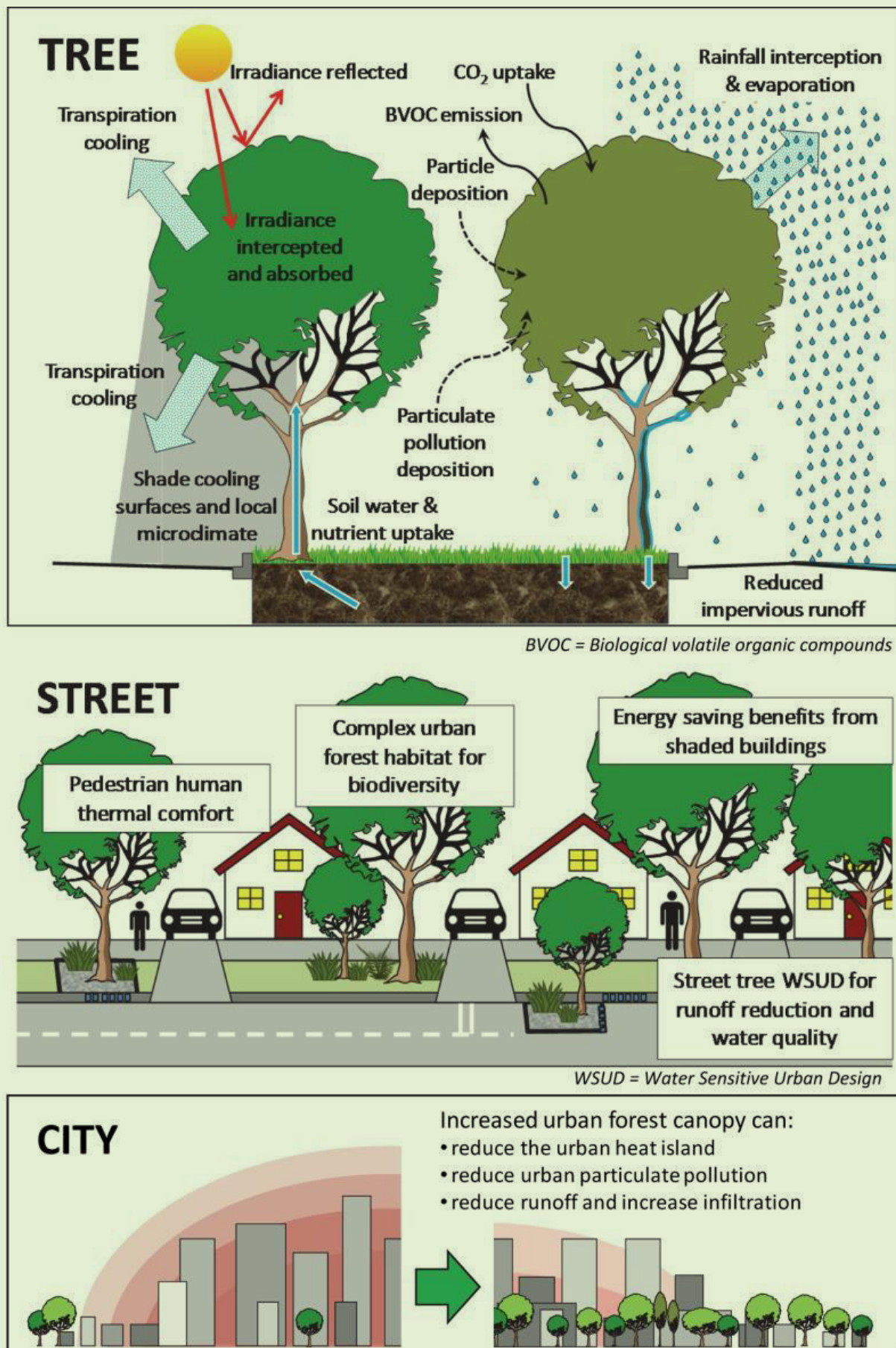
Urban and peri-urban landscapes and green infrastructure is of key importance as a source of a range of benefits like air filtration, city climate regulation and carbon storage, connectivity between natural systems and social cohesion (NEDkov, et al. 2016). The United Nations' Sustainable Development Goals (Goal No.11) emphasizes on making cities inclusive, safe, resilient and sustainable by implementing integrated policies and plans for resource use efficiency and adaptation to climate change, which is not possible without protecting these peri-urban regions.

Preservation and creation of green spaces help in augmentation and sequestration of carbon. Shelterbelts, greenbelts and other types of living fences act as barriers against wind erosion and sand storms. Healthy vegetation and green spaces in the city vicinity influence the quantity of water availability locally. Urban trees are perhaps the most effective and least costly approach to urban heat island mitigation and adaptation (Norton et al., 2015; Solecki et al., 2005) (Figure D.00).

Forests are precious national green assets that play a vital role in ensuring ecological security and sequestering carbon and, thus, reduce the GHG emissions profile of the nation. According to India's State of Forest Report (ISFR) 2015, the total forest and tree cover of the country is 24.16% of the total geographical area (forest cover 21.34% and tree cover 2.82%), which is almost 10% less than the area designated under National Forest Policy of India, 1988. According to the draft National Forest Policy of 2016, India in the past few decades has witnessed a decline in forest quality, impacts of climate change, intensifying water crisis, increase in forest-related disasters including forest fire and decrease in the resilience of the forest-dependent community.

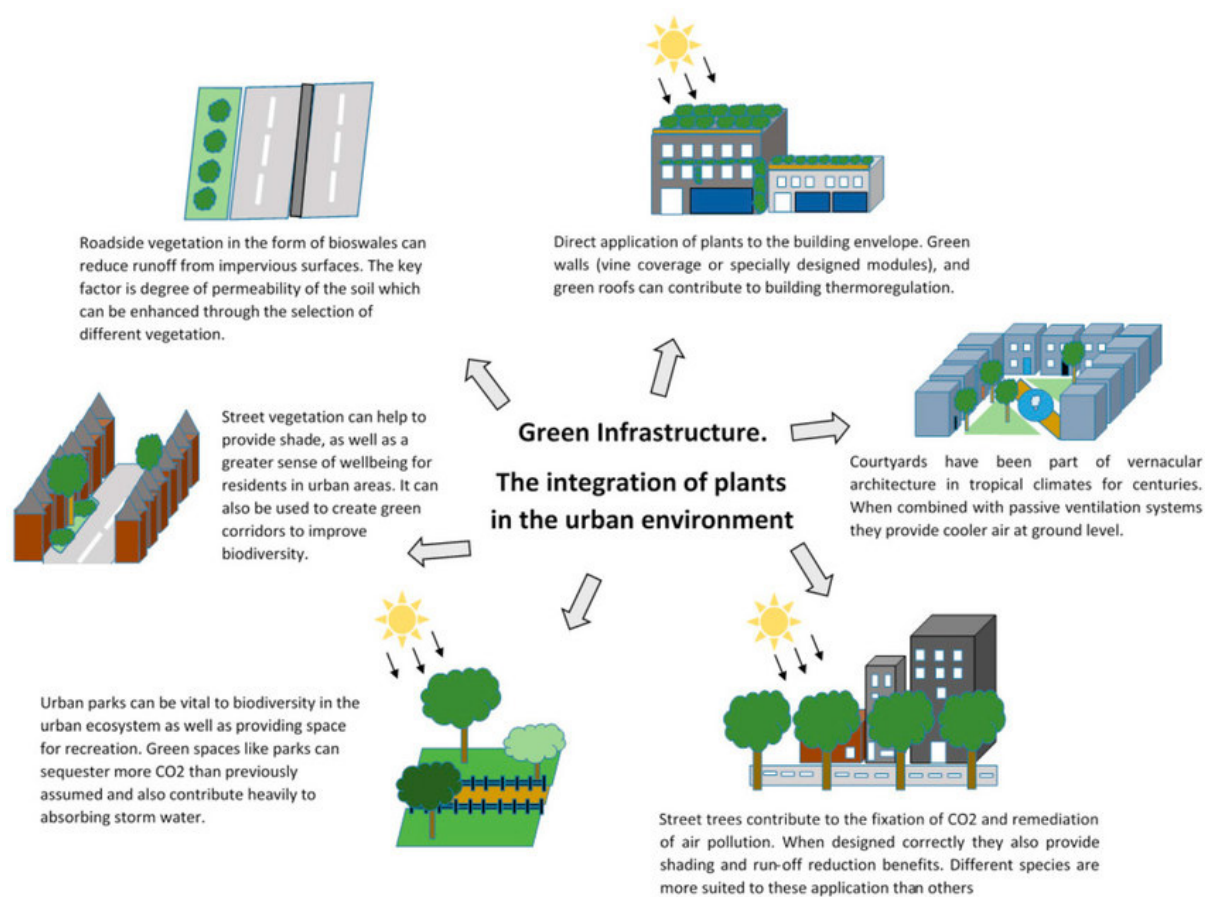
Green India Mission through its various initiatives is determined to improve India's forest cover as well as enhance annual CO₂ sequestration by 50-60 million tonnes by 2020 (MOEF, 2014). The mission while addressing its goals also includes a focus on improving forest and tree cover in 0.20 million hectares of urban and peri-urban lands. Engaging urban population with various government plans and schemes of greenery and forestry can improve awareness, willingness (Livesley et al., 2016) and capacity to tackle various environmental issues. Green infrastructure, therefore, has to be integrated and mainstreamed into the central planning, governance and implementation mechanisms for urban and peri-urban areas, recognizing the well-evidenced benefits of moderation of heat island, flood risk, water scarcity, aesthetics, wind buffers, etc.

Figure D.31. Role of urban forestry at tree, street at city level, against hydro-climatic risks



(Source: Livesley et al., 2016).

Figure D.32: Importance and integration of green infrastructure into mainstream planning and urban/peri-urban governance (Wootton-Beard et al., 2016)



Cities are and will continue to be one of the key contributors to global GHG emissions (UN, 2019). Significant sources of GHG emissions attributable to cities are energy use in buildings, electricity supply, transportation and waste generation. Research indicates that continued growth and unplanned urbanization will lead to a significant increase in energy use and carbon emissions particularly in Asia and Africa where urban energy use is based on carbon-intensive energy sources (Lamia and Robert, 2009). Green growth and carbon-neutral strategies thus become important for cities to overcome several challenges of technology, governance and finance (Merk et al., 2012). Peri-urban regions exhibit an increasing potential for green growth and infrastructure.

This session can be discussed in detail with the case example of Gorakhpur city in choosing a circular economy approach for peri-urban ecosystems and urban resilience.

Learning objectives	Session(s) & methodology
<ul style="list-style-type: none"> Learn basic concepts of green infrastructure and resource efficiency in a peri-urban setting Develop an understanding of diverse forms of green spaces and implications of development pattern thereof Ideate on role and mode of mainstreaming green infrastructure and resource efficiency in peri-urban ecosystem and urban resilience 	<ul style="list-style-type: none"> One session PowerPoint presentation Short film Case study examples Lecture and discussion Question and answer
Enabling unit(s)	
Green infrastructure in a peri-urban setting: Examining the need and strategies for mainstreaming green spaces and resource efficiency in peri-urban ecosystems and resilience	
Guidance	Recommended readings
<ul style="list-style-type: none"> Trainers need to develop a conceptual understanding of green infrastructure and resource efficiency in urban and peri-urban regions It is recommended to read articles on green spaces, green infrastructure and resource efficiency in the context of peri-urban ecosystems and urban resilience 	<ul style="list-style-type: none"> Gupta, A. K., Singh, S., Wajih, S. A., & Mani, N. (2017). <i>Urban Resilience and Sustainability through Peri-Urban Ecosystems</i>. New Delhi: GEAG, ICLEI South Asia, ACCCRN, NET, UNICEF, School of Planning and Architecture, New Delhi, Rockefeller Foundation. Gupta, A.K., Nair, S.S., Wajih, S.A., Chopde, S., Gupta, G. and Aggrawal, G. (2014). Mainstreaming Climate Change Adaptation and Disaster Risk Reduction into District Level Development Plans. NIDM New Delhi (India), GEAG Gorakhpur (UP, India) and ISET, Colorado (US), P 114.

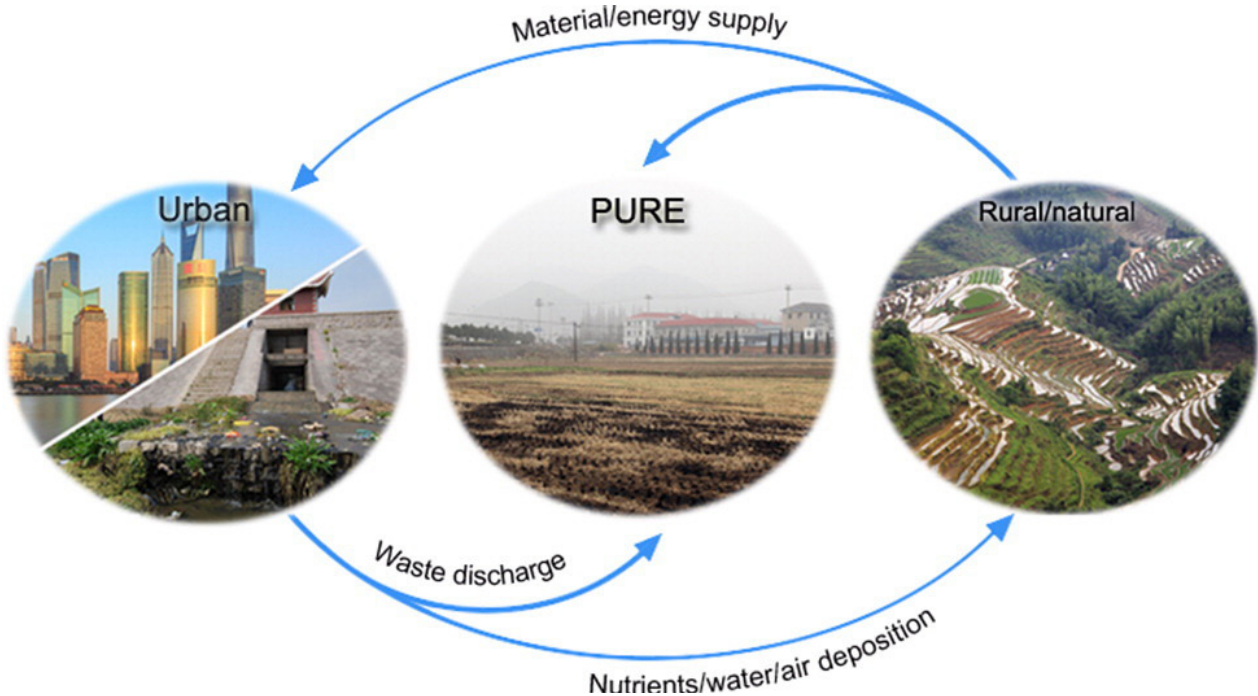
LEARNING UNIT D.4:

RECOGNIZING INPUT-OUTPUT AND RURAL-URBAN NEXUS THROUGH PARTICIPATORY-COMMUNITY INVOLVED PLANNING

Context

A peri-urban area is an ever-changing zone of both interaction and transition due to its geographic location at a city's edge where complex socio-economic processes take place. Therefore, its capacity of resilience is mainly influenced by its input-output dynamics with the adjacent urban area on one hand, and with its following purely rural systems.

Figure D.41: Input-output dynamics of urban ecosystems-peri urban ecosystems (PURE)- rural ecosystems



(Source: Zhu, Reid, Meharg, Banwart, & Fu, 2017)

Recognizing the importance of this input-output dynamics between urban-rural-periurban ecosystems coupled with participatory- community-led planning can also help overcome water shortages, air & water pollution (Wolman, 1965). Once these inputs and outputs are measured, the information can be used for negotiation in public policies and strategies for peri-urban ecosystems and resilience.

Learning objectives	Session(s) & methodology
<ul style="list-style-type: none"> Learn basic concepts of rural-urban nexus and identify the inputs and outputs circulating between urban-peri-urban and rural ecosystems Develop an understanding of vulnerabilities and implications of development pattern on this nexus Identify community-led planning and participatory planning strategies for peri-urban ecosystems and resilience 	<ul style="list-style-type: none"> One session PowerPoint presentation Experience sharing Case study examples Lecture and discussion Question and answer
Enabling unit(s)	
Tapping the dynamics of rural-urban nexus: Community planning for peri-urban ecosystems and resilience	
Guidance	Recommended readings
<ul style="list-style-type: none"> Trainers should have a clear understanding of the rural-urban nexus, input-output dynamics of peri-urban-urban-rural ecosystems and the importance of participatory planning in this equation. Priority should be given to identification of local resources and community-led resilient planning and strategies that recognize the inputs-outputs at the rural-urban nexus. In this session, emphasis should be given to the poor and marginalized community living in the peri-urban areas. Their perspective in peri-urban regions is important in planning strategies aimed at peri-urban ecosystems and resilience. Examples and case studies for mainstreaming community-led planning into development plans and implementable strategies should be discussed. 	<ul style="list-style-type: none"> Gupta, A. K., Singh, S., Wajih, S. A., & Mani, N. (2017). <i>Urban Resilience and Sustainability through Peri-Urban Ecosystems</i>. New Delhi: GEAG, ICLEI South Asia, ACCCRN.NET, UNICEF, School of Planning and Architecture, New Delhi, Rockefeller Foundation Wolman, A, (1965) <i>The Metabolism of Cities in Cities</i>, New York, Scientific American Zhu, Y.-G., Reid, B. J., Meharg, A. A., Banwart, S. A., & Fu, B.-J. (2017). Optimizing Peri-URban Ecosystems (PURE) to re-couple urban-rural symbiosis. <i>Science of The Total Environment</i>, 586, 1085-1090.

TRAINING MODULE

MAINSTREAMING ECO- DRR INTO DEVELOPMENT PLANNING

Background

Planning for the peri-urban area often falls between the cracks of rural and urban development planning. Analysis of the pattern of urbanization and related projections indicate that due to space constraints in cities, urban development is moving into the countryside (Maheshwari et al., 2016), and as a result, the peri-urban areas become part of cities and new peri-urban areas are formed (Bhatt et al., 2016). The lack of basic knowledge and timely information of this urbanization- peri-urbanization process and its long-term ecological impacts constrain development planning authorities in analysing, managing and restoring peri-urban ecosystems (Bhatt et al., 2016; 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).

Maintaining ecosystems' health in development planning is crucial to the resilience of urban settings. For the cities to be liveable as well as sustainable, there is a need to maintain natural resource base more particularly in the peri-urban areas surrounding cities, and there is often a limit to the ecosystem within cities and towns. But the ecosystem upon which these services depend are increasingly under threat due to unplanned urbanization, the encroachment of land and diminishing green spaces, amidst lack of emphasis by government or communities on their roles in protecting people – their land, assets, resources, livelihood and health.

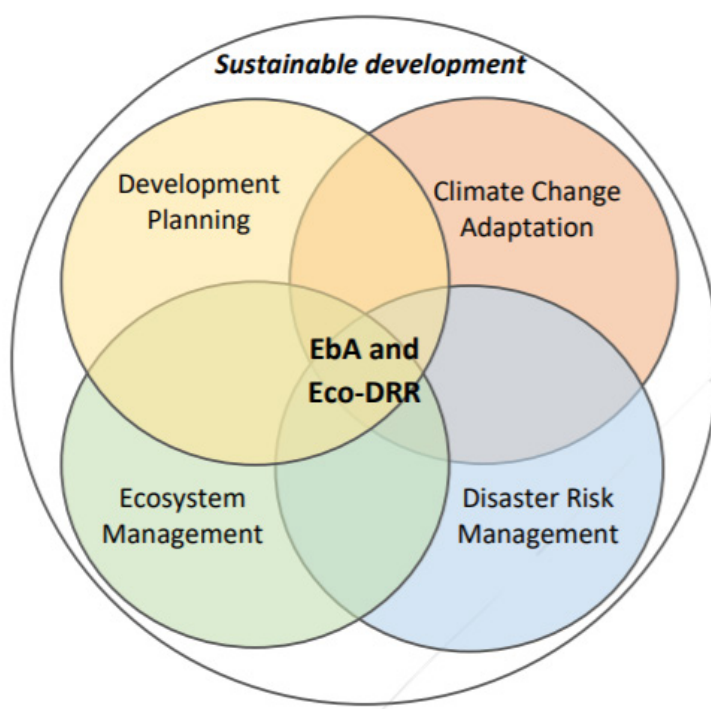
There are concrete ways to improve the decision-making process and development planning to guide cities towards aspired benefits. These include assessment, planning tools and mechanisms, policies and regulations, project cycle management with environmental decisions, cost-benefit etc. However, there is not as yet a systematic approach mainstreamed to incorporate issues of peri-urban land-use and ecological strengths and weaknesses in terms of contribution towards urban resilience against climatic and disaster risks.

Ecosystem Based Disaster Risk Reduction

Ecosystems based disaster risk reduction (Eco-DRR) is defined as “the sustainable management, conservation and restoration of ecosystems to reduce disaster risk, to achieve sustainable and resilient development” (IUCN, 2013).

This ecosystem-based approach for urban adaptation and resilience has been very well placed into Sustainable Development Goals 2030. The goal 11 of SDG refers to urban ecosystems and emphasizes on making cities inclusive, safe, resilient and sustainable by implementing integrated policies and plans for resource use efficiency and adaptation to climate change. SDG 13 is related to climate action, while SDG 15 talks about life on land that emphasizes integrating the ecosystem-based approach in local planning and developmental processes (UN, 2016).

Figure E.01: Ecosystem-based approaches to disaster risk reduction and adaptation (Eco-DRR and EbA) provide benefits for people and nature beyond adaptation and disaster risk reduction within the overall framework of sustainable development (adapted from Midgley et al., 2012, DEA and SANBI 2017, and Sudmeier and Ash 2009)



Training Module

This is the fifth training module of the manual focusing on mainstreaming ecosystem-based disaster risk reduction into development planning. Envisaging holistic urban development, the module emphasizes on the need for a strategic and transformative process fostering sustainable, equitable as well as inclusive development of urban and peri-urban regions. The approach must be multidisciplinary, engaging experts from all fields, sectors, departments, businesses as well as communities (urban and rural) in the planning and management process.

There are 3 learning units under this module:

- LU- E.1.** Approaches, pathways, tools and entry points, for mainstreaming peri-urban eco-DRR for urban resilience
- LU- E.2.** Integration to sectoral/departmental, urban, regional, industrial, infrastructure, business continuity resilience, village/ULB's plans and major projects
- LU- E.3.** Land use and master planning and participatory strategies

Training objectives



- To explain the need and nature of the integration of peri-urban risk concerns into the urban development process to achieve the goal of sustainable development.
- To analyse different roles of peri-urban ecosystem services in building resilience in different sectors and cross-sectoral contexts.
- To describe the integration of ecosystem services in disaster risk reduction planning and policies in a holistic, participatory, inclusive and sustainable manner.
- To understand adaptation practices used by the local communities to reduce impacts of climate change and disasters.

Guidance



- This session aims at discussing the what, why and how of mainstreaming peri-urban concerns into city development.
- This module includes knowledge sharing sessions on various ecosystem services provided by urban and peri-urban regions.
- The facilitators shall have in-depth systems knowledge of development planning processes, pathways, tools and approaches.

Methodology



- Lecture/PowerPoint presentation
- Case study (preferably based on film)
- Group exercises
- Experience sharing
- Discussion

LEARNING UNIT E.1:

APPROACHES, PATHWAYS, TOOLS AND ENTRY POINTS FOR MAINSTREAMING PERI- URBAN ECO-DRR FOR URBAN RESILIENCE

Context

Urban expansions into peripheral areas restructure its development, into unplanned peri-urban areas that undergo land use and occupational changes. These centres of intense economic activities in the vicinity of large cities exhibit urban character in a rural setting, lying beyond municipal jurisdiction. Basic services such as water supply and sanitation, garbage disposal and collection, street lighting and cleaning etc. are not the part of rural bodies neither municipality. Amidst glittering cities adorned with malls and supermarkets, these city fringes represent the sad example of haphazard development, deteriorating quality of life, water pollution and land encroachment rapidly turning into waste disposable sites for cities.

In general, however, despite calling them 'rural' a peri-urban area is defined administratively according to its location- whether the area falls within the limits of city master plan or otherwise. This leads to many administrative issues. A major challenge for mainstreaming peri-urban eco-DRR for urban resilience 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 provision 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 urbanization, democratic good governance that is based on the principles of equity becomes critical. The weak and the marginalized 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. For the first time in the history of urban governance, municipal bodies were provided with the constitutional status of 'third tier of government'. It also sanctioned the citizen participation in planning their city's future and improving the 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 marginalizing the excluded. Good governance and all that goes with it (accountability, transparency and process ownership) are little more than a formality in the hands of the elected elite and participation, at best, is passive.

Because of the above, it is crucial to mainstream peri-urban ecosystem-based disaster risk reduction for urban resilience. There are several approaches, pathways, tools and entry points to achieve this (as enlisted in Table E.11); urban planning is one approach.

Table E.11: Different approaches, pathways, tools and entry points for mainstreaming peri-urban eco-DRR to urban resilience.

Approaches	Pathways	Tools	Entry Points
<ul style="list-style-type: none"> • Development planning • Urban governance • Institutional mechanism • Law • Development plans and programs • Sectoral plans and policies- at center, state, city or local level 	<ul style="list-style-type: none"> • City development planning • Infrastructure planning • Urban planning • Regional planning 	<ul style="list-style-type: none"> • Land use planning • Development regulations • Building bye-laws • Zoning regulations • Permits • Environmental impact assessment • Social impact assessment • Life cycle analysis • Natural resource accounting • Environmental auditing • Risk and vulnerability analysis 	<ul style="list-style-type: none"> • Data, information and knowledge on peri-urban and urban growth and disaster risks • Tools and approaches used for urban planning • Development processes associated with urban infrastructure and services • Institutional capacity • Community development Processes • Tapping the private sector • Catalyzing finances

Adapted from Bahadur, Tanner, & Pichon, 2016)

Urban planning in India is a state subject and under the 12th schedule of the 74th Amendment Act, it is a function of urban local bodies, while regional planning comes under the purview of 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. These areas need guidelines to synchronize bottom-up and top-down approaches across urban and regional areas.

This learning module thus explores different approaches, pathways, tools and entry points (examples enlisted in Table E.00) for mainstreaming peri-urban eco-DRR to urban resilience. Key entry points for action (adapted from Bahadur, Tanner, & Pichon, 2016) are:

Entry Point 1:

Data, information, and knowledge on peri-urban and urban growth and disaster risks.

A significant amount of data required for eco-DRR can be collected as part of data collection exercise led by different agencies and agents involved in planning, management and development of urban and peri-urban areas

Entry Point 2:

Tools and approaches used for urban/regional planning.

Planning and allocation of land to different uses in urban planning's long-term vision allows mainstreaming of eco-DRR and reduce or limit exposure and vulnerability to climate and disaster risks.

Entry Point 3:

Development processes associated with urban infrastructure and services.

Eco-DRR in planning and development of key urban-peri-urban infrastructure and services- water and sanitation, energy supply, transport and telecommunications, built environment, ecosystems, and health and social services- shall focus on the provision of uninterrupted services resilient to shocks and stresses. For example, an electricity distribution or generation system shall never be located in areas prone to disaster risks. Land use planning and zonation need to pay key consideration to disaster risk profile.

Entry Point 4:

Entry Point 4: Institutional capacity.

Mainstreaming eco-DRR for urban resilience is possible only when the agencies and agents' in-charge of planning, development and management and other stakeholders have the capacity to identify and address the impacts of climate and disaster risks factoring in the development priorities, available resources and the costs of operation & maintenance of infrastructure and services.

Entry Point 5:

Community development processes.

Involvement of general public and civil society throughout planning processes and not at the endpoints of the process will help develop and plan for cities people want to live, work and play in.

Entry Point 6:

Tapping the private sector in urban areas.

Private sector including business communities are significantly affected by disaster and climate risks and play a key role in investment for peri-urban eco-DRR. The government can use incentives, zoning and policies to define investment zones and policies but are constrained by financial resources. Involvement of the private sector can help bring financial resources to the government while providing access to untapped markets and incentives to the private sector.

Entry Point 7:

Catalysing finances.

Utilize local resources, explore resources from higher levels of government, external and international agencies as well as innovative financing sources to augment finances that can be used for investment in peri-urban eco-DRR.

Learning objectives	Session(s) & methodology
<ul style="list-style-type: none">Define the need and modes to integrate peri-urban eco-DRR for urban resilienceDevelop an understanding of legal and institutional setup for DRR in urban and peri-urban areasAnalyse approaches, process and tools of urban/peri-urban ecosystem concerns for urban resilience against climatic and disaster risks, through policies, law, strategies and effective governance at sub-national and local levels	<ul style="list-style-type: none">PowerPoint presentationCase study examplesLecture and discussionQuestion and answerExperience sharing
Enabling unit(s)	
Eco-DRR for urban resilience: Exploring tools, pathways and entry points for action	
Guidance	Recommended readings
<ul style="list-style-type: none">The session will cover planning, governance and development issues of peri-urban regions and provide trainees with conceptual understanding.In this context, trainees shall understand that with ongoing population growth, urbanization, overuse of natural resources, and climate change impacts the costs of disasters will likely increase.In this context, governance and institutional analysis is an important instrument for decision making.	<ul style="list-style-type: none">Bahadur, A., Tanner, T., & Pichon, F. (2016). <i>Enhancing Urban Climate Change Resilience: Seven Entry Points for Action</i>. Manila: Asian Development Bank.Gupta, A. K., Singh, S., Wajih, S. A., & Mani, N. (2017). <i>Urban Resilience and Sustainability through Peri-Urban Ecosystems</i>. New Delhi: GEAG, ICLEI South Asia, ACCCRN.NET, UNICEF, School of Planning and Architecture, New Delhi, Rockefeller Foundation.

LEARNING UNIT E.2:

INTEGRATION TO SECTORAL/ DEPARTMENTAL, URBAN, REGIONAL, INDUSTRIAL, INFRASTRUCTURE, BUSINESS CONTINUITY RESILIENCE, VILLAGES/ULBS PLANS AND MAJOR PROJECTS

Context

Various ecosystem services in urban and peri-urban settings, either directly or indirectly, are managed by different ministries and departments at national, state and district levels. Matters pertaining to urban development are the responsibility of State Governments as per the constitution of India. The 74th Constitutional Amendment Act of the constitution has further delegated many of these functions to urban local bodies (ULBs) for management at the city level. At the same time, the Ministry of Housing and Urban Affairs, Government of India, plays an important role in formulating various policies, programs and schemes for urban development in the country.

For example, the first central level effort to provide drinking water in towns and cities was born with Sixth Five-year Plan (1979) and the Plan's focus on Integrated Development of Small and Medium Towns. Later, the Eighth Five Year Plan (1992-97) led to the launch of the Accelerated Urban Water Supply Program (AUWSP). Jawaharlal Nehru National Urban Renewal Mission in 2005 was a landmark shift in the urban sector that emphasized the preservation of water bodies, adequate water supply and replacement of old and worn out pipes in 63 identified cities. Urban Infrastructure Development Scheme for Small and Medium Towns (UIDSSMT) is a component of JNNURM and includes all urban infrastructure development including water supply and sewerage in small and medium towns. Post-2014, Atal Mission for Rejuvenation and Urban Transformation (AMRUT) and Smart Cities Mission, dominate urban dialogues in India.

Ecosystem-based disaster is yet to mainstream into sectoral plans or priorities, or urban and regional plans and policies. Recently, business communities have started to realize the risks and losses from climate and disaster risks. Resilience for the business community is gradually becoming a priority. But for the village and local communities for whom resilience is a priority, options to achieve or improve resilience are often few. It is thus, crucial.

This learning unit will thus focus on the need and modes of integrating peri-urban ecosystems-based disaster risk reduction into sectoral and departmental plans and policies, urban planning, regional planning, industrial planning and local planning. It will also reflect on the need and methods for integrating peri-urban eco-DRR for business community resilience.

Learning objectives	Session(s) & methodology
<ul style="list-style-type: none"> • Understand and discuss the importance of cross-sectoral partnerships for successful socio-economic and political challenges in peri-urban regions • Analyse inclusion of multi-sectoral plans into the developmental process and mitigation measures through schemes and projects for enhancing the development of peri-urban regions 	<ul style="list-style-type: none"> • PowerPoint presentation • Case study examples • Lecture and discussion • Question and answer • Experience sharing
Enabling unit(s)	
Blending peri-urban eco-DRR into sectoral plans & policies: Role of stakeholders across sectors and spatial levels	
Guidance	Recommended readings
<ul style="list-style-type: none"> • This session is intended to give background on how peri-urban eco-DRR can be mainstreamed into both development policies and sectoral plans and policies • It provides several hands-on examples, most of which are also presented in detail in the session handout or presentation 	<ul style="list-style-type: none"> • Gupta, A. K., Singh, S., Wajih, S. A., & Mani, N. (2017). <i>Urban Resilience and Sustainability through Peri-Urban Ecosystems</i>. New Delhi: GEAG, ICLEI South Asia, ACCCRN, NET, UNICEF, School of Planning and Architecture, New Delhi, Rockefeller Foundation. • Rockefeller Foundation (2013) <i>Decision Intelligence Document: Degradation and Loss of Peri-Urban Ecosystems</i>. Rockefeller Foundation, New York, United States

LEARNING UNIT E.3:

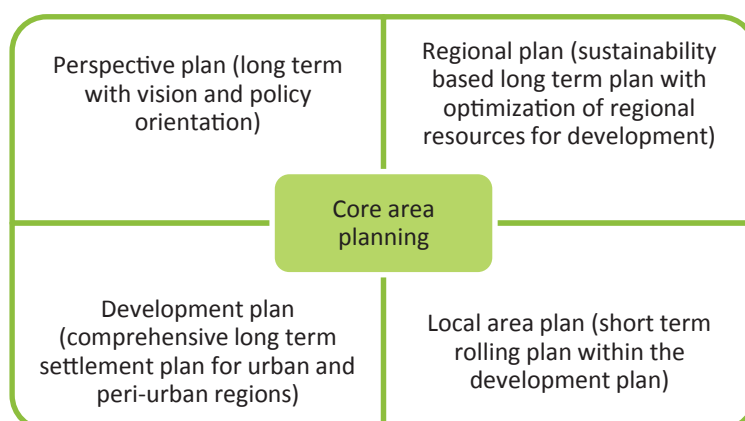
LAND USE, MASTER PLANNING AND PARTICIPATORY STRATEGIES

Context

The peri-urban region is witnessing the deteriorating quality of the environment, loss of biodiversity and diminishing landscapes. The peri-urban areas are not 'the waiting room' (GEAG, 2015) or 'lagging areas' (PURPLE, 2004) and therefore, it is pertinent to find a balance between quality of life and urban development pressures. Holistic urban development is not possible without developing the regions around it to maintain steady input/output flow of materials. Thus, there must be a strategic and transformative process to foster sustainable, equitable as well as inclusive development of urban and peri-urban regions. Urban master plans and regional plans are considered to be a blueprint and need revisiting by city planners and experts. The approach must be multidisciplinary, engaging experts from all fields as well as communities throughout the planning and management process.

Master plans have failed in our country because they are usually rigid and obsolete. Lack of regional planning approach has led to the haphazard proliferation of slums. According to the 12th Five Year Plan of India, only a few Indian cities have 2030 master plans that acknowledge basic services of water, sanitation, food, transportation, roads etc., in the plan document. Learning from the mistakes of past and present, it is critical now to move away from the tradition land use-based master plans towards integrated development of cities aimed at developing urban ecosystems through the strengthening of institutional, physical, social and economic infrastructure.

Figure E.31: Planning aspects for core areas in urban and peri-urban systems



Ministry of Housing and Urban Affairs (MoHUA) has already taken a step in this direction with the notification of Urban and Regional Development Plan Formulation and Implementation Guidelines (URDPFI) in 2015. The objective of the URDPFI guidelines is to promote and facilitate planned, participatory and integrated urban development across Indian cities. As per the URDPFI guidelines, the urban and regional planning system has been divided into two parts i) core area planning and ii) specific and investment planning as shown in Figure E.31.

This learning unit of the module focuses on understanding the importance of master planning, land use planning and participatory strategies in mainstreaming ecosystems-based disaster risk reduction into development planning of urban-peri-urban ecosystems.

Learning objectives	Session(s) & methodology
<ul style="list-style-type: none"> • To define the needs and modes to integrate Eco-DRR in urban planning and land use planning processes • To identify provisions (or lack thereof) for peri-urban ecosystems in key policy and planning documents on sustainable urban planning in India (Example: URDPFI guidelines, master plans, regional plans, mobility plans, national urban policy) • To learn strategic planning and participatory processes which allow local authorities to identify and focus on local resources and priorities for action 	<ul style="list-style-type: none"> • Case study presentation • Question-answer sessions • Discussion
Enabling unit(s)	
Participatory planning of peri-urban ecosystems: Mainstreaming eco-DRR into land-use planning or master planning	
Guidance	Recommended readings
<ul style="list-style-type: none"> • The session will cover the basic concept of sustainable urban planning and develop critical thinking to allow for group discussion and reflections • The facilitators shall have in-depth knowledge of various master plans and regional plans • It is important to think about implementing concrete disaster risk reduction measures throughout the entire planning process rather than waiting until the plan is completed • Priority should be given to actions for which resources and local capacity already exist, i.e. actions which quickly exhibit visible results • When this is recognized through collective consensus, the chances are much greater that the actions will be implementable, productive and sustainable 	<ul style="list-style-type: none"> • Gupta, A. K., Singh, S., Wajih, S. A., & Mani, N. (2017). <i>Urban Resilience and Sustainability through Peri-Urban Ecosystems</i>. New Delhi: GEAG, ICLEI South Asia, ACCCRN. NET, UNICEF, School of Planning and Architecture, New Delhi, Rockefeller Foundation. • Bandyopadhyay, Chandrani (2014). Training Module on Urban Risk Mitigation. National Institute of Disaster Management, New Delhi, P-138.

CONCLUSION AND SUMMING-UP, POST-TRAINING ASSESSMENT AND COURSE FOLLOW-UP RECOMMENDATIONS

Context and description of the Session

Participants' feedback on the program-design, contents, learning and resources, is important for the continuous improvement of the course and its delivery. It also generates various innovative ideas and options for diversifying the courses for effective and objective course delivery.

Feedback of the course faculty/coordinators on the course participants and overall conduct of the course will also be important at the end. A pre-developed feedback format shall be given to the participants for their entries before the valedictory session, which can be later analysed and used in developing a summary course-report.

A valedictory session is important which can be chaired by the host institute's Director/Head or Secretary/Commission of Relief/Labour/Environment or a senior academic faculty on a related subject. Alternatively, the course Director shall preside the session. A brief course report following the welcome note will be followed by a few brief feedback rounds from the participants and messages of long-term interaction and continuous learning on the subject. The valedictory session shall aim at generating the feeling that the training objectives shall be fulfilled by putting into use the lessons discussed in the course, and by initiating a process of improving the delivering on routine basis towards effective risk management and response. A formal vote of thanks shall be given at the end to express gratitude towards the participant's organizations, host institution, collaborators, resource persons, associates, team and all others whose contribution was important in making the course a success.



Training objectives



- To review and understand the suitability of course design and contents for future courses
- To review and enlist the possible improvements/changes and diversifications in the course design and deliveries
- To assess possible cooperation, network and future strategies of applying the course lessons in line functions and practice

Guidance



- Course coordinator shall coordinate the session with a positive attitude for furthering the integration and development of peri-urban ecosystems into developmental plans and policies by generating long-term and effective strategies of cooperation among stakeholders at different levels
- Coordinator shall personally extend thanks to all dignitaries, team of faculty and associates after the session

Methodology



- Brief addresses
- Discussion
- Course feedback and lessons
- Course brief-report
- Roadmap for implementing knowledge and skills
- Broad guidelines for future strategies



References

- Arnold, R.D.; Wade, J. P. A definition of systems thinking: A systems approach. *Procedia Comput. Sci.* **2015**, *44*, 669–678.
- Angela Heymans, Jessica Breadsell, Gregory M. Morrison, Joshua J. Byrne and Christine Eon (2019). Ecological Urban Planning and Design: A Systematic Literature Review. *Sustainability* 2019, 11, 3723; doi:10.3390/su11133723
- Bhatt, S., Singh, A., Mani, N.,(2016). Peri-Urban Agriculture and Ecosystems: Resilient Narratives. Published by GEAG, Gorakhpur.
- Brown, K and Fortnam, M. 2018. Gender and ecosystem services: A blind spot. *Ecosystem Services and Poverty Alleviation: Trade-offs and Governance*.
- DEA and SANBI, 2017. Guidelines for implementation of Ecosystem-based Adaptation in South Africa. Department of Environmental Affairs, Pretoria, South Africa (draft).
- Dutta, P. (2006). Urbanization in India. Retrieved from <http://www.infostat.sk/vdc/epc2006/papers/epc2006s60134.pdf>.
- Gupta, A.K., Nair, S.S., Wajih, S.A., Chopde, S., Gupta, G. and Aggrawal, G. (2014). Mainstreaming Climate Change Adaptation and Disaster Risk Reduction into District Level Development Plans. NIDM New Delhi (India), GEAG Gorakhpur (UP, India) and ISET, Colorado (US), P 114.
- Gupta, A. K., Singh, S., Wajih, S. A., & Mani, N. (2017). *Urban Resilience and Sustainability through Peri-Urban Ecosystems*. New Delhi: GEAG, ICLEI South Asia, ACCCRN.NET, UNICEF, School of Planning and Architecture, New Delhi, Rockefeller Foundation.
- IUCN. (2013). *Eco-Disaster Risk Reduction*. Retrieved February 13, 2020, from IUCN: International Union for Conservation of Nature: <https://www.iucn.org/commissions/commission-ecosystem-management/our-work/cems-thematic-groups/eco-disaster-risk-reduction>
- Kamal-Chaoui. L., and Alexis. R. (eds.) (2009), “Competitive Cities and Climate Change”, OECD Regional Development Working Papers N° 2, 2009, OECD publishing, © OECD.
- Laquinta, D.L. and Drescher, A.W. (2000). Defining the peri-urban: rural-urban linkages and institutional connections. Nebraska Wesleyan University, Lincoln, Nebraska, United States <http://www.fao.org/docrep/003/x8050t/x8050t02.htm#TopOfPage> land reform / réforme agraire / reforma agraria 2000/2.
- Lindholm, G. The implementation of green infrastructure: Relating a general concept to context and site. *Sustainability* **2017**, *9*, 610.
- Livesley, S. J., E. G. McPherson, and C. Calfapietra (2016). The Urban Forest and Ecosystem Services: Impacts on Urban Water, Heat, and Pollution Cycles at the Tree, Street, and City Scale. *J. Environ. Qual.* *45*:119-124. doi:10.2134/jeq2015.11.0567
- Luisa Sturiale 1,* and Alessandro Scuderi 2. *Climate* 2019, *7*, 119; doi:10.3390/cli7100119. The Role of Green Infrastructures in Urban Planning for Climate Change Adaptation
- Merk, O., Saussier, S., Staropoli, C., Slack, E., Kim, J-H (2012), “Financing Green Urban Infrastructure”, OECD Regional Development Working Papers 2012/10, OECD Publishing; <http://dc.doi.org/10.1787/5k92p0c6j6r0-en>

- Midgley, G., Marais, S., Barnett, M., and K. Wågsæther. 2012. Biodiversity, climate change, and sustainable development – Harnessing synergies and celebrating successes. Final Technical Report. SANBI, Conservation South Africa, and Indigo Development & Change
- Ministry of Agriculture (2013). Vegetable Initiative for Urban centres for enhancing vegetable production and productivity. Retrieved from <http://pib.nic.in/newsite/PrintRelease.aspx?relid=93542>
- Mitra, A., Wajih, S., and Singh, B.(2015).Wheezing ecosystems, livelihood services and climate change resilience in Uttar Pradesh. IIED, working paper series 18:2015.
- Narain, V., Anand, P. and Banerjee, P. (2013). 'Periurbanization in India: A review of the literature and evidence ', Report for the project – Rural to Urban Transitions and the Peri-urban Interface. SaciWATERS. India
- Nedkov, S., Zhiyanski, M.,Nikolova, M and Todorov,L.(2016).Mapping of carbon storage in urban ecosystem: a case study of Pleven District, Bulgaria. Conference paper, Conference: Geographical aspects of land use and planning under climate change, At Varshets, Bulgaria, Volume: ISBN: 978-619-90446-1-2.
- Parker, K.; Head, L.; Chisholm, L.A.; Feneley, N. A conceptual model of ecological connectivity in the Shellharbour Local Government Area, New South Wales, Australia. *Landsc. Urban Plan.* **2008**, 86, 47–59.
- Piør A, Ravetz J, Tosics I (2011) Peri-urbanization in Europe: Towards a European Policy to sustain Urban-Rural Futures. University of Copenhagen / Academic Books Life Sciences. 144p. ISBN: 978- 87-7903-534-8.
- Prakash, A. (2012) The periurban water security problématique: a case study of Hyderabad in Southern India. Peri Urban Water Security Discussion Paper Series 2010/ 4, SaciWATERS. See www.saciwaters.org/working_papers.html
- PURPLE (2004). Peri-urban open space: how multifunctional land use can bring multiple benefits. Topic paper. Retrieved from <http://www.purple-eu.org/uploads/Topic%20Papers%20updates/peri-urban%20open%20space%20v2%20-%20purple%20topic%20paper.pdf>.
- Renaud, F.G., Sudmeier-Rieux, K., Estrella, M., Nehren, U. (Eds.) (2016) Ecosystem-Based Disaster Risk Reduction and Adaptation in Practice. Advances in natural and technological hazards research. 42
- Rees, W (1992), “Ecological Footprints and appropriated carrying capacity”, *Environment & Urbanization* Vol 4, No 2, October, pages 121–130.
- Schmidta, K., Sachsea, R. and Ariane, W., 2016). Current role of social benefits in ecosystem service assessments. *Landscape and Urban Planning*, 149: 49-64. <https://doi.org/10.1016/j.landurbplan.2016.01.005>
- Schneiders, A. & Müller, F. (2017). A natural base for ecosystem services. Chapter 2.2. In: Burkhard, B. and Maes, J. (Eds). *Mapping Ecosystem Services*. Advanced Books. Research Institute for Nature and Forest – Brussels (Belgium)
- Suparb, T. and Ranjith Perera, L. A. S. 2008. Environmental assessment for non-prescribed infrastructure development projects: a case study in Bangkok Metropolitan. *Impact Assessment and Project Appraisal*, 26(2): 127–138.
- Sturiale, L.; Scuderi, A. The evaluation of green investments in urban areas: A proposal of an eco-social-green model of the city. *Sustainability* 2018, 10, 4541.
- TEEB (2011). The Economics of Ecosystems and Biodiversity (2011). TEEB Manual for Cities: Ecosystem Services in Urban Management. www.teebweb.org
- Thornton (2008). Beyond the Metropolis: Small town case studies of urban and peri-urban agriculture in South Africa. *Urban Forum*, 19:243-262.
- UN (2016). Sustainable cities: why they matter. Retrieved from: http://www.un.org/sustainabledevelopment/wp-content/uploads/2016/08/16-00055K_Why-it-Matters_Goal-11_Cities_2p.pdf

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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 several 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 the Lighthouse Activity Award by UNFCCC in 2013. GEAG also holds the Observer status to Green Climate Fund.

National Institute of Disaster Management

The National Institute of Disaster Management constituted under the Disaster Management Act 2005, has been entrusted with the nodal national responsibility for human resource development, capacity building, research, documentation and policy advocacy in the field of disaster management. The Institute provides training in face-to-face, on-line and self-learning mode as well as satellites based training. NIDM provides technical support to the state governments through the Disaster Management Centres (DMCs) in the Administrative Training Institutes (ATIs) of the States and Union Territories. Presently NIDM is supporting thirty such centres. Upgraded from National Centre for Disaster Management of the Indian Institute of Public Administration on 16th October 2003, NIDM is steadily marching forward to fulfil its mission to make disaster resilient India by developing and promoting a culture of prevention and preparedness at all levels.

Climate Development Knowledge Network

The Climate and Development Knowledge Network works to enhance the quality of life for the poorest and most vulnerable to climate change. We support decision-makers in designing and delivering climate compatible development. We do this by combining knowledge, research and technical advisory in support of locally owned and managed policy processes. We work in partnership with decision-makers in the public, private and non-governmental sectors nationally, regionally and globally.

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